HUMAN SKELETAL MATERIAL FROM CEYLON, WITH AN ANALYSIS OF THE ISLAND'S PREHISTORIC AND CONTEMPORARY POPULATIONS

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SYNOPSIS

The fossilized human skeletal remains from the prehistoric site of Bellan Bandi Palassa in Sabaragamuva Province, Ceylon, are analysed anthropometrically and biochemically. Results of uranium and radiocarbon assays indicate a relatively contemporary population living at a period around 114 B.C. $\pm$ 200 years, a date that confirms the archaeological evidence which ascribed the cultural associations of the site to the Bandarawelian, a regional variant of the Indian " Mesolithic " or Late Stone Age. Comparative anthropometric studies of these Balangodese fossils with other hominid specimens, both fossil and living, reveal that their closest phenotypic affinities are with the Veddas of Ceylon. Many of the physical traits regarded by earlier investigators as distinguishing the Veddas from their Ceylonese and Indian neighbours and which have been the basis for separating the Veddas into racial sub-types are apparent in the fossil " pre-Vedda " remains from Bellan Bandi Palassa. This suggests a close genetic affinity between these Balangodese–Vedda phenotypes at the dawn of the historic period in Ceylon. The evidence from the ethnographic and prehistoric record for this region strongly supports the view of a continuous cultural tradition with local modifications extending from Late Stone Age times to the present, a situation which lends independent but supportive evidence for the postulation of Balangodese and Vedda phenotypic affinities. The association of contemporary hill tribes or relict populations with the manufacturers of prehistoric lithic industries has hitherto been unsubstantiated in the Indian Sub-Continent, and the anthropological problems inherent in this line of research are discussed.

I INTRODUCTION

The Site of Bellan Bandi Palassa

The presence of palaeolithic artifacts in India and Pakistan testifies to the human occupation of the Sub-Continent during the Pleistocene, but the skeletal remains of the manufacturers of these stone implements have not been found. The most ancient human bones from this part of Asia have been recovered from Langhnaj in Northern Gujarat (Ehrhardt 1960, 1963, Karve & Kurulkar 1945, Khan & Karve 1946, Karve-Corvinus & Kennedy 1964, Kennedy 1964, Sankalia 1945, 1946, 1949, Sankalia & Karve 1944, 1945, 1949, Subbarao 1952, 1955 : 73–74, 1958 : 71–74, Zeuner 1950 : 44, 1951 : 7) and from the District of Mirzapur in Uttar Pradesh (Personal communication with Shri Radhakant Varma in May 1964, Deccan College, Poona) where the cultural associations are ascribed to the Indian Late Stone Age, or Mesolithic, period. For the Island of Ceylon the discovery of the makers of the lithic industries has long been awaited. The work of the Sarasins (1892–93, 1907) confirmed the claims of earlier investigators that the island possessed Stone Age tools, and from their data two problems originate : (1) To which of the prehistoric ages, as understood in terms of conventional typological classifications, can the Ceylonese stone artifacts be assigned : (2) What kinds of hominids manufactured these tools?

> " Until definite stratigraphic evidence, showing a sequence of distinct cultures with perhaps associated animal and skeletal remains, have been established at several sites, the only procedure seems to be to treat the implements as provisionally of one culture ... Subdivisions into cultures and phases can be made when adequate evidence is discovered justifying it ... The Sarasins believed that the people who lived in the rock shelters and made stone implements were ancestors of the Veddah, but without skeletal evidence there is nothing to support such a conclusion." (Noone & Noone 1940 : 20–21).

It is with this latter problem that the present study is concerned, for the anthropometric analysis of the human remains from Bellan Bandi Palassa, Ceylon, indicates that the manufacturers of its Bandarawelian (Late Stone Age) industries bear striking phenotypic similarities to the surviving Vedda population of the island.

The site of Bellan Bandi Palassa is situated at 6 degrees 31 minutes North longitude and 80 degrees 48½ minutes East latitude between the 400 and 300 foot contours in the Balangoda District of Sabaragamuva Province. Three and a half miles to the east of the site is the Pansadara Chena near Hath Kinda where the Valave Ganga ramifies into its seven channels. Traversing the site is an intermittent stream which joins the Pusalli Ara just before its junction with the Valave south of Pansadara (Text-fig. 1). Within the palassa, or glade, of Bellan Bandi an expanse of flat crystalline limestone extends for about a quarter of a mile from the northwest to the southeast and has a width of 70 yards. At right angles to the stream bed and extending across the limestone exposure is a ridge of earth eroded by the stream to form a gap of some 60 feet across. This erosion has exposed on the left bank a kitchen midden some 30 feet wide and averaging 3 feet in height above the limestone.

Some materials have been redeposited about 150 yards downstream from the midden. Erosion has produced along the left bank for a distance of about 100 yards a number of small rock shelters which have since collapsed leaving large limestone blocks which overlie the midden. The surface soil is primarily red sandy loam ranging in depth from 3 feet 6 inches to 4 feet 6 inches above the limestone outcrop. Within this soil cover were found human and animal bones, molluscan shells, chert and quartz implements and potsherds.

FIG. 1. The region of Bellan Bandi Palassa in the Balangoda District of Sabaragamuva Province, Ceylon. One inch to one and a half miles.

The excavation was carried out from 24th June to 6th July, 1956, then resumed on 9th September, 1956. A site survey had been conducted in March of that same year as a result of reports of fossil remains to be found in the forest near the Valave. Mr. Arthur Delgoda sent to Dr. P. E. P. Deraniyagala, Director of the National Museums, some fossilized fragments of human and animal bones, and on 12th March, 1956 led a party of archaeologists under Dr. Deraniyagala to the site. Before the commencement of the excavation the site was pegged out into forty squares each

6 feet by 6 feet. The north–south base line was represented by the plots Beta, Alpha, A, B, C, D, E, F, and the series beginning with Beta in the south end. The east–west base line was represented by the plots 1, 2, 3, 4, and 5, the series beginning with 5 in the west end and adjacent to square Beta. Such a grid was superimposed on the site so that the areas of limestone exposure and the left bank of the stream were approximately equal in extent, the edge of the stream forming a diagonal from square F5 in the northwest to square Beta 1 in the southeast. Consequently the squares which were possible to excavate were Beta 1, Alpha 1, A1, A2, B1, B2, B3,

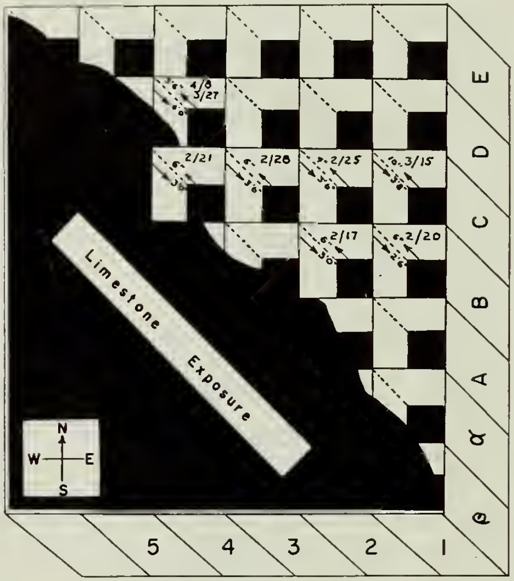

FIG. 2. The plan of excavation at Bellan Bandi Palassa showing the relative distances of the skeletal remains from the ground surface and from the limestone bedrock.

C1, C2, C3, C4, D1, D2, D3, D4, D5, E1, E2, E3, E4, and E5. Digging was continued in each square until the limestone bed rock was encountered. This base was humped with an apex at the C-line and declinations at A to the south and E to the north of the site. The loci of the specimens in this midden are represented in Text-fig. 2.

In some of the burials the corpse was flexed and lying upon its left side (specimens BP2/17, BP4/8, BP2/21) or right side (BP2/25, BP3/27–34). Other skeletons were flexed but supine (BP 3/15a, BP2/15b). Fractional burial and bag burial cannot be excluded from consideration, although difficult to establish. The particular artifacts found in direct contact with the skeletons are as follows: with BP2/17 were three unpitted hammer pebbles, of which one was discoidal, plus a bone dart. A cluster of twelve small pebbles in close proximity to one another suggest that they had once been encased in a bag and placed at the head of the corpse. In cleaning this specimen from its soil matrix, the mandible of a *Macaca sinica*, probably female, was discovered (Personal communication with Dr. W. C. Osman Hill in January 1961, London). With BP2/20 was uncovered the left molar of *Melursus valaha*. With BP2/21 were found unworked spherical pebbles some 60 mm. in diameter which perhaps were bola stones. The mandible of *Hystrix leucurus leucurus* lay across the right zygoma of the specimen. Specimen BP3/27–34 was associated with an unpitted pebble above the level of the skull and a block of quartz under the right humerus.

During the excavation of 1956 the remains of some nine individuals were uncovered. In the decade prior to this discovery, Deraniyagala had found fragmentary skeletal remains of single specimens from the middens of neighbouring sites. The significance of these sites has been discussed by Deraniyagala (1956*b*, 1956*c*, 1956*d*, 1957*a*, 1957*b* : 8, 20, 1958*a*, 1958*b* : 64–71, 1959, 1960*a*, 1960*c*, 1962, 1963*a*, 1963*b*), Clark (1961 : 189–190), Cole (1963 : 87) and Coon (1962 : 424–425). However, no thorough laboratory examination of the bones was undertaken until 1960 and 1961 when the specimens were sent on loan to the British Museum (Natural History) in London. It was advantageous to conduct the programme of research at this institution where the present investigator had available comparative osteological material from several collections of Vedda specimens and where excellent opportunities for subjecting the specimens to various biochemical tests existed.

The Nature and Condition of the Specimens

An abbreviated list of the skeletal specimens described in this report is given in Table 1. These are from the collection made during the 1956 season of excavation. There are, however, two fragments included in the collection sent to the British Museum (Natural History) which cannot be assigned to any of the numbered and catalogued specimens. These are :

1. A fragment of right ischium labelled BP2/17g found in Square B2 with specimen BP2/17.
2. A fragment of right scapula which includes the glenoid cavity and a portion of the axillary border. This fragment is unlabelled but is associated with BP3/27–34 in Square D4.

Two specimens were found at Bellan Bandi Palassa which have not been described by the writer but which are noted in Deraniyagala's report of the site. These are :

1. Specimen BP3/11 from Square C2 which lay at a depth of 2 feet 6 inches below the surface and 2 feet above the limestone. Only the maxilla and femur are described (Deraniyagala 1958*a* : 230, 233, 236–237, table 1).
2. Specimen BP3/15a was excavated from Square C1 at a depth of 3 feet 8 inches above the limestone. A second skeleton, specimen BP3/15b, was discovered beneath it and it has been described by Deraniyagala (1958*a* : 230, 233, 260, pls. 11–13, table 1, 1963*a* : 92–97). The skull of BP3/15b (Deraniyagala 1958*a* : 233, pls. 11, 12) was sent to the American Museum of Natural History in New York where its restoration is now under way. This is the specimen called T–23–B by Coon (1962 : 424–425). Through the kindness of Dr. Harry L. Shapiro the writer was permitted to examine this specimen.

TABLE I

A TABULAR LIST OF THE SKELETAL MATERIAL DESCRIBED

Specimen number	Site location	Sex	Age	Calvaria					Face			
				Frontal	Parietal	Occipital	Temporal	Sphenoid	Maxilla	Zygoma	Nasal	Palatine
BP2/17	B2	Male	25–30	+	RL	+	RL	R	+	RL	..	..
BP2/17i	B2	Male	Adult	..	..	..	..	..	..	..	..	..
BP2/20–41	B1	Male	Adult	..	..	..	..	..	+	..	..	..
BP4/8	D4	Male	Adult	..	..	..	..	..	+	R	..	+
BP1/6	..	Female	Old Adult	..	..	..	..	..	+	..	..	..
BP2/21	C4	Female	20–22	+	RL	+	RL	R	+	RL	..	..
BP2/25	C2	Female	18–20	+	RL	+	RL	..	+	R	..	..
BP3/27–34	D4	Female	35+	+	RL	+	RL	RL	+	R	RL	+

Note: A plus (+) indicates the presence of a bone for any given specimen.
The side of the skeleton for which a bone is available is indicated by an R for right side, an L for left side.

TABLE I (*continued*)

A TABULAR LIST OF THE SKELETAL MATERIAL DESCRIBED

Specimen number	Mandible: Corpus	Mandible: Ramus	Dentition	Trunk vertebral column: Ver. col.	Trunk vertebral column: Rib	Trunk vertebral column: Sternum	Upper extremity: Clavicle	Upper extremity: Scapula	Upper extremity: Humerus	Upper extremity: Radius	Upper extremity: Ulna	Upper extremity: Hand
BP2/17	..	..	Maxilla	Lumbar 3, 4, 5	+	+	L	RL	..	..	..	..
BP2/17i	+	RL	Mandible	..	..	..	..	..	..	..	..	..
BP2/20–41	+	RL	Maxilla Mandible	..	..	..	..	..	..	..	..	..
BP4/8	..	..	Maxilla	..	..	..	..	..	RL	RL	L	..
BP1/6	..	R	Maxilla Mandible	..	..	..	..	..	..	..	..	..
BP2/21	..	..	Maxilla Mandible	..	..	..	L	..	L	..	..	Trapezius Capitate Schaphoid 5 Metacarpals 1 Carpal
BP2/25	..	..	Maxilla	Cervicle 1, 2, 3, 4	+	..	R	..	..	L	..	..
BP3/27–34	..	..	Maxilla Mandible	..	..	..	RL	R	L	L	L	..

Specimen number	Lower extremity: Femur	Lower extremity: Tibia	Lower extremity: Fibula	Lower extremity: Foot	Pelvis: Sacrum	Pelvis: Ilium	Pelvis: Ischium	Pelvis: Pubis
BP2/17	RL	RL	..	Talus Cuboid Calcaneum	+	RL	RL	..
BP2/17i	..	..	..	..	..	..	..	..
BP2/20–41	..	..	..	..	..	..	..	..
BP4/8	RL	RL	L	..	..	..	..	..
BP1/6	..	..	..	..	..	..	..	..
BP2/21	..	..	..	..	..	..	..	..
BP2/25	RL	R	..	..	..	..	..	..
BP3/27–34	..	..	..	..	..	..	..	..

Of the specimens examined by the present writer, two are deserving of special comment. These are :

1. The mandible of BP2/17i which was found some 10 inches away from the calvarium of specimen BP2/17. This was regarded at the time of discovery as belonging to specimen BP2/17, but upon cleaning the calvarium from its matrix it became obvious that the wear patterns of the maxillary and mandibular dentitions were strikingly different for the two specimens.

2. Deraniyagala (1958*a* : 232) mentions the presence of another skeleton in the vicinity of the deposit where specimen BP2/21 was found. Its skull lay in Square C4 with BP2/21 and its post-cranial parts extended into Square C3. Elsewhere in his report Deraniyagala (1958*a* : 230, 233) notes the presence of a specimen uncovered in Square C3 at approximately the same level as BP2/21. This specimen in C3 is called BP2/28 and it is without a cranium. The question arises as to whether these post-cranial bones in C3 may not belong to specimen BP2/21 rather than to another individual. The bones of BP2/28, namely a left humerus, left talus, calcaneum and femur were not available for study by the present writer. Furthermore, the great difference in the appearance of the cranial fragments of specimen BP2/21 is such that they could be certified as belonging to a single individual only after they had been cleaned of their matrix and concretion and examined for the purpose of reconstruction. This question of the presence of one or two individuals in Squares C3 and C4 is further complicated by the fact that Deraniyagala (1958*a* : 232, 260, pl. 9, tables 1–2) notes the presence of certain post-cranial bones belonging to specimen BP2/21—a scapula, humerus, tibia, femur, talus, calcaneum—which again were not observed by the writer.

As the bones were encountered in progress of excavation they were coated with shellac and labelled and packed in cotton. Fragile pieces were plaster-jacketed in a position exactly as they were found *in situ*. The plaster jacket for the calvarium of BP2/17 was later removed from one side and shellac dissolved in alcohol was poured into the mass of matrix and bone. Specimens that were placed into the plaster jackets were BP2/17 (calvarium and pelvis), BP2/21 (cranium), BP2/25 (cranium), BP3/15a (skeleton). Photographs were taken of the specimens *in situ* and some measurements were made upon the bones before their complete excavation. Upon the return of the archaeologists to the laboratory at Colombo these specimens were superficially cleaned. No reconstruction was attempted, save for the mending of bones which had been broken as a result of their transport from the field. Laboratory measurements carried out at the Colombo Museum were of a limited nature since the specimens were not entirely removed from their plaster jackets.

The reconstruction and anthropometric analysis of the specimens was undertaken by the present writer at the British Museum (Natural History). All of the specimens required some restoration, but warping and erosional damage, rather than actual breakage of bone, have most severely altered their pristine condition. Because of the poor state of preservation of the series, a morphological description is of necessity more significant than the tabulation of the metrical data. Nevertheless, where a metrical analysis could be undertaken, a record was made of the quantitative values.

The anthropometry is based upon the particular reconstruction that was considered by the writer to be of greatest accuracy for each specimen. The reconstructions are intentionally impermanent in order that other scholars may realize their own interpretations of the data. The reconstructing media are acetone cement and plaster of Paris, both of which can be flaked or washed from the specimens with ease.

The osseous remains were not found in a uniform state of mineralization, but all were hard, due to the chemical nature of the soil in which they were embedded: the water acidulated by the humus had dissolved the limestone over which it flowed and formed a protecting environment for the calcium content of the bones. The bones of the lowest level were almost resting upon the limestone outcrop. The effluvia of the corpses had caused the limestone to disintegrate into yellow flakes to a depth of 5 cm., and these flakes had been subsequently impacted into a solid mass partially adhering to the bones.

In addition to the osseous remains this series contains 120 permanent teeth of which 52 belong to male specimens and 68 to female specimens.

II DESCRIPTION

The Methodology of the Metrical Analysis

The method of measurement for each of the values listed in Table 2 is to be found in Martin & Saller (1957 : 453–499, 520–595). In this compendium the standard procedures for each measurement are described and listed by number. That number relevant to each measurement in Table 2 is given in parentheses immediately after its name. Indices are based upon these measurements. Variations and additions to these procedures are the following:

1. Auricular-Vertex Height is taken according to the method devised by Ranke with the use of the Mollison craniophor, as described by Hooton (1946 : 738).
2. The Frontal Arc is the first segment of the Glabella-Opisthion Arc and differs from the Nasion-Opisthion Arc described by Martin & Saller (1957, Measurement 25) in its selection of the initial landmark. In the absence of a well defined nasion for any skull in the Bellan Bandi Palassa series, the most anterior point of the glabella in the median-sagittal plane was substituted for the conventional landmark in this arc measurement.
3. The External Palatal Arc is measured from alveolon on one side of the upper jaw to alveolon on the opposite side, the tape passing across prosthion and parallel to the anterior aspect of the dental arcade.
4. Height of the Zygomatic Bone is the distance measured with the sliding caliper from the anterior superior border of the frontal process of the malar to its anterior inferior border at the point of articulation with the maxilla.
5. Breadth of the Zygomatic Bone is the distance measured with the sliding caliper from the superior border of the maxillary process to the anterior inferior border of the frontal process.
6. Breadth of the Frontal Process of the Zygomatic Bone is taken as its greatest anterior–posterior diameter. The sliding caliper is placed at the level of the zygomatico-facial foramen when this measurement is taken.

7. The Mental Foramen Diameter is taken with the sliding caliper, the points being placed upon the medial–lateral borders and the inferior–superior borders of the foramen for the determination of its maximum size.

8. Sternal Head Diameter is the maximum anterior–posterior dimension of the medial extremity of the clavicle taken with the sliding caliper.

9. Corocoid Process Breadth is the maximum anterior–posterior diameter of the corocoid process of the scapula, taken perpendicularly to the plane that the sliding caliper assumes in the measurement of Corocoid Process Length (Martin & Saller 1957, Measurement 11).

10. Length of the Iliac Lines is measured with the sliding caliper from the anterior origin of the arcuate line on the pubic bone to its posterior termination at the sacro-iliac joint just superior to the pre-auricular sulcus. Both ilia are measured for this feature.

In the discussion of the dentitions, the following abbreviations have been used: R = right side; L = left side; M3 = third molar; M2 = second molar; M1 = first molar; PM2 = second premolar; PM1 = first premolar; C = canine; I2 = lateral incisor; I1 = central incisor; the placement of the number above or below the line indicates that reference is made to either the upper or lower dentition, *viz.* RM$\underline{3}$ = maxillary right third molar.

Sex and Age Determination

Specimen BP2/17: This is a male who died between the ages of 25 and 30 years. The calvaria is the largest and most rugged in the series. The brow ridges are prominent and posterior to them is the trace of a frontal sulcus. The mastoid process is large with a supramastoid crest that exhibits a rough inferior margin. This robusticity of the mastoid is reflected also in the area of insertion for the splenius capitis and longissimus capitis. The digastric fossa is deep. The lateral border of the superior nuchal crest forms a moderately well defined ridge, but as its median portion is not represented in the fragment, its overall dimensions cannot be observed. Temporal lines are sharp at their frontal aspect and sweep posteriorly as an arc, of medium prominence on the parietals. The supramastoid crest is large. The zygomatic processes of the temporal are rough along their inferior margins, particularly in the region of the anterior tubercle where some fibres of the masseter have their origin. The region of the attachments of zygomaticus major and minor on the malar shows prominent bossing. Medial to this is an elongated crest for the levator labii superioris and levator labii superioris alaeque nasi. The malar is short but massive. The maxilla exhibits very pronounced subnasal grooves. The alveolar arch of the palate is high. A basal view of the calvaria reveals further evidence of male robusticity: a deep mandibular fossa and a stout occipital condyle.

The right and left innominates are characterized by narrow and deep ischiatic notches, large acetabulum, prominent sacro-iliac articulation, and a high upright ilium. A pre-auricular sulcus is present, but its dimensions are small and narrow. There is pronounced ridging of the region above the posterior superior iliac spine where gluteus maximus originates. The crest of the ilium is sharp, especially along the line of origin of obliquus abdominis externus. The ilium is thick and heavy and the pelvic basin is small. Male characteristics are exemplified in the shoulder girdle with its relatively large clavicle and large scapular glenoid fossa and in the lower extremities where the linea aspera of the femur forms a pronounced pilaster.

The absence of the pubic bones precludes the possibility of aging this specimen on the basis of progressive changes of the symphysial region. The dentition of the maxilla shows that the third molars have erupted and, like the other teeth, have undergone only a slight degree of attrition. Suture closure as an age indicator is of dubious value for this specimen due to trauma it has received from erosional forces and crushing. However, a general impression of its pristine condition can be obtained in a limited number of instances. Of the coronal suture, pars bregmatica is still undergoing closure but pars pterica is advanced. Of the sagittal suture, partes verticis and lambdica are advanced. The bregmatic and obelionic parts are eroded. Pars lambdica of the occipital suture has begun closure, but pars asterica is irregular, being most patent at its inferior portion. The masto-occipital suture is half closed. The squamous portion of the temporal is patent, but the spheno-temporal is advanced. Both spheno-parietal and spheno-frontal are commencing closure. Radiography of the vault confirms visual observation that arachnoid granulations are not present. These observations suggest an age at time of death for the specimen of between 25 and 30 years.

Specimen BP2/17i : This is an adult male. Its mandible, in comparison with those associated with specimens sexed as females, is of greater size, weight and thickness. The symphysis is higher, and the rami form a less obtuse angle in relation to the corpus. The short broad rami have robust pterygoid attachments at their gonia, which are thick and strongly everted. The mylo-hyoid ridge is pronounced.

All of the teeth have erupted, and the third molars are moderately worn. The other molars reveal pronounced attrition.

Specimen BP2/20–41 : This specimen may be that of an adult male, but criteria for sexing and aging are less certain than for other specimens of the series. Subnasal grooves are moderately developed. Of more masculine appearance is the mandible which is large and heavy with a pronounced mylo-hyoid ridge, very prominent pterygoid attachments, medium-sized genial tubercles and large digastric fossae.

The dentition has erupted completely, and there is a moderate degree of abrasion, except for the upper left distomolar which is unworn.

Specimen BP4/8 : This is an adult male characterized by robust musculature of the face and long bones. The malars are large and heavy, as is also the zygomatic process of the temporal. Subnasal grooves are pronounced, particularly in the incisive region. The palate is of moderate height with a large lump-shaped torus. The suborbital fossa is deep. Orbital and nasal borders are dull.

The humeral supracondylar ridges are sharp, but the head of the humerus is reported by Deraniyagala as being comparatively small. The muscularity of the radius is pronounced as represented in the sharpness of the interosseous crest and the inferior border of the pronator quadratus attachment. The oblique line of the flexor digitorum sublimus muscle is well developed. Radial tuberosities are large.

The interosseous border of the ulna is less pronounced, but the groove where the extensor pollicis longus originates is marked. Likewise apparent is the insertion for brachialis on the anterior surface of the coronoid process. The supinator crest is high. The linia aspera of the femur forms a very prominent pilaster, and other well-developed areas of this bone are the crista hypotrochanterica and the trochanter minor. The femur is heavy and massive. The tibia is characterized by a moderate degree of muscularity. Its interosseous borders are sharp. Similarly the fibula has a sharp anterior margin, and the bone is deeply fluted.

The teeth of this individual have completely erupted. The third molar has undergone slight attrition, but the other teeth reveal a moderate degree of wear.

Specimen BP1/6 : This is a female whose mandible exhibits signs of senile modification. The maxilla is delicate and the sub-nasal grooves are of medium development. The mandibular corpus is fragile and constricted at the molar region, but well developed, heavy and wide at the symphysial region. The chin form is median, and projection is pronounced. The mylo-hyoid ridge is of medium muscularity. The ramus is not robust, and its gonion is thin with reduced pterygoid attachments. Eversion of the gonia is medium.

The teeth are erupted and, save for the slightly worn third molars, the remainder of the dentition shows a moderate to pronounced degree of wear.

Specimen BP2/21 : This is a female whose age at time of death was between 18 and 20 years. The supraciliary arches are reduced in development, and the superior orbital border reveals a delicate lipping. The mastoid process is medium in size, but the bossing for the sternomastoid is prominent. The mastoid shows a slight lateral projection. The occipital crests observed from their external aspects are reduced to traces. The supramastoid crest is moderately developed, but the temporal lines are traceable only on the frontal bone, where their conformation is rounded. The zygomatic processes and malars are small and gracile. For the maxilla the subnasal grooves are of medium development and the nasal sills are sharp. The palate is medium in height. Viewed basally, the calvarium presents a shallow mandibular fossa, small postglenoid process, and a minute stylo-mastoid foramen.

The mandible is of medium size. The mylo-hyoid ridge is low, and the fossa for the mandibular gland is prominent. The gonia converge, but are strikingly thick and knobby as in specimen BP2/17i, a male. The mandibular condyles are small and converging, and the coronoid process is high.

The degree of muscularity of the post-cranial bones is within the moderate category. The humerus has a well-marked bicipital groove and tuberosity. The clavicle is sharply ridged in the region of the deltoid attachment. It is the low muscularity of the calvaria, rather than the features of the mandible and post-cranial bones, that suggests that the specimen is a female.

The criteria for age determination are more satisfactory for this specimen. The third molars of the maxilla and mandible have not completed their eruption and lie partially embedded in their alveoli. Save for the lower incisors, attrition is negligible for all of the teeth. Further proof of the young adulthood of this specimen is adduced by the metacarpal bones of the right hand where the epiphyses of the heads and basal condyles have not completed ossification with the shaft. This fusion normally terminates in the twentieth year of life. Finally, sutural closure of the calvaria gives confirming data. The partes bregmatica and pterica of the coronal are commencing closure, but pars complicata remains patent. Of the sagittal suture, pars bregmatica is patent while the partes verticis, obelica and lambdica are commencing closure. The lambdoid suture is open at all regions save for pars media where closure has started. The masto-occipital suture is patent as are the spheno-parietal, spheno-frontal, and spheno-temporal sutures. The squamous portion of the temporal, however, is closed, which is an artifact of the degree of preservation of the specimen.

Specimen BP2/25 : This is a sub-adult female under 18 years of age. The sex criteria are less certain for this specimen than for the others of the series, but the cranium is small and its muscularity is reduced. Unfortunately the frontal and occipital tori can not be observed. There is a moderate degree of ridging of the squamous portion of the temporal. The supramastoid crest is of moderate development, but the zygomatic process of the temporal is very thick. Nasal sills are sharp. Subnasal grooves are pronounced. The mandible is small and has a short corpus with little muscular development. The ramus is short and narrow with negative gonial eversion.

Muscularity is very much reduced on the clavicle which is smooth and gracile. The radius is moderately fluted, but the interosseous crest is high. The radial tuberosity is low. The pilaster of the femur is of medium development and is mound-shaped. The fossa hypo-trochanterica is deep. For the tibia, the anterior ridge is sharply defined but overall muscularity is reduced.

Age is established on the basis of the unerupted state of the third molars of maxilla and mandible. Due to the inferior condition of the specimen the degree of suture closure on the cranium cannot be determined. Epiphyses of the long bones are complete, and this specimen can most accurately be aged as a sub-adult.

Specimen BP3/27–34 : This is a female whose age at time of death was between 30 and 35 years.

The cranium is of medium size and exhibits a low degree of muscularity. The frontal torus is hardly discernible and glabella is very low. The occipital crests are reduced to low mounds. Inion is absent. Temporal crests are sharply defined on the frontal bone, but disappear in their progress posteriorly over the parietals. The anterior and posterior portions of the supramastoid crest are smooth. The malars are small and smooth. The temporal fossa has a moderate degree of roughening, particularly on the posterior sphenoidal surface. The alveolar region is small, but subnasal grooves are pronounced and the palate is high and moderately ridged. The palatine torus is mound-shaped. Orbital and nasal borders are sharp. The suborbital fossa is deep and massive. The basal aspect reveals a deep mandibular fossa and a thick postglenoid process of a length unusual in females. The petrous portion of the temporal is small.

The mandible is medium in size and light in weight. The corpus exhibits a pronounced mental spine emerging from a sharply pointed and projecting median protuberance. Genial tubercles are well defined and of medium size, but digastric fossae are small. The mylo-hyoid ridge is low. The angle formed by the ramus is more obtuse than that for the other mandibles of the series. The ramus is moderately broad and the gonia, while thin, are markedly crested for the attachment of the pterygoid and exhibit pronounced eversion. The coronoid process is high; the condylar neck is short.

The small clavicle is thin and delicate. The scapular is small, and muscular attachments are weakly developed. The humerus is likewise reduced in robusticity, although the bicipital groove is well defined and has a sharp lateral lip. The small and sinuous radius has a large ulnar notch and an extensive but low radial tuberosity. The volar aspect of the radius inferior to the anterior oblique line shows a deep hollow for the reception of the belly of flexor pollicis longus. The styloid is of medium size. The ulna has a more prominent styloid process, and its crests are sharper.

An estimate of age based upon suture closure alone would place this specimen within the range of 30 to 40 years at time of death. Conditions described below as patent or advanced are unreliable, as criteria of age in this specimen, due to absorption of the majority of the sutural margins, the post-mortem separation of the sutures as a result of dessication and the consequences of the pressure of the over-burden upon sutural areas apparently complete in their closure. Hence partes bregmatica, complicata and pterica of the coronal are patent due to erosive factors working on the bone. For the sagittal, pars verticus appears to have been advanced in its closure but the degrees of fusion for pars lambdica, obelica and bregmatica are uncertain due to post-mortem separation of the parietals. The situation is the same for the lambdoid suture where the margins are preserved but unarticulated. Those sutures which have maintained their pristine condition are the spheno-parietal which is completely closed and the spheno-frontal which is advanced. The squamous portion of the temporal is fused to the sphenoid, but its relationship to the parietal cannot be accurately observed, save for a view of its superior portion on the right aspect of the vault where closure is well advanced.

The dentition shows pronounced attrition. The upper third molars have erupted, but the status of the lower third molars is uncertain, for these teeth are not present.

The Metrical and Morphological Analysis of the Osseous Remains

The Cranial Skeleton. *The Calvarium* (Table 2). All four calvaria of the series are dolichocranic, the female specimens being the narrower. There is less agreement in the indices of the Auricular Height of the vault in relation to Cranial Length and Cranial Breadth : the male specimen is hypsicranic and acrocranic, the female specimen is chamaecranic and tapeinocranic. However, if the Basion–Bregma Height is employed as a component of these cranial indices, the values for the male specimen fall within the same categories as do those of the female. Such a discrepancy in the indices of Cranial Height is due to the imperfect preservation of the basion region of specimen BP2/17. Therefore, the indices which utilize the auricular values are those which are preferable as the more reliable.

Cranial capacity cannot be directly measured for the specimens, and four formulae have been employed for the estimation of endocranial size. The calculation of von Bonin, while originally devised for male crania of natives from New Britain, has been demonstrated as suitable for male Australian crania as well (Hambly 1947 : 35–39). Isserlis (1914) worked out a formula for estimating the capacity of crania from the Gaboon area of West Africa, and Hambly has noted its applicability to male and female crania of Vedda and Australian populations (Hambly 1947 : 57). However, when Isserlis' formula is applied to specimens BP2/17 and BP3/27–34 of the Balangoda series, the results are 1589·72 cc. and 919·66 cc. respectively. Although there are known to exist two female Vedda crania with directly measured cranial capacities of 960 cc. (Hill 1941 : 90, 93–94), the value derived from Isserlis' formula in the cases under consideration is questionable. The formula of Lee & Pearson (1901) using Auricular Height confirms a low cranial capacity for specimen BP3/27–34. Without a confirmation of values for specimens of the Balangoda series that can be derived from direct measurement of cranial capacity, one is cautious in favouring the formula best suited to the series. These estimates do serve to illustrate the degree of variation between the large-headed male BP2/17 and the small, nannocranic female BP3/27–34. Differences in the values for the Cranial Module confirm this degree of variation. Specimen BP2/25, which was not reconstructed, appears to have had a small cranial vault and a greater delicacy of cranial architecture than BP3/27–34.

The walls of the cranial vault are uniformly thick and heavy, due in part to their impregnation with mineral matter but to a greater degree this condition reflects their original nature. Porous areas are not observable. Their uniformly dense and grainy character is best observed radiographically. The frontal and anterior portions of the parietals are somewhat thinner than the bones of the posterior region of the vault. There is no sexual dichotomy in the thickness of the bones, although the parietals and occipitals of the female BP2/21 are the least massive in the series. Observed vertically, the conformation of the vault is sphenoid for BP2/17 and BP3/27–34 and rhomboid for BP2/21. In all three crania the greatest breadth is across the posterior third of the skull. The anterior portion of the vault of BP2/21 differs from the others by the reduced proportions of its glabella and superorbital torus. Brow ridges are median in both female specimens. The male specimen exhibits a very large glabella and a heavy, divided frontal torus. The frontal development of BP3/27–34 falls between these extremes. Lateral aspects show a medium height of the frontal region but sexual differentiation in the frontal slope. The frontal bone of the male specimen inclines gradually from glabella to bregma with a curvature limited to the plane of the low frontal eminences. It has a large median boss. The females have a slightly bulbous frontal bone that curves evenly and smoothly to bregma, medium to pronounced frontal eminences, and no median crests. Specimen BP2/21 exhibits a median boss of modest size. Post-orbital constriction of the frontal is prominent in BP2/17 and BP3/27–34, but reduced in BP2/21. Frontal breadth is large for the male vault, small for the female. Supra-orbital foramina are large for both sexes. The frontal sinus is spacious in BP2/17.

The parietal region bears a sagittal crest of medium height in BP2/17 and BP2/21, but this region is not elevated in BP3/27–34. All the vaults of the series exhibit small post-coronal depressions. Parietal bosses are pronounced, and these lie well back towards the wider portion of the vault. From their apices, the sides of the brain case make a steep descent to the temporal fossae. Parietal foramina are not observable. The gradual curvature of the parietal portion of the vault, viewed from the lateral aspect, takes a sudden turn in a more vertical direction at lambda.

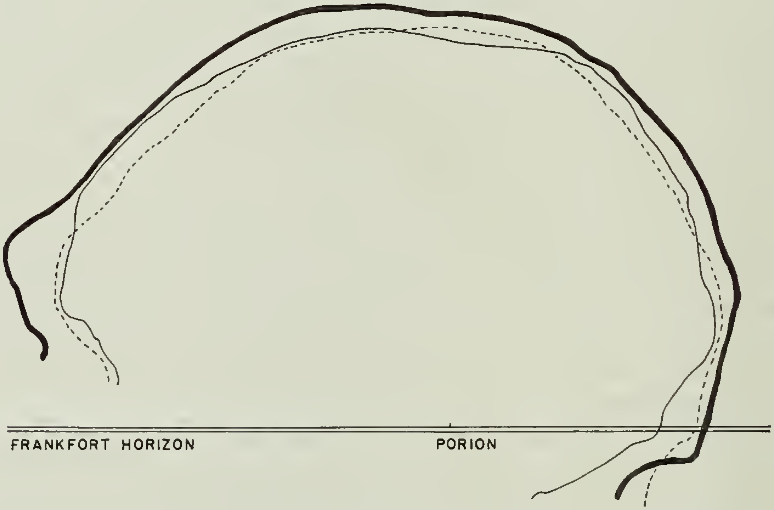

FIG. 3. Left lateral contours of three Balangodese (BP2/17 ———, BP2/21– – –, BP3/27–34 ————).

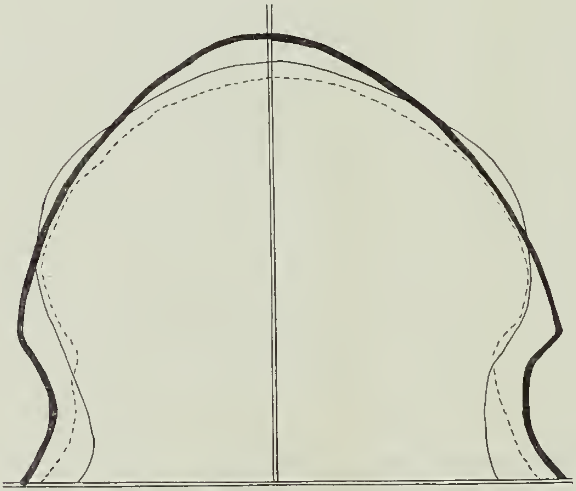

FIG 4. Frontal contours of three Balangodese (BP2/17 ———, BP2/21– – –, BP3/27–34 ————).

Lambda is moderately flat in all specimens but one, BP3/27–34. The occipital curvature is pronounced for all specimens. The occipital torus of BP2/17 is remarkable for its large size and robusticity : the female crania exhibit either reduction or no development of this region (Text-figs. 3, 4).

The temporal region is full, particularly for the male specimen, and the sphenoid depression is remarkably large. The degree of cresting of the temporal lines is never pronounced along the parietals, but is marked on the frontals of the male vault. The squamous portion of the temporal is thick for BP2/17 and BP2/21, but thin for BP3/27–34. The size of the petrous portion is greater for the male. The auditory meatus is elliptical for the male, round for the females. The tympanic plate is consistently thick for both sexes. The mastoid is large for the male. Radiography reveals in the male specimen an extensive mastoid sinus. This consists of two polycameral sinuses in the superior aspect of the process along an anterior–posterior arc which traverses the width of the process. At its apex, a third polycameral sinus is visible.

Sutures of the vault are simple in conformation for all specimens. Complexity is observed only in the peripheral margins of the coronal suture at pterion and of the sagittal at lambda. Wormian bones are not observable. Metopism is absent. The form of Pterion is H.

Facial indices are ascertainable for specimen BP3/27–34. Its total facial index places it at the lower limit of the leptoprosopic class. The upper face is leptene. The nose is chamaerrhine. Whereas its orbits are chamaeconch, the orbits of BP2/17 are hypsiconch. The palates of all specimens are brachystaphyline.

The angle of the upper face of BP3/27–34 places it within the orthognathous category as estimated by both the von Camper and Martin methods. The protrusion is of the alveolar sort rather than subnasal or total maxillary. Facial bones of the other specimens exhibit pronounced alveolar prognathism, save for the males BP2/17 and BP2/20–41 where alveolar protrusion is medium and slight respectively. The very pronounced alveolar prognathism of BP2/25 is to some degree an artifact of post-mortem distortion of the facial bones. Mid-facial prognathism is medium in the two cases where it is observable—specimens BP4/8 and BP2/27–34.

The form of the orbit is rhomboid for the males and the female BP2/21, but square for the other female, BP3/27–34. Orbital inclination is 15° for BP2/17 and 16° for BP2/21, but the inclination is only 8° in the case of BP3/27–34. There is a striking sexual differentiation in the size and robusticity of the malars and zygomatic processes. Lateral malar projection is common to the females, but of the males, BP4/8 shows pronounced anterior malar projection. The total absence of nasal bones in the series precludes any comment as to the structure of this portion of the face save insofar as the maxillary walls and floor of the piriform aperture are preserved in BP4/8. From this evidence the nose appears to have been very broad with a large nasal spine and both sharp and dull sills. The nasal notch appears to have been deep for BP2/17 and BP3/27–34. Subnasal grooves of the incisive region are consistently prominent. The palate is elliptical except in specimens BP2/20-41 and BP3/27–34 where the form is hyperparabolic, an appearance ascribable in part to the absence of third molars. The height of the palate is medium, but specimens BP2/17 and BP3/27–34 have deep palates. Palatine ridges are larger in males than in females and are mound-shaped rather than ridged for both sexes. The palates are unusual in their large overall size and in their considerable breadth (Pls. 1–7, 10–14).

TABLE 2

CRANIAL MEASUREMENTS AND INDICES

	Males			Females		
Measurements	BP2/17	BP2/20–41	BP4/8	BP2/21	BP2/25	BP3/27–34
Cranial Length (1)	200	..	..	183	..	177
Cranial Breadth (8)	147	..	..	133	..	130
Basion-Bregma Height (17)	135	..	..	..	..	..
Auricular-Vertex Height (21)	132	..	..	..	..	93
Auricular-Bregma Height (20)	127	..	..	..	..	95
Minimum Frontal Diameter (9)	117	..	..	110	..	91
Bizygomatic Diameter (45)	..	..	..	121	..	110
Menton-Nasion Height (47)	..	..	..	..	..	101
Prosthion-Nasion Height (48)	..	..	..	..	60	64
Nasal Height (55)	..	..	..	..	..	44
Nasal Breadth (54)	..	23	..	..	..	23
Orbital Height-Right (52)	37	..	..	36	..	..
Orbital Height-Left (52)	37	..	..	..	..	40
Orbital Breadth-Right (51)	41	..	..	..	..	..
Orbital Breadth-Left (51)	41	..	..	..	..	30
Biorbital Breadth (44)	131	..	..	..	..	..
Zygomatic Breadth-Right	55	..	52	40	..	..
Zygomatic Height-Right	52	..	44	42	..	47
Zygomatic Frontal Process Breadth-Right	29	..	22	24	..	22
Zygomatic Frontal Process Breadth-Left	25	..	..	..	..	..
Palate-External Length (60)	61	..	..	62	..	53
Palate-External Breadth (61)	69	70	..	65	..	63
Palate-Internal Length (62)	52	..	..	50	..	45
Palate-Internal Breadth (63)	36	47	..	42	..	42
Palate Height at M^2 (64)	19	15	14	14	..	18
Arc-External Palate	185	..	152	..	..	..
Arc-Transverse (24)	355	..	..	300	..	270
Arc-Glabella-Opisthion (25)	355	..	..	320	..	285
Arc-Frontal Length (25)	132	..	..	135	..	115
Arc-Sagittal Length (27)	146	..	..	152	..	128
Arc-Occipital Length (28)	77	..	..	53	..	58
Chord-Frontal Length (29–1)	118	..	..	120	..	105
Chord-Sagittal Length (30)	130	..	..	132	..	112
Maximum Circumference (23)	..	..	..	520	..	495
Indices						
Cranial	73·50	..	..	72·68	..	73·45
Basion-Bregma Height-Length	67·50	..	..	..	..	..

TABLE 2 (*continued*)

CRANIAL MEASUREMENTS AND INDICES

	Males			Females		
Indices	BP2/17	BP2/20–41	BP4/8	BP2/21	BP2/25	BP3/27–34
Basion-Bregma Height-Breadth	91·84	..	..	..	..	..
Auricular-Vertex Height-Length	66·00	..	..	..	..	52·54
Auricular-Vertex Height-Breadth	89·69	..	..	..	..	71·54
Auricular-Bregma Height-Length	63·50	..	..	..	..	53·67
Auricular-Bregma Height-Breadth	86·53	..	..	..	..	73·08
Total Facial	..	..	..	..	..	91·82
Upper Facial	..	..	..	..	..	58·18
Nasal	..	..	..	..	..	52·27
Orbital-Right	90·24	..	..	..	..	..
Orbital-Left	90·24	..	..	..	..	75·00
External Palate	113·11	..	..	104·84	..	118·87
Internal Palate	69·23	..	..	84·00	..	93·33
Cranial Module	159·67	..	..	..	..	133·33
Cranial Capacity						
Basion-Bregma Height: von Bonin (1934 : 14)	1448·75	..	..	..	..	..
Lee & Pearson (1901 : 225–264)	1580·35	..	..	..	..	..
Auricular Height: Lee & Pearson (*Ibid.*)	1775·83	..	..	..	..	1098·87
Isserlis (1914 : 189)	1589·72	..	..	..	..	919·66

The Mandible (Table 3). In contrast to the brachystaphaline upper jaw, the lower jaw is dolichostenomandibular. The alveolar portion of the mandible conforms to the characteristic shape of the palate, but the ramus describes an obtuse angle with the corpus, and moreover, is very broad. This results in a great Condylo-Symphysial Length but a moderate Bigonial Diameter. The corpus is thick and heavy at the symphysis, but is reduced in size, particularly among the females, as it sweeps posteriorly to the gonia. The chin is prominent and median for all mandibles, save for that of BP2/21 where the chin form is bilateral. The corpora of males are thicker and higher than the corpora of females, due in part to their more developed mylo-hyoid crests. There is less sexual diversity in the development of the digastric fossae and genial tubercles. These range in size from sub-medium to large. Alveolar prognathism is small in males and medium in females. The rami are robust in the males, their pterygoid attachments are well developed and gonial eversion is pronounced. Female rami are delicate and the gonia may be strikingly everted or convergent. The mandibular notch is small to medium, save for specimen BP2/21 which has a deep notch due to the greater length of the coronoid process. In all

TABLE 3

MANDIBULAR MEASUREMENTS AND INDICES

	Males		Females		
Measurements	BP2/17i	BP2/20–41	BP1/6	BP2/21	BP3/27–34
Condylo-Symphysial Length (68)	106	79	..	99	93
Bicondylar Breadth (65)	118	115	..	105	112
Symphysial Height (69)	28	26	31	31	28
Bigonial Diameter (66)	96	110	..	99	101
Height of Ascending Ramus—Right (70)	..	57	70	54	49
Height of Ascending Ramus—Left (70)	65	..	..	48	49
Minimum Breadth of Ascending Ramus —Right (71)	..	..	30	31	31
Minimum Breadth of Ascending Ramus Left (71)	34	35	..	33	31
Maximum Breadth of Ascending Ramus—Right (71–1)	..	..	..	36	41
Maximum Breadth of Ascending Ramus—Left (71–1)	44	..	..	36	40
Bimental Diameter (67)	45	30	..	..	41
Depth at PM^2—Right (69–2)	31	27	..	..	27
Depth at PM^2—Left (69–2)	31	26	27	..	26
Depth at M^1—Right (69–2)	28	25	27	22	23
Depth at M^1—Left (69–2)	31	26	26	..	23
Depth at M^2—Right (69–2)	26	25	23	23	23
Depth at M^2—Left (69–2)	28	26	25	23	20
Depth at M^3—Right (69–2)	26	..	21	24	20
Depth at M^3—Left (69–2)	29	27	22	24	20
Thickness at M^1—Right (69–3)	16	11	14	12	10
Thickness at M^1—Left (69–3)	16	12	15	13	9
Thickness at M^2—Right (69–3)	20	12	18	15	14
Thickness at M^2—Left (69–3)	19	13	17	16	13
Thickness at M^3—Right (69–3)	18	12	17	17	11
Thickness at M^3—Left (69–3)	19	16	18	17	11
Mental Foramen Diameter—Right	..	4×3·5	15×2·5	..	..
Mental Foramen Diameter—Left	..	4×3·5	25×3	..	..
Mean Angle (79)	118	123	..	116	133
Indices					
Mandibular	89·83	68·69	..	94·28	83·03
Fronto-Gonial	..	..	..	104·76	81·25
Zygo-Gonial	..	..	..	81·82	101·81

mandibles the condylar process does not rise very high above the coronoid process and the mandibular head is small. The lingula of the mandibular fossa is uniformly small. The ramus is broad and moderately high. The Balangodese mandible is of medium size but is distinctive for its broad and elevated rami and thick corpora. Sexual differences are difficult to isolate (Pls. 8, 9).

THE POST-CRANIAL SKELETON. *The Skeleton of the Trunk.* Vertebrae were available for two specimens: BP2/17 and BP2/25. Their fragmentary and badly warped condition renders a metrical description of dubious value, but measurements were feasible for the fourth and fifth lumbar vertebrae of BP2/17. The cervical vertebrae are small and delicate with cordiform bodies and triangular neural foramina. The transverse processes are short. The atlas has a thin posterior arch and a very reduced posterior tubercle. The facet for the odontoid process is proportionately large for the accommodation of the thick, bulbous axial dens. The thoracic vertebrae are small. Their vertebral foramina are round and their bodies contain broad costal facets. The transverse processes are bulbous. The spinous processes are not large. In contrast to the pre-lumbar vertebrae, the last five segments of the spine are robust and are equipped with prominent posterior and transverse processes. The kiolorachic lumbar vertebrae of BP2/17 exhibit thick centra and wide epiphysial rings. For the fifth lumbar vertebra the Vertical Ventral (1) and Vertical Dorsal (2) Diameters are 23 mm. and 27 mm. respectively: the Depth of the Body is 30 mm. for the anterior–posterior diameter (4) and 46 mm. for the lateral diameter (7).

Rib fragments accompany the vertebral remnants but none of the ribs is complete. The ribs of BP2/17 are very large at their sternal ends but never exceed 6·0 mm. in thickness. The costal grooves are deep with sharp borders. The ribs of the female specimen attain their greatest size at a point some distance lateral to the sternal head. The first rib shows a well-marked groove for the subclavian vessels, but the ribs just inferior to it are smooth and their thickness averages 3·0 mm. For both sexes the neck of the rib is robust and massive.

The sternum of specimen BP2/17 is lacking its manubrium, but the body measures 96 mm. in length and 32 mm. in breadth. Fusion of the sternal components is complete. Facets for six sternal articulations are well marked. Curvature is very slight. There are no sternal foramina.

The Skeleton of the Upper Extremity (Table 4). The clavicle of the male specimen is large and shows a moderate degree of curvature. The sternal head is oval in form. The acromial head is moderately flat. Muscularity is reduced. In contrast to this condition are the clavicles of the female specimens which are small, delicately built, and with a medium to pronounced degree of curvature. Muscularity is much more apparent among the female clavicles which are characterized by sharp ridges for the deltoid attachment. These also show wide grooves for the subclavian vessels. Like the male clavicles, those of the females have oval sternal heads and flat acromial heads.

The scapula is medium in size for the male, small for the female. For both sexes this portion of the upper extremity is robust. For the male specimen there is a pronounced obliquity in the direction of this spine in relation to a line tangent to the vertebral border. Since this border has undergone damage at the region inferior to the spine, the spino-vertebral angle can only be inferred and cannot be qualitatively or quantitatively ascertained. The axillary borders of both male and female scapulae are thick and tend to double their thickness in the vicinity of the glenoid fossa. The superior border is narrow and is lacking a scapular notch. The angle

TABLE 4

MEASUREMENTS AND INDICES OF THE BONES OF THE UPPER EXTREMITY

	Males		Females		
	BP2/17	BP4/8	BP2/21	BP2/25	BP3/27–34
Clavicle					
Measurement					
Maximum Length—Left (1)	..	..	..	..	123
Mid-Shaft Circumference—Right (6)	..	..	..	28	32
Mid-shaft Circumference—Left (6)	39	..	..	..	33
Mid-shaft Diameter—Anterior-Posterior —Right (5)	..	..	..	..	10
Mid-shaft Diameter—Anterior-Posterior —Left (5)	..	..	..	..	10
Sternal Head Diameter—Right	..	..	..	18	19
Sternal Head Diameter—Left	..	..	22	..	..
Index					
Length—Thickness—Left	..	..	..	..	29·46
Scapula					
Measurement					
Morphological Length—Left (2)	87	..	..	..	..
Corocoid Process Length—Left (11)	43	..	..	..	..
Corocoid Process Breadth—Right	14	..	..	..	..
Corocoid Process Breadth—Left	14	..	..	..	..
Acromion Process Length—Right (10)	53	..	..	..	..
Acromion Process Length—Left (10)	52	..	..	..	..
Acromion Process Breadth—Right (9)	30	..	..	..	22
Acromion Process Breadth—Left (9)	26	..	..	..	..
Glenoid Fossa Height—Right (12)	36	..	..	..	30
Glenoid Fossa Height—Left (12)	38	..	..	..	..
Glenoid Fossa Breadth—Right (13)	..	..	..	..	20
Glenoid Fossa Breadth—Left (13)	28	..	..	..	..
Humerus					
Measurement					
Maximum Length—Left (1)	..	..	..	..	302
Bicondylar Length—Left (2)	..	..	..	..	298
Bicondylar Breadth—Right (4)	..	53	..	..	..
Bicondylar Breadth—Left (4)	..	52	..	..	..
Maximum Head Diameter—Right (9, 10)	..	..	..	..	35
Maximum Head Diameter—Left (9, 10)	..	..	..	40	35
Mid-Shaft Diameter—Anterior-Posterior —Right (6c)	..	21	..	..	12
Mid-Shaft Diameter—Anterior-Posterior —Left (6c)	..	21	..	..	12
Mid-Shaft Diameter Lateral—Right (6b)	..	18	..	..	17
Mid-Shaft Diameter Lateral—Left (6b)	..	18	..	..	17
Mid-Shaft Circumference—Right (7a)	..	59	..	..	..
Mid-Shaft Circumference—Left (7a)	..	59	..	..	48
Index					
Robusticity—Left	..	..	..	..	9·60

TABLE 4 (*continued*)
MEASUREMENTS AND INDICES OF THE
BONES OF THE UPPER EXTREMITY

	Males		Females		
	BP2/17	BP4/8	BP2/21	BP2/25	BP3/27–34
Radius					
Measurement					
Maximum Length—Left (1)	..	248	..	..	..
Least Circumference—Left (3)	..	38	..	35	38
Maximum Head Diameter—Right (4–1, 5–1)	..	22	..	..	..
Maximum Head Diameter—Left (4–1, 5–1)	..	22	..	18	19
Mid-Shaft Diameter—Anterior-Posterior —Left (5)	..	11	..	15	9
Mid-Shaft Diameter—Lateral—Left (4)	..	16	..	19	18
Ulna					
Measurement					
Maximum Length—Left (1)	..	261	..	..	259
Least Circumference—Left (3)	..	33	..	..	25
Mid-Shaft Diameter—Anterior-Posterior —Left (11)	..	15	..	..	12
Mid-Shaft Diameter—Lateral—Left (12)	..	11	..	..	8
Capitate					
Measurement					
Length (1)	..	..	25	..	..
Breadth (2)	..	..	20	..	..
Height (3)	..	..	18	..	..
Trapezium					
Measurement					
Length (1)	..	..	23	..	..
Breadth (2)	..	..	19	..	..
Height (3)	..	..	11	..	..
Scaphoid					
Measurement					
Length (1)	..	..	23	..	..
Breadth (2)	..	..	13	..	..
Height (3)	..	..	8	..	..
Metacarpals					
Digit I Length (2)	..	..	71	..	..
,, II ,,	..	..	71	..	..
,, III ,,	..	..	68	..	..
,, IV ,,	..	..	68	..	..
,, V ,,	..	..	48	..	..
Phalanges					
Digit I ,, (3)	..	..	31	..	..
,, IV ,,	..	..	38	..	..

of the glenoid fossa to the scapular body lies in a plane slightly lateral and superior to it. In form the fossa is elliptical, the inferior half being broad and the superior half narrowly constricted. Lipping of the fossa is submedium. The acromion is long and rectangular. The clavicular facet is unlipped. The corocoid process is flat and extensive.

The humeral shaft is long and only slightly curved. A transverse section shows a prismatic pattern in the male specimen, a plano-convex pattern in the female. Muscularity is pronounced : the tuberosities are large, the bicipital groove is deep, the supracondylar ridges are sharp on medial and lateral aspects of the bone. The head is medium in size. The olecranon fossa is shallow and unperforated. Supracondylar processes are absent.

The radius is large for specimens BP4/8 and BP2/25, but small and sinuous for BP3/27. The shaft is straight in the male, but shows moderate anterior–posterior bowing in the female. The transverse section is oval in these bones for both sexes. The extremities of the radius are more massive for the male, but both sexes have shafts with well-marked muscular attachments. Tuberosities are extensive and low in females, prominent in males. The neck is longer for the male. Lipping of the capitulum occurs in the bones of both sexes. The styloid process is particularly well marked for males. Both sexes exhibit prominent muscular attachments on their radii.

The ulna is triangular in transverse section. Curvature of the shaft is slight, occurring in the male only to a limited degree in the region of the brachialis attachment just inferior to the coronoid process. Muscularity is pronounced for the male, moderate for the female. Both sexes show a prominent styloid process. The interosseous space is large as a result of radial rather than ulnar curvature.

The bones of the hand tend to be large. The crests of the carpals are weakly developed. The form of the capitate is square. The scaphoid assumes a dumbbell conformity, but the trapezium is prominently ridged and metacarpals irregular. The metacarpals are long and exhibit pronounced dorso-ventral curvature. This being the hand of a sub-adult individual, the heads of the shaft are ununited. The metacarpal formula is II > III > IV > V(?) > I(?). The fifth metacarpal is not available for examination.

The Skeleton of the Lower Extremity (Table 5). The femur of BP2/17 is stenomeric, and femora of the other male and the female of this series are eurymeric. Transverse section pattern is either round or quadrangular for the males but plano-convex for the female. The linea aspera is marked with a prominent pilaster, particularly in the case of the males. The shaft is uniformly thick and bowing is slight to medium in its degree. Tortion is slight to medium in its degree. Tortion is within the medium category (10°–20°), save for specimen BP2/17 where the tortion is more pronounced. The crista hypotrochanterica is of medium development for BP4/8, but the fossa hypotrochanterica is deep for all specimens. Trochanters major and minor are large and smooth. The neck of the femur is short and narrow and supports a small head. The intercondylar fossa is deep and broad in its transverse plane. There is a pronounced inferior orientation of the medial condyle and a slight anterior prominence of the lateral condyle. The adductor tubercle is reduced.

Table 5

Measurements and Indices of the Bones of the Lower Extremity

	Males		Females
	BP2/17	BP4/8	BP2/25
Femur			
Measurement			
Maximum Length—Right (1)	419	..	..
Bicondylar Length—Right (2)	414	..	..
Mid-Shaft Circumference—Right (8)	72	80	66
Mid-Shaft Circumference—Left (8)	..	79	71
Sub-Trochanteric Diameter—Anterior-Posterior—Right (10)	25	24	..
Sub-Trochanteric Diameter—Anterior-Posterior—Left (10)	..	26	20
Sub-Trochanteric Diameter—Lateral—Right (9)	20	27	..
Sub-Trochanteric Diameter—Lateral—Left (9)	..	26	23
Mid-Shaft Diameter—Anterior-Posterior Right (6)	24	25	24
Mid-Shaft Diameter—Anterior-Posterior —Left (6)	25	27	25
Mid-Shaft Diameter—Lateral—Right (7)	20	23	18
Mid-Shaft Diameter—Lateral—Left (7)	21	23	19
Maximum Head Diameter—Right (18, 19)	35	..	..
Indices			
Platymeria—Right	125·00	88·89	86·96
Platymeria—Left	..	100·00	..
Middle—Right	83·33	92·00	75·00
Middle—Left	84·00	85·18	76·00
Pilastric—Right	120·00	108·59	133·33
Pilastric—Left	119·05	117·39	131·59
Robusticity—Right	10·63	..	..
Tibia			
Measurement			
Mid-Shaft Diameter—Anterior-Posterior —Right (8)	26	27	23
Mid-Shaft Diameter—Anterior-Posterior —Left (8)	25	27	..
Mid-Shaft Diameter—Lateral—Right (9)	19	22	16
Mid-Shaft Diameter—Lateral—Left (9)	18	21	..
Nutrient Foramen Diameter—Anterior-Posterior—Right (8a)	..	..	27
Nutrient Foramen Diameter—Anterior-Posterior—Left (8a)	26	33	..
Nutrient Foramen Diameter—Lateral—Right (9a)	..	..	19

TABLE 5 (*continued*)

MEASUREMENTS AND INDICES OF THE BONES OF THE LOWER EXTREMITY

	Males		Females
	BP2/17	BP4/8	BP2/25
Nutrient Foramen Diameter—Lateral—Left (9a)	19	23	..
Least Circumference—Right (10b)	69	..	61
Least Circumference—Left (10b)	66	72	..
Index			
Middle—Right	73·07	81·48	69·56
Middle—Left	72·00	77·78	..
Platycnemia—Right	..	..	65·52
Platycnemia—Left	73·08	69·60	..
Fibula			
Measurement			
Mid-Shaft Diameter—Anterior-Posterior—Left (3–2)	..	15	..
Mid-Shaft Diameter—Lateral—Left (3–1)	..	9	..
Least Circumference—Left (4a)	..	33	..
Distal Breadth—Left (4–2)	..	23	..
Talus			
Measurement			
Length—Right (1)	45	..	..
Breadth—Right (2)	32	..	..
Height—Right (3)	18	..	..
Calcaneum			
Measurement			
Length—Right (1)	67	..	..
Breadth (2)	37	..	..
Cuboid			
Measurement			
Length—Left (1)	35	..	..
Breadth—Left (2)	29	..	..

The tibiae are eurycnemic for specimen BP2/17 and mesocnemic for BP4/8 and BP2/25, although these latter two stand at the upper and central loci of the mesocnemic category. Tibial lengths could not be ascertained. The posterior half of the transverse section of the shaft is oval, but in BP4/8 the conformation is closer to plano-convex. The bones are heavy and thick for the males. Bowing of the shaft is very slight. Muscularity is moderate for both sexes.

The fibula is represented by the single fragment belonging to BP4/8. It is the left fibula. The form of its transverse section is triangular. Whereas the anterior border is sharp, fluting of the shaft is sub-medium in development. The lateral malleolus is medium in size and its articular facet is extensive. The shaft is straight.

The talus possesses a large triangular articular facet for the fibular malleolus. The groove for the flexor hallicus longus is medium in development. The neck of the talus is not constricted. The calcaneum is short and deep with a round posterior curvature of the sustentaculum tali. The cuboid exhibits pronounced curvature of the cuboid-lateral cuneiform facet. The articular facet is large, round, and its borders poorly defined. There is no lipping of the facet. The cuboidal ridge is prominent.

TABLE 6

MEASUREMENTS AND INDICES OF THE BONES OF THE PELVIS

	Male BP2/17
Sacrum	
Measurement	
Anterior Length (2)	102
Sacral Breadth (5)	125
Lateral Diameter of Body 1 (19)	46
Anterior-Posterior Diameter of Body 1 (18)	29
Anterior Height of Body 1 (24)	29
Anterior Height of Body 2 (24)	28
Index	
Sacral	122·55
Innominate	
Measurement	
Innominate Length—Right (1)	207
Innominate Length—Left (1)	184
Innominate Breadth—Right (6a)	141
Innominate Breadth—Left (6a)	142
Distance from Acetabulum to Apex of Ilium—Right (9)	132
Distance from Acetabulum to Apex of Ilium—Left (9)	114
Length of Iliac Lines—Right	262
Length of Iliac Lines—Left	260
Vertical Diameter of Acetabulum—Right (22)	42
Horizontal Diameter of Acetabulum—Right (22)	37
Breadth of Sciatic Notch—Right (8)	50
Distance from Anterior Superior to Posterior Superior Iliac Spines—Right (12)	138
Sacrum and Innominates	
Measurement	
Bi-iliac Diameter (2)	218
Sagittal Diameter of the Pelvic Inlet (23)	157
Transverse Diameter of the Pelvic Inlet (24)	107
Index	
Pelvic Inlet	146·81
Innominate Breadth-Height—Right	129·58

The Skeleton of the Pelvis (Table 6). The single sacrum observable in the series is platyhieric. The sacral type is homobasal. Of the five sacral vertebrae the first, second and third articulate with the innominates. Curvature commences at the second sacral body but is not pronounced. Spina fissa is absent. The overall size of the sacrum is large. Deraniyagala considers the Stone Age population of Ceylon to have been steatopygous. He discusses this in relation to the small pelvis of the female skeleton found at the site of Alu galge (Telulla) (Deraniyagala 1955*b* : 301) and considers the fossils from Bellan Bandi Palassa to have exhibited the same trait (Deraniyagala 1958*a* : 255). The present writer is unable to find any evidence either to confirm or reject this opinion.

The innominates of this individual are thick and massive. Their size is moderate and the muscular attachments are prominently sculptured. The ilium has heavy and irregular crests along its superior rim and deep hollowing of the iliacus portion of the medial surface. The origin of gluteus maximus is well marked. There is considerable torsion between ilium and ischium. The anterior superior iliac spine is broad and blunt. The ischia are divergent in their orientation and are moderately elongated in size. The ischiatic notch presents a higher angle than is usual in male specimens. The pelvic inlet is cordiform and its index places it within the dolichopellic group, although the absence of the complete pubic area renders this statement subject to question.

An Estimation of Stature (Table 7). Limb proportions are unfortunately impossible to establish for the Balangoda population due to the paucity of long bones complete enough for their maximum lengths to be accurately measured, and to the absence of any bones of the upper and lower extremities belonging to the same individual. Those long bone lengths which could be measured are listed in the table below, where they are employed as components of the formulae devised by Trotter & Gleser (1952, 1958) for estimation of stature from long bones.

The lengths of the bones of two males, BP2/17 and BP4/8, and one female, BP3/27–34, are employed in formulae appropriate to American Whites, American Negroes, and American Mongoloids, mainly Chinese. The stature estimates for each of the three groups are given.

In an effort to ascertain which of the three formulae might be best suited to the Balangodese, the writer applied them to the long bone lengths of three Veddas whose stature in life was known and whose long bones had been measured by Hill. These individuals were two males—Burunda, specimen 1949–12–7–4, and Tissahamy, specimen 1949–12–7–6, both of British Museum of Natural History (Hill 1941 : 148–149, tables 1, 22). The former individual was from Dambane and was partly Sinhalese ; the latter from Kalakoluebe near Yakkure was non-Sinhalese in racial background. The female Vedda available for comparison was not measured in life but skeletal stature is known. This is the Vedda specimen in the osteological collection of the Bombay Natural History Society (Hill 1941 : 227–235).

Such estimations of stature as given here are only indicative of the order of stature which is to be anticipated for the three Balangodese individuals. For the Veddas, the formula for Mongoloids renders a value that most closely approximates the living stature of Burunda, but for Tissahamy, the formulae for the Negroes is a nearer approximation.

The Metrical and Morphological Analysis of the Dentition

In their dental morphology the Balangodese have teeth which are moderate to large in size by general standards for post-Pleistocene hominid populations (Table 8). The order of size of the molars within the molar rows of each specimen show considerable variation. For BP2/17, the RLM^1 and RLM^2 are progressively smaller than the RLM^3. This is also the case for the mandibular molar row of BP2/17i, but in the remaining male specimens the maxillary molar row shows the first molars of greater size. The mandible of BP2/20–41, however, shows a larger third molar for the row. For the female BP1/6, the maxilla has a second molar of greatest size followed in descending order by the first molar and the third, but the mandibular molar row has the third molar larger than the first and the first larger than the second.

TABLE 7

AN ESTIMATION OF STATURE BASED UPON LENGTHS OF LONG BONES FOR BALANGODESE AND VEDDAS

BALANGODESE

	Males				Female	
	BP2/17		BP4/8		BP3/27–34	
	Length	Stature	Length	Stature	Length	Stature
	Right		Left		Left	
White:						
Humerus	..	..	..	..	302	1654
Radius	..	..	248	1734	..	..
Ulna	..	..	261	1713	259	1706
Femur	419	1627	..	..	..	..
Tibia	..	..	..	..	..	..
Fibula	..	..	..	..	..	..
Negro:						
Humerus	..	..	..	..	302	1624
Radius	..	..	248	1678	..	..
Uina	..	..	261	1663	259	1656
Femur	419	1602	..	..	..	..
Tibia	..	..	..	..	..	..
Fibula	..	..	..	..	..	..
Mongoloid:						
Humerus	..	..	..	..	302	1641
Radius	..	..	248	1698	..	..
Ulna	..	..	261	1683	259	1676
Femur	419	1626	..	..	..	..
Tibia	..	..	..	..	..	..
Fibula	..	..	..	..	..	..

TABLE 7 (*continued*)

AN ESTIMATION OF STATURE BASED UPON LENGTHS OF LONG BONES FOR BALANGODESE AND VEDDAS

VEDDAS

	Males: 1949–12–7–4 Length R	L	Stature R	L	Males: 1949–12–7–6 Length Right	Stature Right	Female Bombay Nat. Hist. Soc. Length R	L	Stature R	L
White :										
Humerus	300	301	1648	1650	..	..	250	262·5	1503	1540
Radius	241	239	1707	1700	..	..	202	202	1560	1560
Ulna	266	263	1732	1721	..	..	221	221	1566	1566
Femur	429	430	1650	1653	398	1579	361	362	1493	1495
Tibia	365	368	1703	1710	328	1613	311	311	1572	1572
Fibula	358	355	1686	1678	325	1600	301	300	1538	1535
	Mean = 1686					1597				
Negro :										
Humerus	300	301	1619	1622	..	..	250	262·5	1475	1512
Radius	241	239	1654	1648	..	..	202	202	1525	1525
Ulna	266	263	1679	1669	..	..	221	221	1535	1535
Femur	429	430	1823	1825	398	1558	361	362	1480	1482
Tibia	365	368	1653	1659	328	1572	311	311	1535	1535
Fibula	358	355	1638	1631	325	1561	301	300	1505	1503
	Mean = 1677					1564				
Mongoloid :										
Humerus	300	301	1636	1638	..	..	250	262·5	1502	1535
Radius	241	239	1673	1667	..	..	202	202	1535	1535
Ulna	266	263	1700	1690	.	..	221	221	1543	1543
Femur	429	430	1648	1650	398	1681	361	362	1502	1504
Tibia	365	368	1687	1694	328	1598	311	311	1558	1558
Fibula	358	355	1665	1658	325	1586	301	300	1528	1526
	Mean = 1667					1622				
Known Stature :	(Living) 1629				(Living) 1493		(Skeletal) 1267			

Specimen BP2/21 offers another variant : the maxilla shows a large first molar, a medium second molar and a smaller third molar, but in the mandible the largest tooth is the second molar followed in size by the first and then the third. Specimen BP2/27–34 has a larger maxillary second molar than the first molar, but a larger mandibular first molar. These data can be summarized as follows :

Males :	BP2/17	*Maxilla.*	M3 > M2 > M1		
	BP2/17i			*Mand.*	M3 > M2 > M1
	BP2/20–41	*Maxilla.*	M1 > M2 > M3	*Mand.*	M3 > M1 > M2
	BP4/8	*Maxilla.*	M1 > M3 > M2		
Females :	BP1/6	*Maxilla.*	M2 > M1 > M3	*Mand.*	M3 > M1 > M2
	BP2/21	*Maxilla.*	M1 > M2 > M3	*Mand.*	M2 > M1 > M3
	BP3/27–34	*Maxilla.*	M1 > M2	*Mand.*	M2 > M1

The molars are round in their conformation, but rectangular molars are present in the $LM^{\underline{3}}$ of BP2/20–41 and in all molars of BP2/21 save for its $RLM^{\underline{1}}$ which is round. Premolars are rectangular in the maxillae of both sexes, but variability occurs in the mandibles. Specimen BP2/20–41 has $RLPM^{\overline{1}}$ and $RLPM^{\overline{2}}$ which are round ; another male, BP2/17i, has a triangular $LPM^{\overline{1}}$ although its other mandibular premolars are round. In both these cases, the molar pattern is round, with the exception of the LM^3 of BP2/20–41 noted above. There is no maxillary dentition available for BP2/17i. The female BP3/27–34 has a round $RLPM^{\overline{1}}$ adjacent to a rectangular $RLPM^2$ and round molars. Canines of the maxillae and mandibles are triangular for both sexes, but rectangularity appears in the $RL\underline{\overline{C}}$ of the male BP2/20–41. Incisors are uniformly rectangular.

Cusp and groove patterns are not observable for all of the teeth of the series due to the high incidence of attrition. For the maxilla, the males show pronounced variability. Specimen BP2/17 shows 5 cusps for the $LM^{\underline{3}}$ and 3 cusps for $RLM^{\underline{2}}$. The other male, BP4/8, has 4 cusps on the $RM^{\underline{1}}$, $RM^{\underline{2}}$, and $RM^{\underline{3}}$, the other molars not being observable. In contrast, the maxillary molars of the female specimens are of the 4-cusp pattern. The $RLM^{\underline{3}}$ of BP2/21 has 6 cusps. In the single male, specimen BP2/20–41, for which the cusps of the lower molars are observable, the $LM^{\overline{3}}$ has 5 cusps and the remaining left and right molars have 4 cusps. The three female specimens show one, BP1/6, with 5 cusps for the $RLM^{\overline{3}}$ and $RLM^{\overline{1}}$, but 4 cusps for the $RLM^{\overline{2}}$. Specimen BP2/21 has 5 cusps for all molars, save for the $LM^{\overline{3}}$ which has 6 cusps. For specimen BP3/27–34 only the $RLM^{\overline{2}}$ with 4 cusps is available. Of the four specimens for which both maxillae and mandibles are available, there is no case of correlation of cusp pattern except for specimen BP3/27–34 where the second molars are alone observable. The upper and lower premolars of females are bicuspid, the buccal cusp being the larger and higher. Male premolars are also of this pattern, save for the $RLPM^{\underline{2}}$ of BP2/20–41 where the premolars have 4 cusps due to the presence of accessory cusps on the distal inclination of the buccal cusp.

Carabelli's cusp is present in the $LRM^{\underline{1}}$ of one specimen, BP2/21. The cusp is small and the mesio-lingual groove is of moderate development.

Accessory cusps are found on the second and third maxillary molars of the male specimen BP2/17. They are small and occupy loci on the mesial half of the buccal surface.

Crenulation or excessive wrinkling of the occlusal surface of the upper third molars is shared by males—BP2/17 and BP2/20–41—and females—BP1/6 and BP2/21. It is absent in the remaining male maxillae and the third molars of the female BP3/27–34 are unavailable for examination. Its occurrence is marked by the presence of 5 cusps in the male maxillae. For the females, BP1/6 has the 4-cusp pattern and BP2/21 has 6 cusps. All cases are characterized by pronounced crenulation regardless of cusp number. The mandible of male BP2/20–41 shows a deeply crenulated $LM^{\overline{3}}$ with 5-cusp pattern—a reflection of the maxillary $LM^{\underline{3}}$ of this same specimen. The mandible of female BP1/6 shows a pronounced crenulation of the $RLM^{\overline{3}}$, but the cusps of these lower third molars constitute the 5-cusp pattern instead of the 4-cusp pattern of the upper third molars of the same specimen. In specimen BP2/21 six cusps are observed in both maxillary and right mandibular third molars but the $RM^{\overline{3}}$ has 5 cusps.

For the maxilla, cusp patterns are unusual in the dentition of female specimen BP2/21 where the $RLM^{\underline{1}}$ and $RLM^{\underline{2}}$ are of the +3 type. The groove patterns for the remaining maxillary dentitions of the males are of the +4 pattern. The mandible of BP2/21 shows a $RLM^{\overline{2}}$ of the +5 pattern and a $RLM^{\underline{1}}$ of the Y5 type. In specimen BP1/6 the $RLM^{\overline{1}}$ is also of Y5 type, but the $RLM^{\overline{2}}$ is +4 and the $RLM^{\overline{3}}$ is +5. The other female specimen, BP3/27–34, has a $RLM^{\overline{2}}$ of +4 type. The only male mandible which offers data on groove pattern is specimen BP2/20–41, whose $LM^{\overline{3}}$ is Y5 and whose $RLM^{\overline{2}}$ and $RLM^{\overline{1}}$ are +4 in form. Taking the series collectively, it would appear that the basic cusp pattern for the upper molars is of the +4 type. The lower molars are characterized by the groove patterns Y5, +5, and +4.

A correlation of cusp type and groove pattern reveals that the presence of 4 cusps is associated with the +4 pattern in the mandible as observed in specimens BP2/20–41, BP1/6, and BP3/27–34. However, the mandibular 5-cusp type may be associated with either the +5 type, as with the $RLM^{\overline{3}}$ of BP1/6 and $RLM^{\overline{2}}$ of BP2/21, or with the Y5 type as represented by the $LM^{\overline{3}}$ of BP2/20–41, $RLM^{\overline{1}}$ of BP1/6, and $RLM^{\overline{1}}$ of BP2/21. As is obvious from an examination of these cases for which a mandibular molar dentition is available, each specimen has its unique combination of cusp type and groove pattern. Nevertheless, where the $M^{\overline{1}}$ has 5 cusps, its groove pattern is a Y5. The $M_{\overline{2}}$ is consistently a + pattern and in three of the specimens a +4, namely with BP2/20, BP1/6, and BP3/27–34. In one specimen, BP2/21, this is +5. Crenulation of the $M^{\overline{3}}$ is associated with the presence of 5 cusps which are either of Y5 pattern like BP2/20 or a +5 pattern like BP1/6. The groove pattern of the $M^{\overline{3}}$ of BP2/21 is unobservable, but the cusp number is 5 for the $RM^{\overline{3}}$ and 6 for the $LM^{\overline{3}}$, both molars showing crenulation. This point cannot be confirmed for the mandibular third molars of BP3/27–34. In the maxilla, as noted above, crenulation of the third molar is associated with 4 cusps (BP1/6), 5 cusps (BP2/17, BP2/20–41) or 6 cusps (BP2/21).

Attrition of the molars of male and female dentitions show considerable variation. The maxillary molars are very slightly worn in BP2/17. All cusps of the $RLM^{\underline{1}}$ and the mesio-labial cusp of the $LM^{\underline{2}}$ exhibit abrasion of the enamel with consequent exposure of the dentin in the form of pits at the apices of the cusps. Direction of abrasion cannot be established for this specimen. In contrast to this condition are the heavily abraded molars of BP2/17i. The $RLM^{\overline{3}}$ show the least wear for the six teeth of the molar rows, but like them a rim of enamel surrounds a lake of dentin from the centre of which protrudes a reduced cusp which is still covered with enamel in the $RLM^{\overline{3}}$, $LM^{\overline{2}}$, and $LM^{\overline{1}}$. Wear is greatest on the labial aspects of each molar, but the enamel rim is everywhere intact. The dentin surfaces are deeply hollowed around the central reduced cusps, the sculpturing being most pronounced on the buccal sides. The maxilla of BP2/20–41 contains a fourth molar on the left side which, like the $LM^{\underline{3}}$ adjacent to it, shows an absence of attrition. The other maxillary molars show a moderate degree of wear, the greatest degree of abrasion occurring on the buccal portions of the occlusal surface. The enamel rim is thin and brittle on the mesial portion of these molars, but thick and robust on the other portions. A similar degree of wear characterizes the mandibular molars, the $LM_{\overline{3}}$ showing less wear than the remaining molars, the buccal sides being the most abraded and denuded of enamel. The male BP4/8 shows slight wear of the $RM^{\underline{3}}$ and medium wear of the $RM^{\underline{2}}$ and $RM^{\underline{1}}$. The exposed dentin forms kidney-shaped lakes over the occlusal surfaces, and the enamel borders are stout.

The $RLM^{\underline{3}}$ of female specimen BP1/6 shows very slight abrasion. The adjacent molars are moderately worn with small pits of exposed dentin on their cusps. The $RLM^{\underline{1}}$ present kidney-shaped lakes of exposed dentin on the mesio-buccal occlusal surfaces. The direction of the abrasive force is lingual for both molar rows. The mandible of this specimen reflects the maxilla in regard to attrition, save that the $RLM_{\overline{1}}$ exhibits pronounced abrasion. The maxillary and mandibular molars of BP2/21 show negligible wear, save for the first molars which have developed small pits of exposed dentin on the apices of their cusps. Direction of this slight abrasion appears to be buccal. As the third molars are in process of eruption, their elaborately crenulated occlusal surfaces are untouched by attrition. The dentition of BP3/27–34 is heavily abraded. The third molars have been lost ante-mortem, and the first and second molars exhibit occlusal surfaces denuded of enamel, save for an island of enamel forming a central cusp. Greatest wear occurs on the lingual surfaces. The enamel rims are narrow and brittle and enclose poorly sculptured lakes of the discoloured dentin.

As with the molars, the premolars of females are more frequently abraded than are the premolars of males. For specimen BP2/17 the premolars are very slightly worn, although attrition of the buccal cusps has resulted in exposure of dentin on the $RLPM^{\underline{1}}$ and $RPM^{\underline{2}}$. The mandibular premolars of BP2/17i are heavily abraded, the $RPM_{\overline{2}}$ exhibiting the greatest degree of attrition. The exposed dentin of these teeth lacks the central reduced cusps found on the molars. Orientation of the abrasive force is buccal. The enamel borders of these premolars are rounded in contrast to the sharpened ridges that constitute the enamel borders of the molars. Maxillary and mandibular premolars of BP2/20–41 show a moderate degree of attrition. The force of abrasion appears not to favour either side of the maxillary or mandibular premolar row, but the distal portions have maintained the greater parts of the enamel, particularly for the $RLPM\frac{1}{1}$. The maxillary premolars of BP4/8 show medium attrition, the $RPM^{\underline{2}}$ having the least amount of dentin visible. Wear is greatest for both $RPM^{\underline{2}}$ and $RPM^{\underline{2}}$ on the labial portion, although the lingual cusps are marked by several small pits and lines of exposed dentin.

All maxillary premolars of female BP1/6 show a moderate degree of wear, except for $LPM^{\underline{1}}$ which is heavily worn. Unlike the other premolars whose bays of exposed dentin are limited to buccal and lingual areas separated by mesio-distal ridges of enamel, the occlusal surface of $LPM^{\underline{1}}$ is denuded of all enamel and its rim is sharp and narrow. This tooth is separated by a gap of 10 mm. from $LPM^{\underline{2}}$ which is due in part to post-mortem distortion of the maxilla, but which perhaps reflects as well an abnormal orientation of this tooth in the molar-premolar row. Unfortunately the mandibular premolars of BP1/6 are missing. Direction of wear appears to have had no preference for either side of the premolar rows. Specimen BP2/21 exhibits very slight attrition of both maxillary and mandibular premolars, although the RLPM^2 shows somewhat more abrasion than the others. Pits of dentin on the occlusal surface are numerous and are greatest in frequency on the labial portions of the premolars. In contrast are the maxillary and mandibular premolars of BP3/27–34, all of which are heavily worn, particularly on their labial sides where the enamel borders of the RLPM^2 have broken down. Vestiges of the lingual cusps are visible on the $\mathrm{RLPM}^{\bar{1}}$.

Canines show slight attrition in specimen BP2/17, the apices of the cusp being marked by very small pits of dentin. Those of BP2/20–41 are moderately worn with the greatest degree of attrition on the labial aspects. The $\mathrm{R}\underline{\mathrm{C}}$ of BP4/8 is characterized by a lingual and labial pit on its occlusal surface, but these are reduced in size. The maxillary $\mathrm{L}\underline{\mathrm{C}}$ of BP1/6 has moderate wear on its labial aspect. Those of BP2/21 are marked by numerous pits of exposed dentin but the cusps are not reduced in size. The canines of BP3/27–34 are very abraded in the maxilla and in the $\mathrm{R}\bar{\mathrm{C}}$ of the mandible, although the enamel borders are well preserved and rounded in form.

Incisors are moderately to heavily abraded for all specimens. The $\mathrm{RLI}^{\underline{2}}$ of BP2/17 present a bar-like incisal margin of exposed dentin, portions of which are pitted. The more pronounced attrition of the $\mathrm{LI}^{\underline{2}}$ of BP2/20–41 shows a triangular mass of exposed dentin on the cutting surface, the enamel rim being reduced in size and very thin along its mesial aspect. The lingual side is worn to the base of the crown. The $\mathrm{RI}^{\underline{2}}$ and $\mathrm{RI}^{\underline{1}}$ of BP1/6 are moderately worn, the central incisor showing slightly greater wear. The exposed dentin is rectangular in form. The maxillary and mandibular incisors of BP2/21 are heavily abraded with their rectangular cutting surfaces. Due to post-mortem damage to the mandible, the RI^2 and $\mathrm{LI}^{\bar{2}}$ have become dislocated so that the RI^2 has been pushed to the left side where it is adjacent to the LI^2. The cutting edges are rectangular. Pronounced wear characterizes the maxillary $\mathrm{LI}^{\underline{2}}$ which is worn to a triangular-shaped stub of exposed dentin.

Deraniyagala (1958*a* : 255, 260) remarks that the lower teeth are always more heavily abraded than the upper teeth. This is the tendency for the teeth taken as a whole, although for the few incisors available in the sample the upper teeth appear to be more heavily abraded. However, if the dentitions are examined according to specimen, only two, BP1/6 and BP2/21, illustrate Deraniyagala's claim. The other two specimens, BP2/20 and BP3/27–34, show an equal degree of wear for teeth in both jaws. There is a higher incidence of mandibular molar wear among males than females, but maxillary molar wear shows no sexual dichotomy. Females show a higher incidence of premolar attrition and maxillary canine attrition, but males have a higher incidence of wear among mandibular canines and maxillary incisors. No comparison by sex is possible for the lower incisors since these are lacking for male specimens.

Shovel shaping of the incisors is lacking in the male dentitions available for examination, but is present in the RI^{2} and RI$^{\underline{1}}$ of female BP1/6 and in the LI$^{\underline{1}}$ and LI$^{\overline{2}}$ and RLI^{2} and RI$^{\overline{1}}$ of the female BP2/21. It is expressed to a pronounced degree only in the maxillary incisors of BP2/21, the size of the shovel shaped depressions of this specimen's mandibular incisors being slightly developed. Development is medium in the BP1/6 incisors. The single case of a lingual tubercle occurs in the LI$^{\underline{2}}$ and RLI^{2} and RI$^{\overline{1}}$ of BP2/21. The tubercle is prominent in the mandible, but small in the maxilla of this female specimen although a foramen cecum incisal to the tubercle marks this feature with clarity.

Some features that frequently appear in the dentitions of other Recent hominid populations are not observable in the Balangoda series. Caries and dental abcesses are not observed. Ante-mortem tooth loss is suggested in the case of a single specimen—the RLM$^{\overline{3}}$ of female BP3/27–34. The alveoli in this case appear completely absorbed. The maxillary third molars of this specimen appear to have been lost post-mortem, the RM$^{\underline{3}}$ showing a small alveolus with unabsorbed borders. Supernumerary teeth are found in the case of the LM$^{\underline{4}}$ of the maxilla of BP2/20–41. The size of this distomolar tooth is reduced, and its form is of the compressional or rectangular type. It was never of any functional benefit. Buccomesial to the RM^{2} of specimen BP2/21 is a peg-shaped paramolar which is encased in enamel and is half as high as the adjacent teeth. Suppression is not a feature of the dentitions of the series. The upper and lower third molars of specimen BP2/21 were almost completely erupted at the time of death of this individual.

Deraniyagala (1958*a* : 255) remarks that bite is of the edge-to-edge type. This cannot be ascertained with certainty for any of the specimens, although it may have been a trait for those individuals with heavily worn teeth. Prominent overbite seems to be the case for specimen BP3/27–34 and possibly for BP2/25, although distortion of the skull precludes certainty for the latter.

As few of the teeth were isolated from their alveoli, examination of the root systems was approached through study of radiographic plates. The number of roots for the mandibular molars was two for all samples in the series. Maxillary molars, however, exhibit greater variation. The distomolar of BP2/20–41 has two roots although the other molars adjacent to it are triradical. The first maxillary molars of BP4/8 are double-rooted. Premolars are single-rooted in the mandibles of both sexes, but in the maxilla the first premolar is double for females BP1/6 and BP2/21. These double roots are small.

The direction of the molar roots within their alveoli shows considerable variation. The roots of the M$^{\underline{3}}$ of BP2/17 are fused and straight. Its neighbour, the M$^{\underline{2}}$, shows fusion of only two of its roots—the mesiobuccal and distobuccal. The M$^{\underline{1}}$ has divergent buccal roots with the radical apices oriented toward each other.

The mandibular molars of BP2/17i are divergent, those of the M$^{\overline{1}}$ curving toward each other.

Maxillary molars of BP2/20–41 show divergent roots for the distomolar, fused roots for the M$^{\underline{3}}$, and divergent roots for the remaining molars. The mandibular molars all have divergent roots. The medial roots curve distally, and the distal roots are straight.

TABLE 8—DENTAL MEASUREMENTS AND INDICES

			Maxilla		Mandible	
			Range	Mean	Range	Mean
Third Molar	R	Mesio-distal	8·5–10 (4)	9·25	11–12 (3)	11·50
		Bucco-lingual	11·5–13 (4)	11·87	10·5–11·5 (3)	11·00
		Index	115·00–151·94	128·94	91·30–100·00	95·71
	L	Mesio-distal	9–10 (4)	9·37	10·5–12 (4)	11·25
		Bucco-lingual	12–13 (4)	12·50	10·5–13 (4)	11·25
		Index	120·00–144·44	133·80	87·50–118·18	100·43
Second Molar	R	Mesio-distal	9–10·5 (6)	9·60	10·5–12 (5)	11·20
		Bucco-lingual	10·5–13 (6)	11·75	9·5–12 (5)	10·50
		Index	105·00–141·18	122·11	86·36–100·00	93·67
	L	Mesio-distal	9–10 (5)	9·50	10–12 (5)	11·00
		Bucco-lingual	10·5–12·5 (5)	11·90	10–11·5 (5)	10·60
		Index	110·53–138·89	125·44	91·30–104·54	96·38
First Molar	R	Mesio-distal	9–11 (6)	10·17	10·5–12 (5)	11·00
		Bucco-longual	11–12 (6)	11·50	10–11·5 (5)	10·80
		Index	109·10–122·22	113–31	91·67–104·76	98·33
	L	Mesio-distal	9·5–11 (5)	10·20	10–11·5 (5)	10·80
		Bucco-lingual	11–12 (5)	11·70	10·5–11·5 (5)	10·90
		Index	109·10–121·05	114·90	95·45–105·00	100·13
Second Premolar	R	Mesio-distal	6–7 (6)	6·75	7–7·5 (4)	7·12
		Bucco-lingual	9–10 (6)	9·67	8·5–9 (3)	8·83
		Index	128·57–153·85	143·50	120·00–128·57	123·33
	L	Mesio-distal	6·5–7 (5)	6·90	7–7·5 (4)	7·25
		Bucco-longual	9·5–10 (5)	9·80	8–8·5 (4)	8·12
		Index	135·71–153·85	142·20	106·67–121·43	112·26
First Premolar	R	Mesio-distal	6–7·5 (5)	6·80	7–7·5 (3)	7·17
		Bucco-lingual	9–10 (6)	9·50	8–9 (3)	8·33
		Index	128·57–158·33	140·42	114·28–120·00	116·19
	L	Mesio-distal	6·5–7·6 (5)	6·90	6·5–7·5 (4)	7·00
		Bucco-lingual	9–10 (5)	9·70	8–8·5 (4)	8·12
		Index	128·57–153·85	140·95	106·67–123·08	116·36
Canine	R	Mesio-distal	6·5–7 (6)	6·92	5·5–7 (2)	6·25
		Labio-lingual	7–10 (6)	8·33	9·5 (1)	9·50
		Index	100·00–142·86	120·42	172·73	172·73
	L	Mesio-distal	6·5–7·5 (4)	6·75	5–6·5 (3)	5·83
		Labio-lingual	8–8·5 (4)	8·37	7–9·5 (3)	8·00
		Index	113·33–130·77	124·49	115·38–190·00	140·68
Lateral Incisor	R	Mesio-distal	6·5–7 (2)	6·75	6 (1)	6·00
		Labio-lingual	6·5–7 (2)	6·75	6 (1)	6·00
		Index	92·86–107·69	100·27	100·00	100·00
	L	Mesio-distal	6–7 (4)	6·62	5·5 (1)	5·50
		Labio-lingual	6·5–7·5 (4)	7·00	6 (1)	6·00
		Index	100·00–108·33	105·79	109·09	109·09
Central Incisor	R	Mesio-distal	8·5 (1)	8·50	..	..
		Labio-lingual	7 (1)	7·00	..	..
		Index	82·35	82·35	..	..
	L	Mesio-distal	9 (1)	9·00	7 (1)	7·00
		Labio-lingual	7 (1)	7·00	6.5 (1)	6·50
		Index	77·78	77·78	92·86	92·86

N.B. The small size of the dental series has led the writer to include the data of male and female specimens together in the tabulations of Ranges and Means. The numbers in parentheses refer to the frequency of observations.

The double roots of the $M^{\underline{3}}$ of BP4/8 converge, but are distally oriented. The remaining molars of the maxilla diverge and are also distally oriented.

Among the females, BP1/6 shows three converging roots for the $M^{\underline{3}}$ and M^2, but divergent roots for the $M_{\overline{2}}$. The mandibular molars also have divergent roots. The $M^{\overline{2}}$ has a medial root that is distally oriented. The $M^{\overline{1}}$ shows distal curvature for both its roots.

For specimen BP2/21 the radical apices of the maxillary second molar are oriented distally, but this trait is less prominent in the other maxillary molars. Mandibular roots are divergent and are distally overted. The tips of the roots of the $M^{\overline{3}}$ which has not completely erupted, are still not fully developed.

BP2/25 has fused roots for the $M^{\underline{2}}$ and divergent roots for the $M^{\overline{1}}$, the apices of which are curved toward each other. The mesial root shows the greatest curvature.

The mandibular molar roots of BP3/27–34 are short and distally oriented. The LM^2 has a functional neck that includes the upper third of its roots. The other molars have their roots buried in their alveoli.

The direction of the premolars is most usually straight. The mandibular premolars of BP2/21 and BP3/27–34 are curved distally, particularly at the radical apex.

The pulp cavities vary in size for the molars, but in the maxilla they are universally within the cynodont class. Taurodontism is present in the mandible as seen in the third molars of BP2/20–41 which is mesotaurodont and in BP2/21 which are hypotaurodont. The second mandibular molar is mesotaurodont in BP2/21 and hypotaurodont in BP2/25. The $M^{\overline{1}}$ is mesotaurodont for BP2/21, thus giving to all the lower molars of this specimen the taurodont condition.

Pulp cavities for the other teeth are variable. They are large for canines and incisors, but for premolars greater differences are observable. The maxillary premolars of BP2/17 have sinuous pulp chambers. Those of BP2/20–41 are broad. These canals are straight. BP4/8 has narrow chambers. Those of BP2/21 are short for the maxillary premolars but long and broad for the mandibular premolars. The largest pulp cavities for premolars are found in the mandible of BP2/25. The premolars of the remaining specimens are of moderate size (Pls. 7, 9, 14–15).

The Biochemical Analysis

(*Table* 9)

Fifteen samples of ground bone from the Balangoda skeletal series were selected as suitable for an analysis of their biochemical properties. Of these, two were analysed for amino acids by chromatography, three for antigen content by two paleoserological techniques, four for nitrogen content, five for the presence of fluorine, iron, calcium carbonate and the phosphate P_2O_5, and six were subjected to radioactive methods of dating. Criteria for the selection of these five samples were : (1) the observation of osseous tissue in the ground bone sample when subjected to low power microscopic examination ; (2) the separation of osseous tissue from the gross inorganic content of the sample (concretion, sand, dirt, etc.) after rapid and prolonged centrifugation in a saline suspension.

TABLE 9

BONE SAMPLES SELECTED FOR BIOCHEMICAL ANALYSIS

Skeletal Specimen Number	BP3/27–34			BP2/17g			BP2/17		
	Sample number	Portion of skeleton	Depth below surface	Sample number	Portion of skeleton	Depth below surface	Sample number	Portion of skeleton	Depth below surface
Chemical Assay F, P_2O_5, Fe, $CaCO_3$	AS.99	Rib	4′	AS.100	Ischium	3′	AS.101	Head of Humerus	3′
Amino Acid Chromotography	32	Head of Humerus and glenoid fossae of scapulae	..	..	..	..	II–III	Head of Femur and 4th–5th lumbar vertebral bodies	..
Nitrogen	32	,, ,,	..	IV	Ischium	..	II–III	,, ,,	..
Paleoserology	X	,, ,,	..	Y	,,	..	Z	,, ,,	..
Radioactivity	AS.99	Rib	..	AS.100	,,	..	AS.101	Rib	..

TABLE 9 (*continued*)

BONE SAMPLES SELECTED FOR BIOCHEMICAL ANALYSIS

Skeletal Specimen Number	BP2/21			BP2/25		
	Sample number	Portion of skeleton	Depth below surface	Sample number	Portion of skeleton	Depth below surface
Chemical Assay: F, P_2O, Fe_5, $CaCO_3$	AS.102	Cranium	3′	AS.103	Cranium	3′ 6″
Amino Acid Chromography	..	..	..	..	..	..
Nitrogen	AS.5	Tibia	..	..	..	..
Paleoserology	..	..	..	..	..	..
Radioactivity	AS.5 AS.102	Tibia Cranium	.. ..	AS.103	Femur	..

Chemical Assay (Table 10). In order to reduce the effects of contaminates in the ultimate samples of ground bone, the skeletal fragments were cleaned of surface dirt by means of a coarse-burred dental drill (Flat Fiss No. 9) and a wire brush. Those which were to be subjected to nitrogen (and paleoserological) analysis were washed in a solution of 2% absolute ethyl alcohol (denatured) and 98% distilled water, then air-dried for 30 minutes and oven-dried for 1 hour. The diploë was extracted from each bone fragment with the use of the coarse-burred drill after an orifice for penetration had been cleaned with a finer drilling piece (Flat Fiss No. 6). For cranial fragments, a portion of the left parietal $1\frac{1}{2}'' \times 1\frac{1}{2}''$ was removed from the brain case with a high-speed circular saw (HSS. 18). The sides of the section were cleaned with the fine-burred drill before the diploic tissue was extracted. Large bits of bone in each sample were separated from the powdery bone and inorganic residue by sifting. The ground bone samples were placed in a mortar where they underwent further pulverization. These samples were then deposited in labelled and sterilized bottles which were tightly sealed. Securing the sample from the diploic tissue has the virtue of reducing the risk of contamination as well as preserving the external morphology of the skeletal specimen for further anthropometric study. The cranial sections can be reset into the parietals from which they were taken without visible evidence of the marks of the saw. The diploë may be substituted with plaster-of-Paris in order to prevent the walls of the section from being crushed. It was at this level of preparation that the five specimens were selected from the series of nine for biochemical analysis.

The chemical assay of the Balangoda skeletal series was conducted by Mr. G. F. Phillips of the Laboratory of the Government Chemist, London. Nitrogen analysis was reported by Mr. G. C. Ross of the Central Laboratory, Department of Zoology, British Museum (Natural History). The nitrogen content and radioactivity of specimen BP2/21 had earlier been reported by Dr. Kenneth P. Oakley (Deraniyagala 1960*a* : 97). It should be noted that the results obtained from specimen BP2/25 were variable as the sample contained a high proportion of sand.

Amino Acid Chromatography. This analysis of two bone samples from the Balangoda skeletal series—BP2/17 and BP3/27–34—is taken from the report of Mr. Ross.

> " The samples were treated with 6N HCL (5 ml. to approx. 0·1–0·3 gms.) and hydrolysed at boiling pt. under reflux condensation for 16 hours. After successive evaporations to dryness in vacuo over conc. H_2SO_4 and caustic soda, and resolution in distilled water (to remove excess NCl) the filtered hydrolysates were subjected to electrolytic desalting to remove excessive inorganic ions present. To facilitate the desalting the solutions were diluted to about 1 in 10. After final evaporation to dryness the residue was dissolved in 0·5 ml. water prior to chromatography."

Mr. Ross has noted that the quantities of amino acids present in these two samples are extremely small. The limited quantities of material available for examination and the short time available for analysis have contributed to the fact that positive chromatograms could not be completed. Such duplicated chromatograms would have contained all suspected known substances run in conjunction and parallel with the mixtures of unknown composition. Furthermore, because of the trace quantities of nitrogenous material the problem of the elimination of contaminants was not investigated as thoroughly as it would have been had more time been available.

" One way chromatograms were prepared on Whatman No. 1 sheets measuring $22\frac{1}{2}'' \times 18''$ to give ' runs ' of approx. 18 inches. Each sheet contained base line spots of 0·2 ml. of each extract interspersed with 25 spots of known amino-acids each spot containing proline for reference Rp values.

" The runs were made as follows :

Sheet A. Solvent : Tertiary Butanol : Methyl Ethyl Detone : water : diethylamine :: 80 : 80 ; 40 : 8. Ascending 22 hours.

Sheet B. Solvent : Ethanol : water : Ammonia :: 180 : 10 : 10. Descending. Overnight.

Sheet C. Solvent : n-Butanol : acetic-acid : water :: 120 : 30 : 50.

Sheet D. Solvent : 80% Phenol : Ethanol : Ammonia :: 150 : 40 : 10. Ascending. Overnight.

Sheet E. Solvent : Methanol : water : Pyridine :: 160 : 40 : 8. Ascending. Overnight.

" Sheets were dried in a cold air stream.

" Spots were located by dipping through 0·2% Ninhydrin in acetone containing 2% Pyridine and developing in a warm air stream for $\frac{1}{2}$ hour then leaving for 24 hrs. at room temperature. After marking the spots the colours were made permanent with alcoholic copper nitrate reagent.

" Distances of centres of spots were measured from the base-line and (Proline) values obtained for all substances except on sheet C where the proline was not added (to detect if any in the tests) and sheet B where the proline and substances of higher Rf values overran the paper.

" *Results.* The listed amino-acids are those probably present as determined by single substance spots shown on one or more chromatograms and/or by process of elimination from the combinations or substances in ' multiple spots '."

These results are the following :

Specimen BP2/17 :	(Granular)	(Pulverized)
	Palantine	Palantine/Tyrisine*
	Glutamic acid	Glumatic acid
	Glycine	Glycine
	Leucine/Iso Leucine	Leucine/Iso Leucine
	Methionine	Methionine
	Serine	Serine
	Glutamine	
	Lysine	Crystine/Cysteine
		Taurine

Specimen BP3/27–34 :	Palinine	Palinine
	Crystine/Cysteine	Crystine/Cysteine
	Glutamic acid	Glutamic acid
	Glycine	Glycine
	Leucine/Iso Leucine	Leucine/Iso Leucine
	Methionine	Methionine
	Ornithine	
	Serine/Asparagine	Serine
	Taurine	Taurine
		Arginine/Asparagine*
		Thrionine?
		Aspartic acid?

The asterisk (*) following the notation of certain of the above mentioned substances indicates that either one or both are present.

PALAEOSEROLOGY (Table 10). Bone fragments used as samples for palaeoserological procedures were washed and dried by the methods already described. After pulverization of the diploë for each of the three specimens, the samples were weighed out into 0·2 gm. amounts and placed in sterilized 75 × 10 mm. tubes which were then tightly stoppered. These were reserved for the Standard Absorption Technique. Bone samples for the Alcohol Extraction Test were prepared by the same methods, but the amount of bone in this second procedure was 1·0 gm. for two specimens. These amounts were placed in two 25 ml. Earlemeyer flasks bearing the appropriate label for each of the samples.

Standard Absorption Technique. This procedure is one based upon the presumption that a group specific antigen is present in the given sample if antiserum of proper concentration is inhibited in its activity with red cells of the appropriate group following its prolonged contact with the test sample. It is a technique developed originally for dried saliva and muscle tissue samples (Boyd & Boyd 1933, 1934), and later modified for bone samples (Candela 1936). It is a variation of the Standard Inhibition Test for blood group-containing substances.

Four naturally occurring human Anti-A and four Anti-B sera from individuals of known serological constitution were selected for use with each of the three bone samples. These anti-sera were recognized as yielding reliable results from previous testings with controls of known blood groups. In setting up a titration series, buffered saline, to which had been added 1% sodium azide as a preservative, was used as a dilutant. The determination of the titre for the anti-sera was established as the third or fourth dilution from the end-point for any one serum as judged from microscopic examination of a smear on a glass slide. A panel of anti-sera was regarded as preferable to pooled anti-sera by this investigator. The volumetric unit was used for all titrations in this analysis since it allows for greater accuracy than the more commonly used drop technique. To the 0·2 gm. of ground bone deposited in each of the labelled tubes was added 0·5 cc. of neat serum of the appropriate type. After these contents were mixed, the tubes were placed in the refrigerator for an incubation period of 24 hours. At the termination of this period of time, the tubes were centrifuged for 4 minutes at moderate speed. The supernatant was then drawn from each tube by means of a Pasteur pipette with its tip encased in sterilized cotton wool. The titration for the sample series and a control series was then conducted. Both series contained equal volumes of saline. In the sample series titration was carried out with the supernatant, in the control series with the neat sera. To each were added equal volumetric units of 1% suspension in saline of red cells of the appropriate type. The sample and control series were then incubated for 2 hours at room temperature. At the termination of this period smears from each of the tubes were placed on glass slides and interpreted under microscopic examination. Three tests were conducted over three 24-hour intervals.

Results are based upon the presence of agglutination in one or both of the anti-sera or the absence of agglutination in both anti-sera for any given sample. If agglutination occurs in both the Anti-A and Anti-B sera, as a result of the introduction of red cells of appropriate type, the blood group is assumed to be O. Likewise if agglutination is absent from both anti-sera, AB type blood is suggested. Type A blood is marked by the presence of agglutination in the Anti-B sera but absence of agglutination in Anti-A sera. Type B blood is marked by a reversal of this situation.

Alcohol Extraction Test. This technique is devised to reduce the problem of non-specific absorption and thus allow for the correct identification of blood type AB (Gray 1953, 1958). It was applied to the bone samples X and Z noted in Table 10. Five different anti-sera were selected for the test.

In each of two 25 ml. Earlemeyer flasks, which were labelled x and z for the two samples being tested, was deposited 1·0 gm. of ground bone of the appropriate specimen. Both flasks were then filled with 25 ml. of absolute ethyl alcohol (denatured). Each preparation was heated for a period of 2 hours at 78 degrees C. The alcohol extracts, which contained the group substance, were filtered off and placed in sterilized beakers. To the bone residues were next added 15 ml. of absolute ethyl alcohol and each preparation was heated as above. After filtering this second quantity of alcohol extract, it was added to that extract initially collected in the beakers. The two extracts were placed over a steam bath until the lipid material began to come out of solution. The extracts were removed from the heat to redissolve the precipitate. The contents of the beakers weıe then deposited in sterilized bottles which were tightly stoppered. These extracts are the stock antigens. The antigen suspensions were prepared by first placing 1·0 ml. of each stock antigen into test tubes containing 5·0 ml. of buffered saline. Milky-appearing emulsions resulted. These were used for the determination of the presence of blood group antigens by first adding 0·5 ml. of each antigen suspension to 0·5 ml. of Anti-A and Anti-B sera whose titres had already been established. These were mixed in 10 × 75 mm. tubes and incubated at room temperature for 2 hours. At the end of the incubation period, the tubes were centrifuged for 4 minutes at high speed. Then 0·5 ml. of supernatant was removed from each tube and placed in a sterilized tube by the same technique described for specimens in the Standard Absorption Technique. A titration for both samples and controls was arranged. To equal volumes of saline, placed in all but the first tubes of the panel, were titrated the neat sera with the controls and the supernatant with the sample series. Each tube received equal volumes of a 1% suspension in saline of red cells of appropriate type. Samples and controls were then incubated for two hours at room temperature.

After incubation the contents of each tube were read under the microscope and the results were recorded. This technique was limited to a single test.

Interpretation of these results is based upon the following conditions :

1. The known type A extract suspension should lower the titre of Anti-A by 3 or more tubes.

2. The known type B extract suspension should lower the titre of Anti-B by 3 or more tubes.

3. The known type O extract suspension should not lower the titre of either Anti-A or Anti-B by more than 1 tube.

4. If the test extract suspension lowers the titre of Anti-A by 3 tubes or more then the sample is type A.

5. If the test extract suspension lowers the titre of Anti-B by 3 tubes or more then the sample is type B.

6. If the test extract suspension lowers the titre of both Anti-A and Anti-B by 3 tubes or more then the sample is type AB.

7. If the test extract suspension lowers neither the titre of Anti-A nor Anti-B by more than 1 tube then the sample is type O or else the antigens in the sample have deteriorated to the point where conclusive typing is impossible.

Radioactivity Methods of Dating. Radiocarbon analyses of human bone and charcoal from Bellan Bandi Palassa have yielded results that confirm Deraniyagala's (1943*a* : 112 : 1945) contention that the Balangoda Culture persisted until comparatively recent times and existed for some time side by side with ferrolithic cultures.

Two samples of charcoal were tested by Isotopes Incorporated in 1956. Sample 394K was taken from 2′ 8″ below the surface and 1′ above the limestone bed rock in Square C1. This was the locus of skeletal specimen BP3/15a. The charcoal lay 3′ north of the skull of this specimen. Its dating is 508 ± 150 years B.P. or 1448 A.D. ± 150 years. Sample 394L was taken from 2′ 6″ to 3′ below the surface and almost resting upon the bed rock in Square B1. This was within the vicinity of skeletal specimen BP2/20. Its dating is 2070 ± 200 years B.P. or 114 B.C. ± 200 years (Deraniyagala 1958*a* : 259).

The radioactivity of the bone sample was assessed in the laboratory of the Anthropology Sub-Department, British Museum (Natural History), in 1959. This was a sample of tibia from specimen BP2/21. This skeleton was found in Square C4 some 3′ below the surface and 6″ above the limestone. Oakley's report to Deraniyagala stated :

> " In answer to your previous letter, I can tell you that the radioactivity of the human leg bone from the Ballanbandi Palassa site indicated 0. 6 p.p.m., *e*U308. This is consistent with the specimen being ancient—say, having an antiquity

measured in millenia rather than in centuries. Chemical analysis shows 1·3% nitrogen which suggests in the circumstances of its occurrence, that the bone is Post-Pleistocene " (Deraniyagala 1960*a* : 97).

In 1962 osseous specimens from the Balangoda series were assayed by Mrs. Elizabeth Gardiner in the same Department. In a personal communication concerning the results of the assay, Oakley reports :

" A sample of the ribs of skeleton BP3/27–34 (D) was assayed completely (For three hours), and gave the result (calculated as *e*U308 p.p.m.) : 10 ± 2. The remaining Balangoda samples were assayed for half an hour each and gave readings which when averaged amounted to approximately the same figure. As the order of magnitude is low I do not think that anything would be gained by assaying all the samples completely."

Oakley notes that all of the samples proved to have a uranium content that was fairly uniform.

TABLE 10

RESULTS OF THE BIOCHEMICAL ANALYSIS

Chemical Assay :

Skeletal specimen Number	%F	$\%P_2O_5$	Ratio × 100 $F : P_2O_5$	%Fe	$\%CaCO_3$	%N
BP2/21	..	..	..	..	..	1·3
BP3/27–34	0·60	23·1	2·6	2·5	17·1	0·05
BP2/17g	0·38	12·5	3·0	2·8	21·6	0·078
BP2/17	0·32	18·0	1·8	5·0	23·7	0·016
BP2/21	0·58	21·7	2·7	1·5	19·5	..
BP2/25	0·15	7·0	2·0	3·0	10·5	..

Palaeoserology :

Standard Absorption Technique

Test No.	1				2				3			
Anti-Sera	81–02	90–11	B–25	R–58	81–02	90–11	R–25	R–58	81–02	90–11	R–25	R–58
Sample												
X	O	O	A	O	O	O	O	O	O	O	O	O
Y	O	O	A	O	O	O	A	O	O	O	O	O
Z	A	A	A	?	A	A	A	A	A	A	A	A

Alcohol Extraction Test

Anti-Sera	Gr–02	42–46	51–59
Sample			
X	A	A	AB
Z	AB	A	AB

Of these five techniques of analysis of the biochemical nature of the osseous material from Bellan Bandi Palassa, four are related to the problems of chemical dating:

the palaeoserological analysis stands apart from these considerations save in so far as the identification of antigens can verify the presence of organic elements in the bone samples. Since the accumulation or depletion of substances in ancient bone is ultimately dependent upon the characteristics of the environment in which it has been deposited, and since these environments may alter due to redisposition of the bone and/or disturbances of the deposit, it is not surprising that the results of the biochemical analysis of these Balangodese specimens exhibit some variations. Not all of the skeletal remains from Bellan Bandi Palassa occurred at the same level. Thus specimen BP3/27–34 rested only 3″ above the limestone bed rock and its contact with the hard crystalline limestone caused the bones to become coated with a yellowish concretion, a very different micro-environment from that of specimen BP3/15a, from which level one of the charcoal specimens was taken for radiocarbon dating.

The presence of nitrogen in bone indicates protein and protein derivatives. Nitrogen quantities of the order of hundredths of 1% have no significance since the method of analysis becomes progressively less reliable when working with lower quantities (Barber 1939, Cook 1960 : 229, Pin 1950). Therefore the value obtained from the sample for specimen BP2/21 is more significant than the values obtained for the other specimens whose nitrogen content was examined. This discrepancy may be due to the fact that cancellous osseous tissue was used in these tests instead of the compact bone which offers more reliable analytic results. Oakley (1949, 1953, 1955) finds that the nitrogen values are reliable as a cross-check to fluorine analysis, particularly since the results from both kinds of tests may show radical differences for a single specimen. But calcite has a sealing effect on bone, and at Bellan Bandi Palassa, where the skeletal specimens lie at different levels above the limestone bed, this phenomenon cannot be excluded from a consideration of the results of tests. Temperature and moisture are other factors influencing the chemical nature of bone, and the evidence for believing that climatic changes have affected particular biotic modifications in the region around Bellan Bandi Palassa is considerable. Because of these factors of alteration and contamination, Oakley (1953 : 52) has the phosphate content of each sample checked and he regards the percentage fluorine/phosphate ratio as the best standard of comparison in fluorine dating. He has found that the average fluorine content of Lower Pleistocene bones is circa 2·0% ; of Mid-Pleistocene bones, circa 1·5% ; and of Upper Pleistocene bones, circa 0·5%. The percentages for the Bellan Bandi Palassa specimens fall within this latter category, a situation confirmed by the radiocarbon data for the site which marks the age of the site as post-Pleistocene.

The development of chromatographic techniques has expanded the data of protein analysis to include not only nitrogenous components but also the amino acids (Abelson 1954, 1955, Ezra & Cook 1957). Bones of a woolly rhinoceros from an Upper Pleistocene deposit of the Lloyds site, London, contained traces of glutamic acid, B-alanine, proline, OH-proline, leucine, valine, glycine, aspartic acid and arginine. (The writer is indebted to Dr. K. P. Oakley and Mr. A. E. Rixon of the British Museum (Natural History) for the notes of this research carried out in 1956. For illustration of the

Lloyds bone chromatogram see Oakley 1963). Those amino acids present in the Balangoda series but absent in this Pleistocene sample are taurine, serine, methionine, ornithine, cystine, glutamine, theonine (?) and tyrosine (?). The presence of different percentages by weight of amino acids for blood group substances may be explained by variations in the preparation of the serological sample and hence bear no relation to immunological specificity (Kabat 1956 : 149–151). However, should certain blood group substances be demonstrated as having characteristic components of amino acids, the findings of palaeoserology would become pertinent to problems of chemical dating. The nature and quantity of protein decomposition products in ancient bone might well be utilized as a method or technique of chemical dating which Cook (1960 : 232) suggests would be superior to the analyses of total organic matter or nitrogen content.

The problem of contaminants cannot be minimized for any of these biochemical tests but their effect, if present, is most serious in the establishment of the nature of the antigen content. It is impossible at present to detect the presence of foreign substances in the sample which would bias the results of analysis, but by running the sample through several tests and subjecting it to different techniques of analysis the researcher is encouraged in verifying a certain percentage of his results. Thus, the behaviour of sample Y in the Standard Absorption Technique cautions reservation of opinion since it may have undergone a non-specific absorption with the Anti-A sera. The Z sample is more reliable, its consistent type A reaction being hindered only at one place in the test due to lysis of the Anti-B serum. Of the four Anti-A sera used, the B sample is somewhat erratic in its behaviour and its unsuitability for testing with these bone samples is suggested. The results of the Alcohol Extraction Test cannot be accepted as being as reliable as the data derived from the initial test for antigen identification. Reactions are all very weak. The presence of type A antigen for sample Z is confirmed by both tests and the Alcohol Extraction Test suggests that this may be linked with the B antigen, thus indicating for specimen Z an AB blood type. The occurrence of the A gene in the Balangodese series is of particular interest since this gene has a very low frequency among the Veddas and its presence in this population in the past has been doubted by some investigators (Wickremasinghe, Ikin & Mourant 1963).

The presence of pottery at the upper portions of the Bellan Bandi Palassa midden and its absence in the lower portions has led Deraniyagala (1958*a* : 258) to conclude that the site had been occupied either continuously or periodically over a period of sufficient duration to allow the inhabitants to pass through both phases of his Balangoda culture. Furthermore he had suggested a correlation of cultural stratigraphy with the physical type of the skeletal specimens found in the site : the robust male specimen BP2/17 appears to him as " Australoid " while the specimens from the upper pottery-bearing levels reveal " Negroid " phenotypic traits. Regardless of what racial features one may perceive in the series, the radiocarbon methods of dating affirm that these specimens were relatively contemporary in time. In the opinion of the present writer it seems improbable that the specimens from Bellan Bandi Palassa constitute a stratigraphical progression of phenotypes representative of earlier and later phases of a pre-metal using culture, nor do the artifacts found in association with the burials suggest a cultural succession : the phenotypic variation which the series displays is what can be expected from normal sexual dimorphism and morphological variation across sexual lines, and the question of cultural sequences at the site cannot be answered without confirming evidence from further archaeological investigation of other Ceylonese sites. If the osseous specimens were not all members of the same community, the dating of the bones by radiocarbon methods indicates that they were not separated by many generations.

III COMPARATIVE ANALYSIS

The Nature of the Comparative Data Used in the Determination of the Biological Affinities of the Balangodese with Other Populations

In compiling the comparative data of Tables 11 and 12 the writer has selected several contemporary and prehistoric populations and individual specimens from the Indian–Southeast Asiatic–Oceanic area. The arrangement of the prehistoric series in the Tables corresponds to their chronological relationship to the modern populations listed. Of these, the writer has examined at first hand the Vedda series and the specimens from Brahmagiri, Adichanallur, Mohenjo-daro, Nal, Langhnaj, Bayana, Sialkot and Niah, and casts of Talgai, Keilor and Wadjak. Comparisons have also been made with the original specimens from such Indian prehistoric sites as Nevasa, Chandoli, Maski, Piklihal, Harappa, Lothal, Ruangarh and Raigir, whose metrical values are not included in Tables 11 and 12. On the basis of this extensive comparative analysis it is the thesis of the writer that of the living populations of southern Asia the Veddas of Ceylon most closely resemble the Balangodese in their physical morphology. It must be emphasized that the fragmentary nature of the Balangodese skeletal remains limits their significance in a purely metrical comparative analysis with larger and more complete osteological specimens. Hence the data of the tables are less helpful than a morphological comparison in affording the reader a clear idea of the phenotypic similarities of the prehistoric inhabitants of Ceylon. The Crown Indices of Table 12 have been calculated with the formula

$$\frac{\text{Bucco-Lingual Diameter}}{\text{Mesio-Distal Diameter}} \times 100.$$

It should also be noted that the series of five specimens from Brahmagiri are regarded as males although another investigator has regarded specimen IE as female (Sarkar 1960).

The Vedda osteological specimens employed in this analysis were examined by the writer from collections from the following institutions : Sub-Department of Anthropology, British Museum (Natural History), London ; Royal College of Surgeons, London ; Anatomical Museum, University College, London ; Museum of Comparative Anatomy, University of Oxford ; Museum of Human Anatomy, University of Cambridge. The comparative study was supplemented by the comprehensive work on the physical anthropology of the Veddas by Hill (1941). In his study of this population Hill makes a distinction between specimens that he regards as " pure Veddahs " and those of " half-breed Veddah, portraying ... certain distinctive Veddah features upon a basically different structure." (Hill 1941 : 107, 124–125). This dichotomy is a subject of discussion elsewhere in this paper, but the terminology that Hill employs is repeated here when comparing Balangodese specimens with the Veddas of his " Average " series and " Selected Average " series. Reference was made as well to Stoudt's (1961) anthropometric survey of living ethnic groups in Ceylon, a study based in part on data collected by the late J. R. de la Haule Marett.

A Comparison with the Veddas

The Calvarium. The Veddas and Balangodese are dolichocranic. Mean indices are 71·24 for Vedda males and 72·72 for Vedda females, with a " Selected Average " of 71·57 for specimens of known Vedda ancestry. The Vedda female has a Cranial Length–Breadth Index slightly greater than that of the male. Hill notes that the discarding of the indices of Vedda specimens of doubtful purity makes little difference in this Index, the average for all Vedda crania being 71·60. The Length–Height Index based on Basion–Bregma Height averages 74·64 for both male and female Veddas, thus placing them at the upper limit of the orthocranic class. However a number of Vedda crania which Hill regards as belonging to pure-blooded individuals have Basion–Bregma Height–Length Indices that place them in the hypsicranic group. When the Vedda series is examined with respect to the Auricular Height–Length Index, the male mean of 61·00 falls within the orthocranic category, but the females are hypsicranic with a mean index of 63·50. Here is a situation that is not paralleled in the Balangoda series where the male is hypsicranic and the female chamaecranic. There is closer agreement between the two populations in terms of the relation of cranial height to cranial breadth since the acrocranic condition which is common to Veddas of both sexes, is also apparent in the Balangodese male. The low Cranial Height–Breadth Index of the Balangodese female stands outside the mean values of 105·5 for Vedda males and 103·9 for Vedda females.

The " Selected Average " of cranial capacities for male and female Veddas are 1250 cc. and 1166 cc. respectively. Although the addition of values for crania of dubious ancestry does not raise these mean values to a marked degree, the values for unmixed Tamils and Sinhalese are significantly higher than those for unmixed Veddas. These low values include within their range the estimated cranial capacity for the Balangoda female BP3/27–34, but the large-headed male, BP2/17, falls well outside the range. A further comparison of cranial size is offered by the measurement of the Maximum Circumference of the vault where the values for the Veddas are close to those of the Balangoda females, but from which again the male BP2/17 stands apart.

Vedda cranial bones, which are uniformly thick and heavy, particularly in their posterior regions, are regarded by Hill as belonging to individuals of doubtful purity and it is these which most closely approximate a condition evident in the Balangodese crania. The latter series lacks the pathological thinning peculiar to the parietals of

Vedda crania of the classic type. Both series exhibit little or no sexual differentiation in cranial thickness.

The Vedda crania observed by the present writer were rhomboid although the crania of males with well developed supraorbital ridges approached a sphenoid cranial conformation. Supraorbital ridges are well developed in both Veddas and Balangodese, and the very pronounced ridges of BP2/17 are occasionally found among the Veddas as well. Confluence of ridges at glabella is present in half of the Vedda series and in both sexes, but among the Balangodese females the brow ridge form is median. A low vertical forehead with flattened parietals and a posteriorly compressed occiput is the most typical Vedda cranial contour, and it is this form which also is characteristic of the Balangodese females. The medium receding forehead of BP2/17 has been observed among Veddas where it is accompanied by some lateral compression of the frontal. The presence of a median boss and frontal eminences are frequent in the crania of both series. The Balangodese females approach that degree of frontal constriction common to Vedda crania, but the frontal of BP2/17 is considerably broader than that of most Vedda males. Supraorbital foramina are prominent in both series.

Slight keeling of the parietal region is both a Vedda and Balangodese trait. Posterior to vertex the vaults of crania from both series undergo a gradual slope to lambda, at which point a sudden change of direction brings the curve vertically downward to the basi-occiput region. The flattening of regions anterior–superior and posterior–inferior to the parietal eminences contributes to the prominence of the bosses in the vaults of both series. Differences appear in the occipital portion of

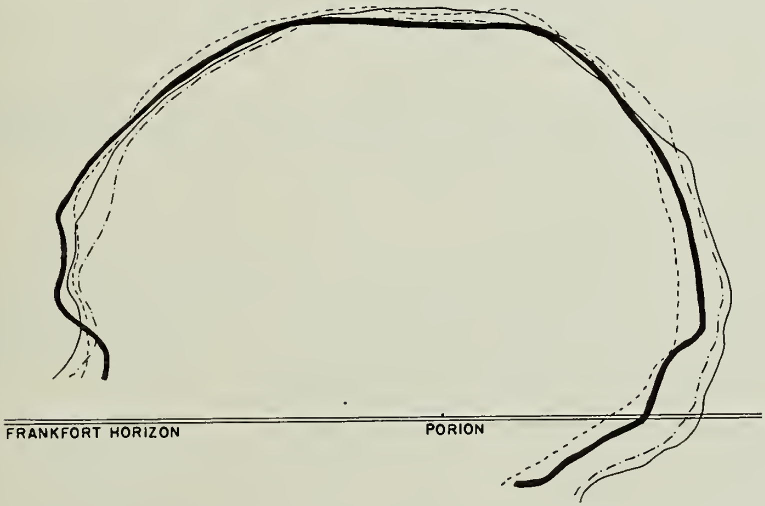

Fig. 5. Left lateral contours of one Balangodese (BP3/27–34 ——), one Vedda (1949. 12.7.2 – – –), a compound tracing of eighty-two male Australians (Wagner 1937 ——), a compound tracing of one hundred and twenty-four male New Guineans (Hambly, 1940 – · – · –).

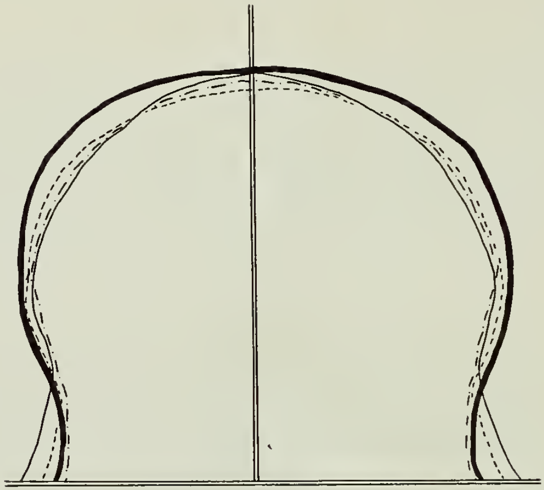

Fig. 6. Frontal contours of one Balangodese (BP3/27–34 ————), one Vedda (1949.12.7.2 – - –), a compound tracing of eighty-two male Australians (Wagner 1937 ————), a compound tracing of one hundred and twenty-four male New Guineans (Hambly, 1940 –·–·–).

the cranial profile. The musculature of the nuchal crests is weakly developed among the Veddas, a condition reflected in the Balangodese females but not in the robust male BP2/17 (Text-figs. 5–6).

The temporal muscles occupy extensive areas of the crania in both populations. The temporal lines rise high along the vault of the Vedda skulls. They are less prominent on the parietals of the Balangodese. The mastoid process is generally small among the Veddas, but several skulls of Hill's series possess large processes like that of BP2/17, and these generally belong to males of dubious ancestry. The tympanic plate is thick in Veddas and Balangodese. The oval form of the Vedda auditory meatus contrasts with the elliptical and round conformations of this structure in the fossil population.

Like the Balangodese, the Vedda cranial vault is characterized by suture patterns of simple design with some slight complexity apparent at peripheral margins. Metopism, which is uncommon in Veddas, is absent in the Balangodese specimens. However the former series exhibits a high frequency of Wormian bones, especially at lambda and pterion. Sutural patterns are complex in this area in Balangodese skulls but Wormian ramifications are absent (Text-fig. 7).

Hill regards the typical Vedda face as euryprosopic for males and hypereuryprosopic for females, the mean index of his " Selected Series " being 84·14. The males average 85·44, the females 79·73. However, for the living individuals that Hill examined, the average Total Facial Index is within the leptoprosopic category, the class to which the Balangoda female BP3/27–34 is also assignable. Concerning this problem he writes : " This feature is evidently very variable among the existing Veddah population. Combining this with the fact that previous writers have

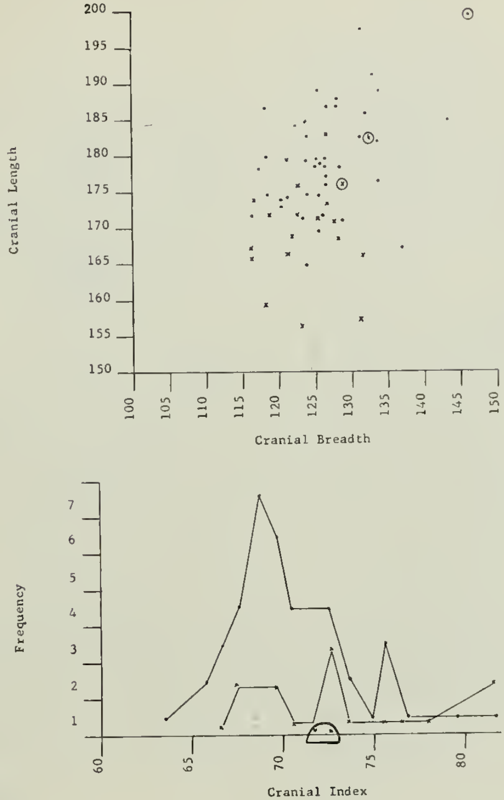

FIG. 7. Scatter diagram and frequency polygon of cranial measurements and indices of three Balangodese (BP2/17, BP2/21, BP3/27–34) and sixty-two Veddas (Hill 1941). Males are represented by a dot (.) ; females by a cross (×).

placed the Veddahs in the chamaeprosopic class, and also that the index based on osteometry is well within the euryprosopic category . . . it can only be inferred that the results . . . are the effect of recent miscegenation with the leptoprosopic neighboring peoples " (Hill 1941 : 74). The leptene upper face of the same Balangodese female stands in contrast to the euryene value of 49·00 for typical Vedda specimens. Closer agreement of Vedda and Balangodese indices is apparent in the chamaerrine nasal forms of both groups. The average for Veddas of the " Selected Series" is 55·80 and the male and female mean values are 54·24 and 57·30, respectively. The Orbital Index is 74·00 for Vedda males and 73·70 for Vedda females, hence both come within the chamaeconch class, a condition found in the female Balangodese BP3/27–34, but not in the male BP2/17 whose orbits are hypsiconch. The External Palatal Indices are brachystaphaline, but the indices for the Balangodese are considerably higher than the mean index of 96·50 of the Veddas of the

" Selected Series ". The Vedda males have an average External Palatal Index of 97·06, the females are even lower—94·30.

Like the Balangodese, the Vedda face owes its prognathism to the projection of the total maxillary or subnasal region, although prognathism of the latter sort is characteristic of a number of Vedda specimens. Hill finds that alveolar prognathism is more common among the Vedda crania of earlier collections : subnasal prognathism is more often found among recent specimens. The average Vedda Gnathic Index is 96·70 which places it within the orthognathic category, and in the "Selected Series" this index drops to 94·50. Males have a mean index of 95·04, females of 93·37. Facial angles of Vedda crania show that almost all values fall within the prognathous category if von Camper's method is used, but when using Martin's method almost all the faces are orthognathous.

Both Balangodese and Veddas have square or quadrilateral orbits. Further comparisons of the orbit are prohibited by the imperfect condition or the absence of the orbital walls in the fossil specimens. Malars are larger in the latter series, and the temporal process of the zygomatic and the zygomatic arch is less attenuated in Balangodese. The anatomical aberrations that Hill notes as common to the region for Vedda crania—a prominent marginal process, a maxillary-zygomatic notch—are not present in the fossil series. Malar projection is variable for both populations. The nasal aperture is wide, short, and piriform for the two series. The inferior nasal margins are variable in form, the oxycraspedote and orygmocraspedote conditions being represented in equal frequency for both series. The absence of nasal bones in the Balangoda series precludes further comparison of this region. The forms of the glabella of BP2/17 and BP3/27–34 infer a deep nasal notch for these specimens such as is found among the Vedda. The anterior nasal spine is large

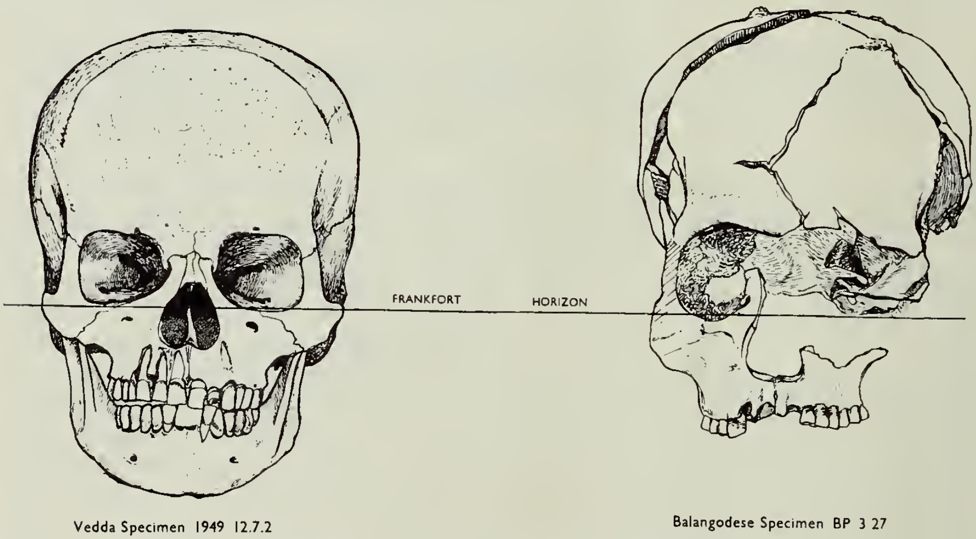

FIG. 8. Dioptrographic drawings. Frontal aspects.

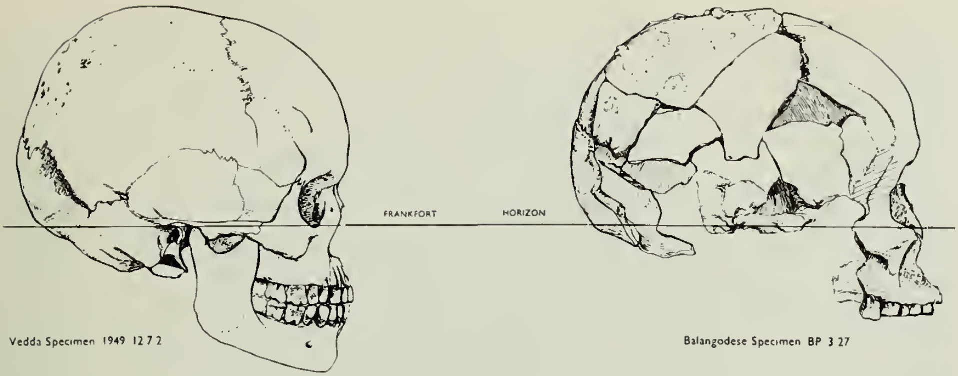

Fig. 9. Dioptrographic drawings. Right lateral aspects.

among the Balangodese, but its size is variable in Vedda crania. It is lacking in those specimens that have orygmocraspedoty. The alveolar borders of the palates of the Balangoda series are more greatly divergent than those of the Vedda series although both series may be described as having the parabolic and elliptical palatal conformation. In size and depth the palates of the fossil series attain the higher values (Text-figs. 8, 9).

The Mandible. The Mandibular Index of the lower jaws of Veddas falls within the dolichostenomandibular category with an average Index of 80·11. This is within the range represented by the fossil series. The mean Fronto-Gonial Index of the Vedda series is 97·11, and the two indices available for the Balangodese fall on either side of this value. The average Zygo-Gonial Index for the Veddas—135·79—is considerably higher than that obtained for the Balangodese, and this reflects the greater bizygomatic diameter of the latter population.

A comparison of the gross sizes of the mandibles in the two series shows close similarity, but those of the Balangodese are marked with greater muscularity and an increase in the thickness of the corpus, particularly in the symphysial region. The chin is prominent among the latter : Veddas have moderately developed mental protuberances. In both series the chins are most commonly of the median type. Genial tubercles are feebly developed in the Vedda mandibles, and not all Balangodese mandibles have prominent genial tubercles, *viz.* BP2/17i and BP3/27–34. The digastric fossae, which are prominent in some Vedda specimens, are variable in development in the fossil series. In both series the corpus tapers posteriorly from the symphysis, thus giving a gracile appearance to this portion of the jaw. The exception to this is the Balangodese male, BP2/17i whose corpus is massive throughout its length. Mental foramina are large for most Vedda specimens, but their size can be matched in only half of the individuals in the Balangoda series. The position of these foramina is the same in both series.

The rami form a wide angle with the corpora in the mandibles of both series. It is broad and short in the Vedda series, and broad and somewhat more elevated in the Balangoda series. In the fossils the gonia are frequently everted, but this is rare among Vedda specimens where the muscular development of the pterygoid attachments are reduced. The sigmoid notch is broader and shallower among Veddas. The condylar neck is reduced in both series, and a mandibular head of small dimensions is the most common condition. As with the Veddas, the linguia of the Balangodese mandibles is reduced in size, although strongly marked in the male BP2/20–41. Alveolar prognathism is most pronounced in the fossil series.

The morphological features that characterize the mandible of the Balangoda series, namely the depth of the corpus, the greater height of the ramus, and the presence of mandibular alveolar prognathism, are traits that Hill finds most frequently represented among Veddas of doubtful purity, i.e., individuals with longer and narrower faces than those of the classic Veddas with their broad chamaeprosopic faces accompanied by short, narrow mandibles. This situation parallels the conditions noted above for the cranium where the Balangodese reflect some morphological features not present in Veddas that Hill regards of pure type.

The Skeleton of the Trunk. Comparisons of the vertebral columns of Veddas and Balangodese reveal striking similarities. The cervical vertebrae are very small in the absolute sense and considering the evidence for regarding the stature of the Balangodese as taller than that of the Veddas, the sizes of their vertebral elements seem disproportionately small. Neural foramina are triangular, and transverse processes are short within both groups. However, the bodies are round rather than cordiform among the Veddas. The atlases in both series are delicate with sinuous posterior arches. The thoracic vertebrae described for the Balangodese fall within the range of normal features common to the Veddas. The lumbar vertebrae of the fossil series are uniquely robust and have a greater mass than the lumbar segments of the recent series. The Balangoda specimen BP2/17 has a Lumbar Index that falls within the koilorachic group. While this index is matched by several Vedda specimens, the average index of the latter is orthorachic. Broad truncated spines are characteristic of the lumbar vertebrae of both series. The instability of the lumbar and sacral regions and of the thoraco-lumbar and lumbo-sacral junctions, which is a characteristic of the Vedda spine cannot be ascertained for the Balangodese due to the paucity of bones from this region.

The ribs of the Balangodese and Vedda specimens have a thickness ranging from 3 mm. to 6 mm. with maximum expansion at the sternal end for males of both series. The first rib has a small head and a tapered neck. Its grooves for the subclavian vessels are apparent. Lower ribs have more massive heads. The degree of individual variation among the Veddas for this part of the thorax cannot be established for the Balangodese, since their ribs and vertebrae are fragmentary and present for only two specimens.

The sternal corpus of BP2/17 approaches the Vedda form in terms of its slight curvature, short and broad dimensions, and its number of segments for sternal rib articulations.

The Skeleton of the Upper Extremity. Except for its large size, the clavicle of BP2/17 closely resembles the clavicles of Vedda specimens, as does also the smaller clavicle of BP3/27–34. Similarities are found in the oval form of the sternal head, the moderate to slight degree of flattening of the acromial head, and a general gracility of the form of the shaft. The clavicle of the female Balangodese specimen differs from the Vedda only with regard to its greater muscularity, and the presence of pronounced grooves for the subclavian vessels. Clavicular curvature is poorly developed in the females of both series.

There is some difference in the scapulae of the two series, that of the male BP2/17 being larger and more robust than the scapulae of the Balangoda female and the majority of other scapulae of the Vedda series. Other differences are noted in the longer and more rectangular form of the acromion process of BP2/17, its shorter and narrower fossa supraspinata, and the greater curvature and length of its corocoid process. In the Vedda series, the acromion is usually triangular in form, the fossa supraspinata tends to be broad, and the corocoid process is short, massive, and flattened from its anterior to posterior aspects. The scapula of the female BP3/27–34 more closely approximates the Vedda norm, as does that of BP2/17, in all other respects than those noted above. There is a pronounced obliquity of the spino-vertebral angle. The superior border lies in the horizontal plane and the supra-scapular notch is absent. This notch is absent in half of the scapulae of the Vedda series. The axillary borders of scapulae in both series show an increased thickening in the direction of the glenoid fossae. The latter structure is broadest at its inferior portion, and its angle to the body of the scapula is slightly elevated and lateral.

The Balangodese and Vedda humeri are alike in their relatively long diaphysial lengths and small extremities. Their shafts are straight, but the sigmoid curvature that Hill notes for his Vedda series is not apparent among the Balangodese. Due to the poor condition of the humeri of the latter group their angle of torsion could not be estimated. Like the humerus of the Veddas, that of the Balangodese shows a prominent bicipital groove. The high incidence of the perforation of the olecranon fossa has been found to occur in only 25·60 per cent of the series examined by Hill and this feature is absent in the Balangodese.

The trait that most strikingly sets apart the Balangodese radius from that of the Vedda is its greater muscular development. The Vedda radius is characterized by an extensive tuberosity, rounded borders, and slender form. Both series, however, present a pronounced hollowing of the volar aspect of the shaft for the reception of the flexor pollicis longus. The styloid process is prominent in both groups, save in the case of BP3/27–34 where its size is reduced. A lateral curvature of the shaft is more common in the Vedda radius; the shafts are straight or, as in the case of the female specimens, curvature is in an anterior–posterior direction. In both series the head is small, and the neck is narrow and elongated. The ulnar notch is well marked and extensive.

The curvature of the ulna is considerably less prominent among Balangodese than among Veddas, and the muscular attachments are more obvious among the former. Where the interosseous space is large for the Balangoda series, it is a result of radial rather than ulnar curvature.

The bones of the hand of the immature specimen BP2/21 show certain features that resemble the Vedda hand. In gross size the carpals and metacarpals lie at the upper limit of the range for the Veddas. The total digital formula for the Vedda hand is III > II > IV > V > I; the metacarpal formula for the Balangodese is II > III > IV > V(?) > I. The metacarpals of both series show curvature in the dorso-ventral plane, but Hill does not regard this as a feature unique among the Veddas, since it is found as well among other Ceylonese groups. The shapes of the carpal bones which are peculiar to the Veddas are also approximated in the hand of the Balangodese, *viz.* the dumbbell conformation of the scaphoid as a result of central narrowness, the cuboidal form of the capitate, and the well-defined ridging of the trapezium.

The Skeleton of the Lower Extremity. While the Vedda femora are platymeric with an average index of 78·50 for males and 80·40 for females, the Balangodese male BP2/17 is stenomeric and the other specimens of the fossil series, both male and female, are eurymeric for this index. With regard to the Pilastric Index, the male BP4/8 comes nearest the Vedda means of 108·80 for males and 106·90 for females. There is a discrepancy in the size of the femora of BP4/8, however. The other Balangodese have a Pilastric Index which is outside the upper range observable for the Veddas. There is close agreement, however, between the two series as regards the Index of Robusticity, that of Vedda males averaging 11·69, and the females averaging 10·80. Osteological features of greatest similarity for the femora of the two series occur more frequently at the extremities of the bone rather than at the mid-shaft region. To the differences of the shaft noted above should be added the greater torsion of the femur among Veddas. Both groups have very thick shafts and a pronounced development of the pilaster with the lips of the linea aspera separated to a marked degree. A short neck, compressed antero-posteriorly, and supporting a spherical head, is common to the proximal ends of the femora of both series. The greater trochanter is prominent and the trochanteric fossa is deep. The lesser trochanter is large and smooth. A third trochanter is absent. The crista hypotrochanterica is of variable development in the femora of both series. The distal end is marked with a broad intercondylar fossa for both Veddas and Balangodese, and a further example of similarity is afforded by the weak development of the adductor tubercle. Hill notes the great backward extent of the medial condyle and the anterior development of the lateral condyle of the Vedda femur. This trait is reminiscent of the orientation of the condyles of the Balangodese femur.

The tibia is mesocnemic for the majority of Vedda and Balangodese specimens, the index for the former series averaging 65·95 for males and 68·70 for females. None of the Balangodese tibias are pathologically affected as are many of the Vedda specimens with consequent distortion of their conformation. Only BP2/17 exhibits anterior–posterior bowing of the shaft to the extent found among the greater number of Vedda tibiae. The lateral prism formed by the transverse section of the Vedda tibia is not observable in the fossil series. Muscularity is moderate for bones of both series. The Balangodese tibia is somewhat more thick and massive. Torsion of the shaft is most prominent among the Veddas.

The fibular fragment of BP4/8 resembles the Vedda form in its straightness and triangular transverse section. However its articular extremities are more prominently developed. In muscularity it is more strongly marked, although the Vedda fibula also exhibits some hollowing for the peroneal and tibialis posticus muscles.

The tali of the two series are very similar in size and muscular development. The area for the fibular malleolus is extensive. However, the neck of the talus is broader among the Balangodese and the forward extension of the superior articular facet that Hill notes as a common feature of the Vedda talus is not apparent among the fossil specimens. The calcaneus is longer and narrower for the Veddas, but the pronounced curvature of the sustentaculum tali brings it nearer to the form found in the older group. The latter have a cuboid bone that approximates that of the Vedda cuboid in its squat form. The articular facets are prominent, but the Vedda cuboid shows greater convexity of the plantar surface.

The Skeleton of the Pelvis. Apart from the greater size of the Balangodese sacrum this bone falls well within the range of variation for other features observable in Vedda sacra. The platyhieric sacrum of BP2/17 can be matched with several Vedda specimens although the average for the series lie between the dolichohieric and sub-platyhieric categories. Closer similarity is seen in the uniform curvature and hyperbasal form of this bone. Four out of the eleven Vedda sacra examined by Hill showed an articulation of three sacral vertebrae with the ilium. The other Vedda sacra have only one or two segments connecting with their ilia. The various sacral aberrations that Hill finds in his Vedda specimens are not present in BP2/17, i.e., incomplete union of sacral vertebrae, failure of closure of the neural arches, and spina fissa of the terminal segments.

The pelvic bones of BP2/17 exhibit a combination of infantile and "paedomorphic" traits which are common for Vedda pelves plus "gerontomorphic" features that are characteristic of specimens of Australian aboriginal populations. Of the traits of the latter sort, BP2/17 shows prominent muscular attachments, a thick and massive ilium, and a size that is at the upper limit of the range of variation for the Vedda pelvic dimensions. Like the more gracile innominates of the Veddas, however, the male BP2/17 shows a sciatic notch with a fairly high angle, pronounced torsion between ilium and ischium and a deep hollowing of the gluteal fossa. The ischium of BP2/17 is narrow and long, but the Vedda form is broader and shorter. The Height–Breadth Index for the Veddas measured by Hill is 80·50 for males and 76·60 for females, indices considerably lower than that obtained by the present writer for the Balangodese. The mesopellic category of the Veddas—95·60 for males and 95·20 for females of Osman Hill's series—also contrasts with the higher index for the Balangoda pelvis. The neural foramina in both groups are cordiform.

THE DENTITION. The mean values for the sizes of molar and premolar teeth of Balangodese and Veddas show that the higher values occur in the former series. Where the Balangodese means are lower—as with the bucco-lingual diameter of the $RM^{\underline{3}}$ and mesio-distal diameters of the $RM^{\underline{2}}$, $LPM^{\underline{1}}$ and $RLM_{\overline{1}}$—the differences are very slight. Only in the latter case are the grinding teeth of both sides of the mouth smaller in size. The Balangodese molars and premolars are larger bucco-lingually than those of the Vedda series, hence their greater Length–Breadth Index. The anterior teeth in the two series show a significant difference from this molar-premolar size relationship. The upper canines of the Balangodese are smaller than those of the Vedda, but the labio-lingual diameter retains its relatively greater size over the mesio-distal length, and the indices are not as low as they are in the Vedda ratios. The mandibular canines reflect this situation. The mesio-distal length is greater for the maxillary and mandibular lateral incisors of the Vedda series, but the labio-lingual diameter shows no difference, save for the $\mathrm{RI}^{\underline{2}}$ which has a higher mean value among the Balangodese. The Length–Breadth Index remains higher for the fossil series, however. Their mean index for the upper central incisors is less than that for the Veddas, due to their smaller labio-lingual diameter. The mesio-distal diameter is larger for the $\mathrm{RI}^{\underline{1}}$ but the same for the $\mathrm{LI}^{\underline{1}}$. The mandibular central incisors cannot be compared due to the inadequate size of the sample. The Balangodese $\mathrm{LI}^{\overline{1}}$ shows the higher mean labio-lingual and mesio-distal values, but the index is below that of the Vedda series.

None of the specimens of the Vedda series exhibits on the occlusal surface of the lower molars the rectangular form, such as that found in BP2/21. However, the maxillary teeth in both series show a low incidence of occlusal rectangularity—a deviation from the common rounded molar form. The triangular premolar form is absent in the maxilla of the fossil series but present among the Veddas. The mandibles of both series have triangular premolars, but the rectangular form predominated in the Balangoda series, the round form in the Vedda. Canines are only triangular in the maxillae of the Veddas but BP2/20–41 has a $\mathrm{RL}\underline{\mathrm{C}}$ which is rectangular. This same specimen has a $\mathrm{RL}\bar{\mathrm{C}}$ of like pattern. This form is not absent in the Vedda mandibular canines although the common pattern is triangular. Some Vedda males have triangular upper incisors, but the only form found in the fossil series is rectangular. This is the case for upper and lower dentitions.

The Balangodese exhibit a greater variation in cusp pattern than do the Veddas, who offer no examples of molars with 5 or 6 cusps in the maxillary dentition. Cases of tricuspid molars are absent in the mandibles of both series, and 6 cusps are found in this region only among the Balangodese—the $\mathrm{LM}^{\overline{3}}$ of BP3/27–34. This variation in the molar cusp patterns, particularly in the maxilla, is a peculiar feature of the Balangodese dentition. It is further exemplified in the 4-cusp pattern of the $\mathrm{RLPM}^{\underline{2}}$ of BP2/20–41. The buccal cusp(s) of the premolars is consistently the higher in both series. The Veddas offer no cases of Carabelli's cusp nor the presence of other accessory cusps, but both are to be found in the Balangoda series. Crenulation of the third molar appears to be a common feature of both series, although it is found exclusively in the females of the Vedda group. The strict correlation of cusp number and groove pattern which is universal in the latter series does not hold true with the Balangodese. Furthermore, there are no cases of Y4 or +5 groove patterns in the Vedda series, the 4 cusp and 5 cusp patterns relating to the +4 and Y5 groove patterns, respectively. In both series the maxillary cusp pattern for molars is +4.

The greater degree of attrition of the molars and premolars of male specimens, as is the situation in the Vedda series, is not encountered in the fossil series where the degree of wear is more pronounced among females. More of the posterior teeth of the Balangodese exhibit pronounced abrasion than do the corresponding teeth of

Table II

Comparative Anthropometric Data: The Cranial Vault

Specimen or group	Frequency by sex	Source of data	Cranial length	Cranial breadth	Cranial index	Basion-Bregmatic height	Basion-bregmatic height-length index	Basion-bregmatic height-breadth index	Auricular-vertex height	Auricular-bregmatic height	Auricular-vertex height-length index	Auricular-vertex height-breadth index	Auricular-bregmatic height-length index	Auricular-bregmatic height-breadth index
Balangodese	BP2/17	..	200 M	147 M	73·5 M	135 M	67·5 M	91·8 M	132 M	127 M	66·0 M	89·6 M	63·5 M	86·5 M
	BP2/21	..	183 F	133 F	72·6 F	..	..	..	..	..	..	..	..	..
	BP3/27–34	..	177 F	130 F	73·4 F	..	..	..	..	..	..	..	..	..
Veddas	44 M	Hill 1941	178 M	126 M	71·2 M	132 M	74·6 M	105·5 F	..	110 M	61·0 M	..	..	..
	18 F		169 F	123 F	72·7 F	128 F	74·6 F	103·9 F	..	108 F	63·5 F	..	..	..
Sinhalese	9 M	Sarasins 1892	183 M	132 M	72·5 M	135 M	73·9 M	..	..	..	..	..	..	..
	4 F		169 F	126 F	74·5 F	127 F	75·1 F	..	..	..	..	..	..	..
Ceylon Tamils	13 M	Sarasins 1892	185 M	131 M	70·8 M	136 M	73·6 M	..	..	..	..	..	..	..
	7 F		179 F	125 F	70·2 F	129 F	72·1 F	..	..	..	..	..	..	..
Mundas	5 M	Basu 1932–1933	178 M	128 M	72·0 M	130 M	72·9 M	101·3 M	..	..	..	..	..	..
	2 F		167 F	117 F	70·3 F	129 F	77·2 F	110·0 F	..	..	..	..	..	..
Oreans	4 F	Basu 1933–1934	182 M	130 M	71·4 M	130 M	71·0 M	99·8 M	..	..	..	..	..	..
Male	1 M	Sarkar 1954	167 M	121 M	72·4 M	..	..	..	..	107 M	..	..	..	..
	1 F		157 F	125 F	79·6 F	118 F	75·1 F	94·4 F	..	105 F	..	..	..	..
Andamanese	23 M	Sullivan 1921	164 M	136 M	83·4 M	130 M	..	95·7 M	..	..	..	..	..	..
	18 F		160 F	131 F	81·0 F	124 F	..	94·2 F	..	..	..	..	..	..
Papuans	124 M	Hambly 1940	177 M	131 M	74·0 M	131 M	74·3 M	99·6 M	..	..	..	..	..	..
	70 F		170 F	126 F	74·3 F	128 F	75·4 F	98·8 F	..	..	..	..	..	..
Australians	162 M	Morant 1927	187 M	132 M	70·8 M	133 M	71·8 M	..	115 M	113 M	..	..	..	..
	75 F		175 F	127 F	72·2 F	125 F	71·6 F	..	110 F	108 F	..	..	..	..
Tasmanians	60 M	Morant 1927	182 M	136 M	74·2 M	130 M	71·3 M	..	109 M	108 M	..	..	..	..
	36 F		174 F	132 F	75·1 F	125 F	71·6 F	..	..	..	..	..	..	..
Tirukketiswaram	1 F	Chanmugam and Jayawaradena 1954	184 F	136 F	74·0 F	131 F	71·4 F	96·4 F	124 F	..	..	..	..	..
Brahmagiri	5 M	Sarkar 1960	187 M	144 M	77·1 M	138 M	74·8 M	94·5 M	..	112 M	..	..	59·9 M	78·0 M
Adichanallur 1	1 M	Zuckerman 1930	183 M	124 M	67·8 M	..	69·4 M	103·2 M	..	..	61·2 M	98·2 M	..	..
Prehistoric Chinese	64 M	Black 1928	180 M	138 M	76·0 M	137 M	75·9 M	99·2 M	116 M	..	64·1 M	..	..	..
	20 F		175 F	134 F	77·8 F	130 F	76·3 F	98·1 F	111 F	..	65·6 F	..	..	..
Mohenjo-daro	3 M	Sewell & Guha 1931*a*	197 M	130 M	66·0 M	139 M	70·6 M	107·2 M	112 M	..	..	..	62·0 M	..
Nal	1 M	Sewell & Guha 1929	188 M	132 M	70·0 M	146 M	77·4 M	110·6 M	120 M	..	63·6 M	90·9 M	..	..
Makran B	1 M	Sewell & Guha 1931*b*	..	..	..	119 M	..	..	..	..	..	..	..	..
Sampung	1 M(?)	Mijsberg 1932	170 M	133 M	78·2 M	..	..	..	117 M	..	..	..	68·8 M	81·5 M
Langhnaj	3 M	Karve & Kurulkar 1945	197 M	136 M	69·3 M	..	..	..	119 M	..	60·4 M	87·5 M	..	..
Bayana	1 M	Keith 1919	178 M	127 M	71·3 M	131 M	73·6 M	103·1 M	108 M	..	60·6 M	85·0 M	..	..
Sialkot	1 M	Keith 1919	180 M	128 M	71·1 M	140 M	77·7 M	109·3	119 M	..	66·1 M	92·9 M	..	..
Talgai	1 M	Smith 1918	192 M	141 M	73·4 M	..	..	..	105 M	..	54·7 M	..	..	..
Keilor	1 M	Wunderly 1943	197 M	143 M	72·6 M	143 M	72·6 M	100·0 M	120 M	..	60·9 M	83·9 M	..	..
Niah	1 M	Brothwell 1960	180 M	140 M	77·8 M	128 M	..	112·0 M	..	..	..	..	..	..
Wadjak	1 M	Dubois 1922	200 M	145 M	72·5 M	140 M	70·1 M	96·5 M	..	..	59·0 M	..	..	..

TABLE II (*continued*)

COMPARATIVE ANTHROPOMETRIC DATA: THE PALATE AND MANDIBLE

		External palate length	External palate breadth	Palate index	Condylo-Symphysial length	Bicondylar breadth	Symphysial diameter	Bigonial diameter	Maximum breadth of the ascending Ramus	Minimum breadth of the ascending Ramus	Mean angle of the Ramus-Corpus
Balangodese	BP2/17	61 M	69 M	113·1 M	..	..	..	..	..	..	..
	BP2/17i	..	..	..	106 M	118 M	28 M	96 M	..	..	118 M
	BP2/20	70 F	..	..	79 M	115 M	26 M	110 M	..	..	123 M
	BP1/6	..	..	..	..	..	31 F	..	..	30 F	..
	BP2/21	62 F	65 F	104·8 F	99 F	105 F	31 F	99 F	36 F	31 F	116 F
	BP3/27–34	53 F	63 F	118·8 F	93 F	112 F	28 F	101 F	41 F	31 F	133 F
Veddas	..	50 M	44 M	97·0 M	104 M	111 M	27 M	89 M	33 M	30 M	119 M
		46 F	42 F	94·3 F	98 F	99 F	26 F	83 F	33 F	26 F	118 F
Sinhalese	..	56 M	61 M	108·2 M	..	116 M	..	97 M	..	..	..
Ceylon Tamils	..	62 M	55 M	88·7 M	..	..	..	..	..	..	..
Mundas	..	49 M	41 M	83·6 M	..	112 M	31 M	89 M	42 M	32 M	120 M
		49 F	37 F	75·5 F		112 F	31 F				
Oreans	..	55 M	40 M	67·1 M	..	114 M	29 M	94 M	42 M	29 M	113 M
Male	..	..	35 F	..	..	116 F	27 F	92 F	..	27 F	132 F
Andamanese	..	..	..	..	..	..	26 M	91 M	..	..	..
							26 F	83 F			

TABLE II (*continued*)

COMPARATIVE ANTHROPOMETRIC DATA: THE FACE

	Minimum frontal diameter	Bizygomatic diameter	Upper facial height	Upper facial index	Total facial height	Total facial index	Nasal height	Nasal breadth	Nasal index	Orbital height	Orbital breadth	Orbital Index
Balangodese												
BP2/17	117 M	..	..	..	..	..	..	..	..	37 M	41 M	90·2 M
BP4/8	..	..	..	..	..	..	..	23 M	..	..	..	..
BP2/21	110 F	121 F	..	..	..	..	..	..	..	36 F	..	..
BP2/25	..	..	60 F	..	..	..	..	..	..	..	..	..
BP3/27–34	91 F	110 F	64 F	58·1 F	101 F	91·8 F	44 F	23 F	52·2 F	40 F	30 F	75·0 F
Veddas	91 M	121 M	60 M	49·0 M	105 M	85·4 M	44 M	24 M	54·2 M	32 M	38 M	74·0 M
	88 F	116 F	56 F	49·1 F	90 F	79·7 F	41 F	22 F	57·3 F	31 F	36 F	73·7 F
Sinhalese	94 M	126 M	67 M	53·2 M	114 M	89·7 M	49 M	24 M	50·6 M	31 M	37 M	83·6 M
		114 F	60 F							32 F	36 F	89·1 F
Ceylon Tamils	93 M	125 M	65 M	52·2 M	111 M	88·2 M	47 M	25 M	53·7 M	32 M	38 M	86·7 M
		118 F	65 F	54·0 F						32 F	36 F	86·7 F
Mundas	90 M	125 M	61 M	48·9 M	108 M	85·7 M	47 M	24 M	52·3 M	31 M	38 M	82·0 M
	88 F	116 F	56 F	48·2 F	99 F	85·3 F	42 F	25 F	59·5 F	30 F	35 F	85·7 F
Oreans	91 M	126 M	61 M	48·6 M	119 M	92·9 M	46 M	25 M	54·7 M	31 M	37 M	85·1 M
Male	91 M	..	..	..	..	..	..	..	..	..	..	..
	91 F	..	..	52·0 F	..	..	41 F	25 F	60·9 F	31 F	34 F	97·1 F
Andamanese	92 M	124 M	61 M	..	99 M	..	45 M	23 M	51·0 M	32 M	36 M	89·0 M
	89 F	117 F	56 F	..	92 F	..	43 F	22 F	52·0 F	31 F	35 F	89·1 F
Papuans	95 M	128 M	66 M	69·1 M	..	..	49 M	25 M	51·7 M	33 M	39 M	86·3 M
	90 F	119 F	63 F	69·3 F	..	..	46 F	24 F	52·6 F	33 F	38 F	84·9 F
Australians	96 M	133 M	66 M	50·2 M	..	..	49 M	26 M	54·6 M	33 M	40 M	78·9 M
	91 F	122 F	62 F	51·1 F	..	..	45 F	25 F	55·7 F	32 F	38 F	78·9 F
Tasmanians	94 M	131 M	62 M	49·6 M	..	..	47 M	27 M	29·1 M	31 M	38 M	..
	90 F	122 F	59 F	49·6 F	..	..	44 F	26 F	59·0 F	..	..	81·5 F
Tirukketiswaram	95 F	122 F	..	..	114 M	93·4 F	48 F	24 F	50·0 F	33 F	40 F	82·7 F
Brahmagiri	94 M	89 M	59 M	57·3 M	..	..	48 M	25 M	58·8 M	33 M	42 M	73·3 M

TABLE II (*continued*)

COMPARATIVE ANTHROPOMETRIC DATA: THE FACE

	Minimum frontal diameter	Bizygomatic diameter	Upper facial height	Upper facial index	Total facial height	Total facial index	Nasal height	Nasal breadth	Nasal index	Orbital height	Orbital breadth	Orbital index
Adichanallur 1	90 M	128 M	70 M	54·6 M	..	..	50 M	27 M	54·0 M	35 M	40 M	87·5 M
Prehistoric	91 M	132 M	75 M	56·0 M	120 M	90·6 M	54 M	25 M	47·6 M	33 M	44 M	76·1 M
Chinese	87 F	125 F	70 F	56·0 F	114 F	92·1 F	51 F	25 F	46·4 F	33 F	43 F	82·0 F
Mohenjo-daro	95 M	127 M	..	53·9 M	..	88·9 M	46 M	22 M	51·0 M	31 M	37 M	84·4 M
Nal	93 M	120 M	72 M	60·0 M	..	..	49 M	23 M	49·9 M	33 M	40 M	82·5 M
Makran B	..	116 M	81 M	70·3 M	130 M	97·4 M	54 M	23 M	43·5 M	..	..	..
Sampung	91 M	134 M	45 M	61·0 M	..	..	45 M	25 M	56·7 M	31 M	43 M	72·1 M
Langhnaj	105 M	118 M	..	..	..	..	..	..	..	..	..	..
Bayana	90 M	136 M	..	..	..	..	..	..	..	..	..	..
Sialkot	98 M	..	..	..	..	..	..	..	..	..	..	..
Talgai	99 M	128 M	65 M	..	..	..	..	25 M	61·6 M	32 M	40 M	81·2 M
Keilor	101 M	136 M	74 M	54·4 M	..	..	52 M	27 M	51·9 M	30 M	39·5 M	76·0 M
Niah	98 M	..	55 M	..	..	..	42 M	28 M	66·3 M	..	..	..
Wadjak	99 M	140 M	73 M	52·1 M	..	..	50 M	30 M	60·0 M	33 M	42 M	78·6 M

TABLE II (*continued*)

COMPARATIVE ANTHROPOMETRIC DATA:
THE PALATE AND MANDIBLE

	External palate length	External palate breadth	Palate index	Condylo-symphysial length	Bicondylar breadth	Symphysial height	Bigonial diameter	Maximum breadth of the ascending Ramut	Minimum breadth of the ascending Ramus	Mean angle of the Ramus Corpus
Papuans	53 M	40 M	75·2 M	..	..	..	..	..	..	..
Australians	50 M	41 M	81·8 M	..	..	..	..	..	..	..
	50 F	39 F	77·9 F	..	..	..	..	..	..	..
Brahmagiri	..	44 M	..	..	..	..	..	..	..	..
Tirukketiswaram	..	..	..	..	110 F	23 F	86 F	..	28 F	..
Adichanallur I	53 M	65 M	122·6 M	..	..	..	..	..	..	..
Prehistoric	46 M	50 M	95·2 M	..	..	..	-..	..	..	..
Chinese	45 F	49 F	92·0 F							
Mohenjo-daro	53 M	46 M	89·3 M	..	121 M	..	..	..	..	..
					115 F					
Nal	..	..	79·2 M	..	..	..	..	..	..	..
Makran B	50 M	42 M	84·0 M	..	108 M	..	95·5 M	..	..	..
Talgai	62 M	42 M	67·7 M	..	..	..	..	..	..	..
Keilor	56 M	47 M	83·6 M	..	..	..	..	..	..	..
Niah	47 M	37 M	78·9 M	..	..	..	..	..	..	..

the Vedda series. The condition of the canines is similar in both groups, the lower canines being the more heavily worn. There are no incisor teeth in the Balangoda series whose abrasion might be described as " slight " or " sub-medium " as is the case for the Veddas. The condition of moderate to pronounced wear is the norm for this fossil series. Only among Vedda females do the lower molars appear more heavily worn : among the Balangodese the more severe forms of mandibular molar abrasion are represented by the males. The Vedda male specimens show greater maxillary molar abrasion, but for the Balangodese this sort of sexual differentiation does not exist. Both groups, however, show greater wear of the upper incisors among the males. The assymetrical wear pattern observable in the right and left sides of the dentitions of certain Vedda specimens is not apparent in the fossil series.

The occurrence of shovel-shaped incisors, while present only in the dentitions of the females of the Balangoda series, is found in both sexes of the Veddas. Furthermore the development of this feature is considerably more prominent among the Veddas. This trait appears in the lower dentition of a single Balangodese female—BP2/21. Lingual tubercles are absent from the anterior teeth of males of both series. Among females their presence may or may not be coincident with shovel-shaping.

With respect to dental anomalies the Balangodese and Veddas exhibit some striking differences. Caries and evidence of abscess are absent in the former but not infrequent in the latter population. The frequency of ante-mortem tooth loss is high for Veddas, negligible in the fossil series. Both populations show cases of supernumerary teeth. Among the Balangodese these are found in the molar portions of both jaws and for the Veddas there is a single case of a supernumerary tooth in

TABLE 12

COMPARATIVE ANTHROPOMETRIC DATA: THE MAXILLARY MOLAR DENTITION

			M^1			M^2			M^3		
			MD	BL	I	MD	BL	I	MD	BL	I
Balangodese	BP2/17	..	10	12	114·2	10·5	12	114·2	10	11·5	115·0
	BP2/20	..	10	11	110·0	8·5	12	141·1	..	..	..
	BP4/8	..	10	11	110·0	9	11	122·2	9	11·5	127·7
	BP1/6	..	10·5	12	114·2	10	12	120·0	9·5	11·5	121·0
	BP2/21	..	11	12	109·1	10	13	130·0	8·5	13	151·9
	BP3/27	..	9	11	122·2	10	10·5	105·0	..	..	..
Veddas	..	..	8·5	12	150·0	10	10·6	107·4	10	10·9	109·4
Mundas	..	..	9·6	10·2	106·2	8·5	10·2	120·5	..	..	..
Oreans	..	..	9·2	10·7	116·2	8·7	10·7	122·8	..	..	..
Male	..	..	10	10	100·0	8	10	125·0	..	..	..
Australians	..	..	11·4	12·8	105·2	10·9	13·1	120·1	10	12·3	123·0
Sampung	..	..	11·2	12·8	114·2	10·9	12·8	117·4	10	12·4	124·0
Gua Cha	..	Brothwell 1960	10·3	12·1	117·4	10·2	12·2	109·6	9·3	12·0	119·0
Talgai	..	Campbell 1925	12·6	13·1	103·9	11·3	13·3	117·6	..	..	..
Keilor	..	Adam 1943	11	13·2	120·0	9·9	13	131·3	9·7	12	123·7
Niah	..	..	10·2	12·3	120·5	10·7	13	121·4	11·5	12·4	107·8

the mandibular incisive region. Suppression of teeth is not a feature in either series. Crowding is found only in the third mandibular molars in the prehistoric group. Crowding is not observable among the Veddas who show, however, a high incidence of maladjustment for other parts of the dentition.

The first molar is more commonly the larger in the posterior dental rows of both series, but the presence of the third molar as the one of greater size is found more frequently in the earlier series, particularly in the mandibles. There are no cases of the first molar being the larger in the lower jaws of the Balangoda series, although the Vedda series affords several such cases. Where the third molars are absent, the second molar is larger than the first.

The overbite type of occlusion, which is common for jaws of the Vedda series, appears to have been present also among the Balangodese, although only BP2/25 and BP3/27–34 afford evidence of this.

IV DISCUSSION

From the anthropometric and comparative analyses of the human remains from Bellan Bandi Palassa originate certain problems of interpretation which require comment. Regarding the question of the phenotypic affinities of the Balangodese, Deraniyagala has entertained several views. His earliest opinion, conceived at a time when the only prehistoric Ceylonese hominid specimen was the one from the site of Batadomba lena, was that the Veddas were a composite race of several different population elements from India which had introduced the Neolithic culture to the Island. " The tendency of the Veddas to throw back to two physical types differing from other races in Ceylon ... " suggested this hypothesis (Anonymous 1941 : 354). Later he remarked that " ... the supposedly autochthonous Vaddha of Ceylon possibly carries some proportion of the blood of Balangoda man ... " (Deraniyagala 1943*a* : 112), but following the discovery of the specimens from the sites of Ravan alla and Telulla he wrote,

> " This race may be termed ' Proto-Vaddoid '. The so-called Vaddahs who do not differ in culture, religion, and language from the forest villagers can only be regarded as hybrids between this extinct autochthonous Stone Age race and the more modern metal using ones of Ceylon. Supporting this view is the fact that the so-called Vaddahs display a variety of physical types that have puzzled the anthropologists who attempted to study them under the impression that they were a distinct race " (Deraniyagala 1955*a* : 40).

As to the Sinhalese he conjectures,

> " The blood of *Homo sapiens balangodensis* however exists in almost equal intensity in the colonies of the so-called Vaddahs of today, and among the Sinhalese so that in most cases it would be impossible to distinguish a so-called Vaddah from a Sinhalese if both were clothed alike and placed in the same village ... the only recognizable autochthonous race in Ceylon is the extinct one in a lithic culture phase ... " (Deraniyagala 1955*b* : 301–302).

Since the appearance of the fossils from Bellan Bandi Palassa, he has insisted that the Balangodese show a combination of Neanderthaloid and Australoid traits that he calls " Proto-Australoid ", plus a Negroid element added at a later time (Deraniyagala 1957*a* : 3, 4). He suggests that the Balangodese replaced the people of the " Ratnapura " culture who were the true autochthones of Ceylon and that the Balangodese continued to practice their distinctive culture until the fifth century A.D. The Veddas are, he concludes, " a degenerate mixed population " of Balangodese and Sinhalese racial elements (Deraniyagala 1958*a* : 258, 1960*a* : 96, 108).

The only other published discussion of the racial affinities of the Balangodese known to the present writer is Coon's (1962 : 424–425). This author agrees with Deraniyagala that there is a Negroid element in the series, but believes that the dominant strain is " Caucasoid " rather than " Australoid " ; although he hastens to add that the presence of some " Australoid " features should not be surprising considering the location of the Island of Ceylon just south of a " Caucasoid–Australoid zone of contact ". He appears to base this opinion upon the presence of reduced frontal brow ridges, a sharply pointed chin, the lack of a prominent nuchal crest and what he regards as a narrow and prominent nasal structure which are represented in the single specimen now on loan at the American Museum of Natural History in New York (Specimen T–24–B or BP3/15b). Although Dr. Coon saw six of the Balangodese specimens in Ceylon in 1957, these had not yet been cleaned, repaired or described. While the present writer, basing his analysis upon the restored specimens, agrees that Balangoda Man did not differ subspecifically from the living Veddas, as Coon states, the complete series supports an interpretation that must take into consideration the non-Caucasoid phenotypic traits of the Balangodese. Since Coon regards the living Veddas as " Caucasoids " along with their Sinhalese neighbours, it is not surprising that he has emphasized the racial criteria of this phenotype in his interpretation of the Balangodese population.

Emerging from this very general comparative analysis of the Balangoda phenotype with the phenotypes of other populations and individual specimens, both prehistoric and contemporary, are two major considerations : (1) the high frequency of similar morphological traits shared by the Balangodese and the Veddas which suggests a positive genetic affinity between them ; (2) the number of unique morphological traits that characterize the Balangodese which are among those traits recognized by various students of the Veddas as the phenotypic hallmarks of half-breeds or " Vedda sub-types ". Hill (1941 : 134) lists the main effects of miscegenation in the Vedda population as the tendency to increase of the cranial capacity above 1,300 cc., an increase in the relative height and/or breadth of the cranial vault with a consequent lessening of the steepness of the lateral walls and the formation of reduced temporal fossae, an elongation of the face, especially in the increased depth of the mandible, an absence of prognathism, a constriction of the orbits and rounding off of the outlet of the orbital fossae, a narrowing of the spheno-maxillary fissure, a reduction in the extent of the frontal bone on the inner wall of the orbit, and the presence of leptorrhiny which is accompanied by longer nasal bones, an elevated nasion and an oxycraspedote apertura pyriformis. In the majority of cases Hill can confirm the mixed ancestry of certain Vedda crania by facts relating to their history. Indeed the proportion of these atypical crania is greatest for those collected since 1886. However, Hill is cautious in assigning to these crania on the basis of his observations alone any traits that would identify the non-Vedda phenotype per se, i.e., absolute traits indicative of admixture from Sinhalese, Tamils, Malays, etc. Nor does he regard *all* crania well outside the modal values for the Vedda phenotype as specimens which are non-Vedda in pedigree. Rather, he notes the presence of a third type of cranium which is less typical than his " classic Vedda " type but which he cannot place with the " half-breed Veddas ". He suggests that these individuals may either be the result of remote miscegenation followed by a later addition of Vedda genes from unadulterated gene pools, or else representatives from within the range of variation of pure Veddas. The skulls of the second type, he notes, exhibit a number of traits described as " primitive, even simian " (Hill 1941 : 124, 125, 134).

This is the most recent of several schemes to account for physical subtypes among the Veddas. That of von Eickstedt (1927*a*) allows for five types : (1) the " Veddoid " which corresponds to the conventional " pure Vedda " type living the old way of life ; (2) the " Singhalesoid " or acculturated Vedda living in villages ; (3) the " Mongoloid " type which shows admixture with Malays ; (4) the " pseudo-Australoid " whose criterion is a heavier facial beard than that of the Veddoid type ; (5) the Coast Vedda who has become mixed with Tamils. Two or three subtypes were mentioned by Topinard (1885) after an examination of twelve Vedda crania at the Royal College of Surgeons. Hocart (1931 : 5) suggests that there is an element in Ceylon's population that has not as yet been identified, and Raghaven (1953 : 51), seeing Mediterranean and Australoid elements at opposite ends of the range of variation of Vedda morphology, finds a third type. This he claims is shorter in stature than the Australoid and Mediterranean and has been called Negritoid.

This observation that certain physical features found in the Balangodese are among those features that anthropologists have held to be the criteria of Vedda crosses or sub-types does not weaken the claim that considerable miscegenation of the Veddas with the Sinhalese, Tamil and other ethnic groups of Ceylon has transpired : rather, it attempts to explain how those physical features which cannot be attributed to the modern non-Vedda populations happen to be manifested in certain proportions among the Veddas of the present day. That the presence of relatively compressed temporal fossae and the absence of total facial prognathism in Vedda populations are related to their recent genetic crossings cannot be doubted. But other features—leptoprosopy, hypsicrany, greater thickness of the cranial bones, prominent mastoid development, the peculiar morphology of the mandible—are examples of physical features shared by both the Balangodese and the Veddas. On the basis of the Balangoda specimen T–24–B the presence of leptorrhiny in the Balangodese gene pool cannot be excluded, although specimen BP4/8 indicates that platyrrhiny was also a feature of the group. In addition to these traits which have been selected as evidence of Vedda miscegenation or penetrance of archaic sub-types are a number of others which the Veddas share with the Balangodese but which have a very low frequency among any of the Ceylonese populations today. The most striking of these are the similarities in cranial conformation, prominence of supra-orbital tori, the depth of the nasal notch, platyrrhiny, chaemaeconchy and certain similarities of the post-cranial skeleton. Of those physical traits that distinguish Balangodese from Veddas as well as from other Ceylonese, the majority appear in the post-cranial skeleton. Apart from their greater lengths, the long bones are more robust and lack the bowing and torsion that characterizes those of the Veddas. Some cranial distinctions are reflected in their greater palate dimensions, pronounced mandibular muscularity and a dentition in which the molars are larger in size and exhibit cusp patterns of a more complex development. These would appear to be physical characteristics that were never manifested in the Vedda phenotype. But while the Balangodese may share a similar genetic background with the Veddas, they are " pre-Vedda " primarily in the chronological sense of that term. Genetically both Balangodese and Veddas appear to have been recipients of a common gene pool in the past. Affinities with other phenotypic groups, living and prehistoric, cannot be questioned, as the comparative Tables are able to illustrate to a certain degree. But of all the populations with which the Balangodese were compared by the present describer, none appioached them in number and significance of morphological similarities to the degree represented by the Veddas of the historic period of Ceylon.

Historically the Veddas have been treated as though they were a homogeneous racial or sub-racial entity which the physical anthropologist could clearly distinguish from other ethnic groups living in Ceylon. However a little investigation into the problem of how the Veddas have been biologically and culturally defined indicates that this subject has been the focus of considerable debate, as attested by the fact that certain writers have declared the Veddas to be extinct while their contemporaries have estimated that they number in the thousands. It is suggested here that the matter of how the concept of the Veddas as a distinctive phenotypic pattern within Ceylon came to be is deserving of some careful research in the light of the new osteological evidence from Bellan Bandi Palassa. Conceivably such a programme of research could be approached along three avenues of investigation : (1) the problem of how the term " Veddas " has been employed and the determination of what this means when applied to the population as a whole as well as to individuals within the population so defined, (2) the problem of how the Veddas have been described in scientific and popular literature and in oral traditions, (3) the analysis of the various interpretations that have been made by those writers concerned with the Veddas when applying their data to the wider fields of human evolution and cultural behaviour.

Regarding the first problem, it must be understood that the concept of the Veddas as a relict population with ancient indigenous roots in Ceylon has been a basic assumption behind all definitions of their culture and phenotype. For the Sinhalese, Tamils, Malays, Chinese, Moormen, Europeans and other ethnic groups of the Island there are historical accounts of their colonization, but for the Veddas (and Balangodese) there is no historical documentation of their longer habitation here. Their past must be reconstructed from prehistoric archaeology, native Sinhalese and Tamil chronicles, and anthropometric data. The problem is further complicated by the fact that the term Vedda has become defined not only as a distinct physical type but on the basis of sociological criteria as well. By the close of the 19th Century three concepts regarding the physical morphology of the Veddas had been put forward (1) the Veddas constituted a single homogeneous racial population morphologically distinct from the macro-population of Ceylon ; (2) the Veddas were racially heterogeneous save for " true ", i e., " pure Veddas ", who followed a primitive hunting-gathering economy ; (3) the " true Veddas ", whatever their economic status, were definable in terms of one or more osteological specimens proclaimed as typical of the Vedda phenotype. An additional concept has been offered by Hill (1945 : 202–203) who considers the geographical area rather than the degree of acculturation to be the vital factor in the recognition of a physical type definable as Vedda.

In scientific and popular descriptions of the Vedda phenotype, selection has been the major stumbling block of physical anthropologists. The number of osteological specimens collected from Ceylon since 1827 and bearing the name " Vedda " on their labels is impressive and exceeds in size the series accessible for many other Asiatic tribal groups of higher population frequency, and the amount of anthropometric data pertaining to both osseous and living Vedda specimens is not inconsiderable. Nevertheless this abundance of data has not deceived the more perceptive students of the Veddas who have troubled themselves to investigate the histories of particular so-called Vedda specimens and Vedda communities. The history of the scientific investigation of Ceylon's aboriginal population has yet to be written, but a cursory glance at the published data indicates that evidence gleaned from small samples often has been considered applicable to the Vedda population as a whole. In most cases the fact that the specimens were from Vedda populations at all is questionable, for the majority of collectors obtained them through Sinhalese and Tamil contacts by offering to pay the latter for every skull they could procure, leaving it up to the contacts to decide what was or was not a Vedda. The care taken by the Sarasins and Hill to get their osseous specimens from Vedda cave sites and cemeteries, personally excavated, is a commendable but infrequent condition in the history of Vedda osteological collections. Furthermore, even those specimens which most experts would recognize as Veddas were taken from a fairly circumscribed sector of the eastern portion of the Island, although historical accounts make it clear that in the past the Veddas were more widespread if not ubiquitous.

Scientific research on the Veddas, which may be said to have commenced in the early decades of the last century, has never been completely independent of the notions contained in fantastic traveller's accounts or of the oral and written traditions concerning this population. Even in the rigour of the determination to select those Vedda specimens, osseous or living, which are " typical ", scientific workers have repeatedly emphasized the importance of certain phenotypic traits and thus introduced additional selective factors into the interpretation of What is a Vedda? Of these notions of the Vedda phenotype, the most common is that it is infantile and/or anthropoidal and hence representative of a very primitive and even atavistic kind of humanity. Some writers have barely accorded the Veddas human status. The selection of certain Vedda crania as prototypes, even though it was an attempt to define with clarity the concept of the Vedda phenotype, has tended to obscure the factor of normal variability of this population. The ghost of this tradition lingers in the works of those researchers who, even in the manipulation of large series of Vedda specimens, have not been emancipated from the employment of such terms as " typical Veddas ", " pure Veddas " or " classic Veddas " in their writings. Such expressions may be useful when denoting specimens for which no admixture with non-Vedda phenotypes is suspected, but they are misleading when the total Vedda phenotype is the subject of consideration. Such terms are meaningless when the physical anthropologist attempts to understand the phylogeny of the Veddas since the gene pool of any population is never static. In Ceylon population shifts have been especially encouraged through the operation of frequent genetic intercourse between groups as well as by the dynamics of genetic drift and natural selection in local areas of the Island.

An examination of the archaeological complex at Bellan Bandi Palassa forces the anthropologist to ask these questions : (1) How are the cultural artifacts found in association with the Balangoda skeletal series related to the prehistoric picture of Ceylon and the Indian mainland and to southern Asia as a whole? (2) What affinities, if any, can be demonstrated between the cultures of the Balangodese and the historic Veddas? These problems of the archaeological significance of the cultural assemblage at Bellan Bandi Palassa are complementary to the problems of the physical anthropology of the human remains. In comparing certain elements of the Balangoda culture with that of the Veddas, attention is directed to a paper by Allchin (1959). In summarizing the evidence of the prehistoric cultures of Ceylon, Allchin has pointed out striking similarities between certain of its elements and particular cultural traits of the Veddas. The present writer, although restricting himself to the cultural evidence from the single site of Bellan Bandi Palassa, finds grounds for justifying a similar comparison. To the early prehistorians who pioneered research into Ceylon's prehistory the suggestion that the ancestors of the Veddas were the manufacturers of the ubiquitous stone tools seemed obvious. Those who questioned this apparent relationship between the prehistoric or contemporary cultures did so because they thought the Veddas incapable of producing a lithic industry, and not because they questioned the validity of the archaeological evidence in the Vedda caves. Now that the physical remains of the artisans of these lithic industries have been recovered, the contentions of the Sarasins and the Seligmanns must be re-evaluated along with the concepts of their opponents about the role that the ancestors of the Veddas played in Ceylon's prehistory.

As a final point in this discussion it must be mentioned that what is now required of the prehistorians of Ceylonese studies is a compilation of data concerning the Veddas from ancient native chronicles and later travellers' accounts. Whatever the affinities of the Veddas to the prehistoric and historic populations of Ceylon might be, the invasion of the Sinhalese in the Fifth Century B.C. caused a concentration of the indigenes in the eastern wilderness of the Island—the Veddarata—where they are still to be found in isolated chena villages. That they once occupied the entire Island, as has been suggested by the Sarasins (Sarasin & Sarasin 1907 : 189, F. Sarasin 1926 : 83) cannot be proved as yet, but references to their presence in other portions of Ceylon can be inferred from a cursory glance at the native Sinhalese and later European records as well as from a mapping of the Vedda place names across Ceylon. These data establish that the territory of the Veddas extended far beyond the present limits of this relict group within the recent historic period. What their area of occupation may have been during the period that Ceylon was known only along its coastline and before its interior had been penetrated by Sinhalese and Tamil colonization awaits further research. The migration of Vedda communities over the Island during the past three millenia and earlier is relevant to the problems of their physical morphology today. One wonders what selective factors, be these biological or cultural, influenced the preservation of certain Vedda populations in the relict areas of the Island while other Vedda groups became incorporated in communities of invading peoples or failed to pass on their genes at all. Useful as Hill's concept of Vedda geographical–biological areas may be to the physical anthropologist desirous of obtaining " typical Vedda " specimens, it must be borne in mind that these individuals are a segment of a much larger Vedda gene pool which existed in the past and the factors conducive to their survival are unknown. Furthermore we are ignorant of the genetic shifts that have taken place within these population segments since the commencement of their isolation. Such considerations are relevant to the problem of identifying the Balangodese when one considers that this stone-using prehistoric population was in existence at the dawn of the period of Sinhalese settlement and that the genetic complex that makes it distinctive as a phenotypic entity at this period must have had considerable influence upon the genetic composition of the present-day peoples of Ceylon.

V CONCLUSIONS

The Balangoda skeletal series from Bellan Bandi Palassa constitutes a unique phenotypic pattern present in Ceylon at the dawn of the historic period, a time within the second and third millenia B.P. While possessing certain biological features that distinguish them from other fossil hominids found thus far, the Balangodese fall within the range of polytypic variation representative of post-Pleistocene *Homo sapiens* of the Indian–southeast Asian–Australian gene pool. The phenotypic pattern most closely resembling that of the Balangodese is that of the Veddas of Ceylon. Similarities are not only quantitatively provocative but striking as well in terms of particular isolated physical traits that distinguish both Veddas and Balangodese from other southern Asiatic populations. Indeed, certain of the morphological and anthropometric characteristics of the fossil series have been cited by physical anthropologists studying the Veddas as indicative of Vedda sub-types or as the evidence of their miscegenation with other living racial groups. It would seem therefore that both the Balangodese and the Veddas are biologically united through their possession in the past of a common gene pool, although it must be stressed that the former are " pre-Veddas " in a chronological rather than in any direct phylogenetic kind of relationship. Both populations appear to have been subject to separate evolutionary pressures for a long period of time, but for reasons which are yet unknown the Balangodese phenotypic pattern did not persist into the historic period. It is the variety and nature of physical differences between these two populations that suggests their bifurcation from a common stem at a time several millenia prior to the occupation of Bellan Bandi Palassa. At the dawn of the historic period in Ceylon, the Veddas were in all probability distributed throughout the Island, save perhaps along the northern coastline, and as a dispersed population their phenotype reflected local variations as a consequence of isolation between the segments of their population. That the Veddas are simply the hybrid descendants of a crossing of Balangodese with Sinhalese or Tamils cannot be supported on the basis of the anthropometric and historic data, although the presence of a yet unidentified phenotypic element in Ceylon in the prehistoric period must not be entirely excluded from considerations of the Balangodese–Vedda phylogeny.

The cultural affinities of the Balangodese from Bellan Bandi Palassa are with the manufacturers of the lithic industries which have been assigned to the Indian Late Stone Age or its Ceylonese manifestation, the Bandarawelian. The number and kinds of similarities that exist between the prehistoric and Vedda cultures forcefully suggests the existence of a cultural continuum in Ceylon that extends into the historic period. Such traits as the use of iron and Sinhalese weapons by the Veddas of recent centuries find their parallels in the acquisition of painted pottery, ground stone tools, and perhaps other traits by the hunting-gathering and microlith-using Balangodese who may well have been introduced to these by trading peoples from coastal Ceylon and the Indian mainland. Further speculations of the biological and cultural affinities of this prehistoric population await additional research along these lines : (1) a resolution of the problem of what constitutes the Vedda phenotype apart from the traditional methods of defining this population, (2) an orientation of archaeological investigation in Ceylon that can demonstrate the role that the Vedda's have played in the manufacturing of the Island's prehistoric industries, (3) the mapping of Vedda occupation sites throughout the Island with the view of establishing the migration patterns and degree of mobility of the Veddas within the period of recorded history, (4) the recovery of additional osteological material from Ceylonese sites for the purpose of broadening our knowledge of the physical anthropology of the region. This present analysis of the Balangodese is an initial attempt to extend our understanding of the evolution of human populations during that interim which is marked by the close of the Pleistocene and the dawn of the historic period in southern Asia.

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PLATE 1

Specimen BP2/17. Unreconstructed calvarium cleared from its matrix. Left lateral aspect.


5 cm

PLATE 2

Specimen BP2/17. Unreconstructed calvarium cleared from its matrix. Left lateral aspect.


5cm

PLATE 3

Specimen BP2/17. Partial reconstruction of calvarium.
Frontal aspect.


5cm

PLATE 4

Specimen BP2/17. Partial reconstruction of calvarium.
Left lateral aspect.


5 cm

PLATE 5

Specimen BP2/17. Partial reconstruction of calvarium.
Right lateral aspect.

PLATE 6

Specimen BP2/17. Partial reconstruction of calvarium.
Superior aspect.


5 cm

PLATE 7

Specimen BP2/17. Unreconstructed maxilla. Palatal aspect.


5 cm

PLATE 8

Specimen BP2/171. Mandible. Left lateral aspect.


5 cm

PLATE 9

Specimen BP2/171. Mandible. Superior aspect.


5cm

PLATE 10

Specimen BP3/27–34. Partial reconstruction of calvarium. Left lateral aspect.


5 cm
B.P.3

PLATE 11

Specimen BP3/27–34. Partial reconstruction of calvarium.
Right lateral aspect.


BP3
27e
5 cm

PLATE 12

Specimen BP3/27–34. Partial reconstruction of calvarium.
Occipital aspect.


5cm

PLATE 13

Specimen BP3/27–34. Partial reconstruction of calvarium. Superior aspect.


5 cm

PLATE 14

Specimen BP3/27–34. Mandible. Superior aspect.


5cm

PLATE 15

Specimen BP3/27–34. Radiograph of mandible and the premolar and molar teeth. Right lateral aspect.


R