

# New Evidence of the Genus *Homo* from East Rudolf, Kenya. II

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**ABSTRACT** Eight specimens, attributed to *Homo*, from East Rudolf, Kenya, are described. They include two well preserved mandibles and a smaller mandibular fragment, a maxillary fragment, an associated talus and tibial fragment and collections of isolated teeth. Each specimen is described and the important ones are illustrated. These descriptions are not intended to be exhaustive; comparative studies and the results of more detailed examination of the material will be published in a monograph.

This preliminary account of fossils attributed to *Homo* recovered from East Rudolf, Kenya, in 1971 is intended to complement the descriptions given by Leakey, Mungai and Walker ('71, '72, '73), of australopithecine fossils from the same site. We feel that such positive generic attribution, prior to the completion of detailed study, is necessary in order to provide a framework for the discussion of the fossil material, but fully accept that evidence from future finds may necessitate modification of our classification.

The placing of the talus, and its associated tibial fragment, (KNM ER-813) in the genus *Homo* is considered justified on functional anatomical grounds, and these bones are described here in the belief that post-cranial material will prove to be at least as important as cranial evidence in the distinction between the evolutionary lineages of *Homo* and *Australopithecus*.

With the exception of KNM ER-817, which was found in area 123, all the other fossils described here were found in the Ileret and Koobi Fora areas.

The mandibles, KNM ER-820 and KNM ER-992, were found respectively below and above the Middle tuff complex in the Ileret area. This tuff complex lies above a normal geomagnetic event in the Matuyama reversed epoch; tentative identification of this event as the Olduvai means these fossils are younger than about 1.6. 10<sup>6</sup>BP.

The talus and tibia, KNM ER-813, were found in the Upper Member of the Koobi Fora formation, in a horizon between the KBS and Koobi Fora tuffs.

The stratigraphic situation of the fossils, with the exception of KNM ER-817, has been described elsewhere (Leakey, '72). Preliminary geological survey shows that KNM ER-817 comes from a horizon that correlates with the lower member of the Koobi Fora succession, but so far the KBS tuff has not been identified at this locality.

## DESCRIPTIONS

KNM-ER922 (Plate 1, A, B, C;  
plate 3, A)

This specimen consists of an adult mandible (broken in the region of the symphysis) with a well preserved dentition complete apart from three incisors.

Damage is restricted to the symphyseal region, the rami and the posterior part of both sides of the body. Breakage and displacement of bone at the anterior end of the body, especially on the left side, precludes accurate articulation of the hemi-mandibles, and requires that comments on the shape of the tooth row and dimensions of the whole mandible must await expert reassembly of the damaged area. The right ramus is represented by the region of the angle (*angulus mandibulae*), and a separate fragment that includes the lingula. The left ramus, more

TABLE 1  
Measurements of mandibular body  
of KNM-ER992<sup>1</sup>

Tooth	C	Right			M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>
		P <sub>3</sub>	P <sub>4</sub>				
Depth	37	33	32		32	35	37
Thickness	20	21	21		20	24	25

Tooth	C	Left			M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>
		P <sub>3</sub>	P <sub>4</sub>				
Depth	—	(33)	31		31	33	35
Thickness	22	21	20		20	22	24

<sup>1</sup> All measurements in millimetres. Depth measured from the alveolar margin to the base on the inner surface. Thickness measured at right angles to the long axis of the body. Estimates are given in parentheses.

nearly complete, carries also the coronoid process (*processus coronoideus*), but much of the bone around the base of that process is missing.

The mandibular body (*corpus mandibulae*) is well preserved, with the alveolar margin parallel to the base (*basis mandibulae*). Depth and thickness measurement are given in table 1. On each side the teeth lie in a row running obliquely across the mandibular body, from its outer margin anteriorly to the inner margin posteriorly, and, as seen from above, the long axis of the body intersects the tooth row between M<sub>1</sub> and M<sub>2</sub>. Anterior to this point the inner part of the body is thickened as a superior transverse torus which is maximally thickened at the level of the canine teeth. At the most anterior part of the right side of the body the torus is 18 mm thick, and its maximum convexity is 14 mm below the alveolar margin at that point. Posterior to the M<sub>1</sub>/M<sub>2</sub> junction the outer aspect of the mandibular body bulges and forms a rounded prominence at the base of the anterior border of the ramus on each side. The maximum convexity of this prominence is 15 mm below the alveolar margin, and 12 mm superior to a second, separate, tubercle. Leading anteriorly from both tubercles are low parallel ridges, the superior one leading to the mental foramen, the inferior to blend with the base. Between these ridges, and extending posteriorly from the symphysis to the root of the anterior border of the ramus, is a broad shallow depression. Similar areas in modern human mandibles give attachment to the depressor

anguli oris and depressor labii inferioris muscles.

A cross-section of the symphyseal region is seen on the fractured surface on the left half of the body, and shows a post-incisive planum leading inferiorly to a superior transverse torus. Between this, and a less well developed inferior transverse torus, is a genial fossa perforated in its base by vascular foramina. Inferior to the genial fossa, on the inferior transverse torus, are a pair of mental spines. The mental aspect of the cross-section is smoothly curved convexly from the alveolar margin to the base.

The single mental foramen (*foramen mentale*) is in line with P<sub>4</sub> on the left and between P<sub>3</sub> and P<sub>4</sub> on the right. It lies approximately 15 mm below the alveolar margin and 17 mm above the base, and is directed postero-superiorly with a rounded posterior border.

The base of the mandible bears a digastric fossa (*fossa digastrica*) extending from the symphysis posteriorly as far as the level of P<sub>4</sub>. It is some 20 mm long and 9.0 mm wide. Between the fossae of the two sides the base of the mandible is relatively prominent as a basal trigone. There are two other shallow grooves marking the base; the first is 15 mm anterior to the mandibular angle, and is for the facial artery. The second, 64 mm anterior to the angle, and more marked on the right side, corresponds to the groove in modern human mandibles occupied by the mandibular branch of the facial (VII) nerve. The inner aspect of the mandibular body is marked on each side by a roughened line for the attachment of the mylo-hyoid muscle (*linea mylohyoidea*); this is seen more clearly on the left, and is distinct below M<sub>2</sub> and M<sub>3</sub> but fades out anteriorly. At the level of M<sub>2</sub> and M<sub>3</sub> it is respectively 13 mm and 14 mm below the alveolar margin. Postero-inferior to the left mylo-hyoid line, and beginning 11 mm behind M<sub>3</sub>, is an antero-inferiorly directed mylo-hyoid groove. Inferior to the mylo-hyoid line, and deepest at the level of M<sub>1</sub>/M<sub>2</sub> is the submandibular fossa (*fovea submandibularis*).

The mandibular angles are preserved on both sides and project inferiorly to a lower level than the posterior part of the

mandibular body. The margin of the outer aspect of the angle is slightly flared, and bears raised, roughened, areas marking the limits of the masseteric fossa. The inner aspect of the ramus is marked by ridges running from the margin of the angle in the direction of the extra molar sulcus. The ridges originate from tubercles on the margin of the angle, and with them mark the attachment of the medial pterygoid muscle. The left ramus is only partly preserved, but its breadth can be measured between the maximum concavity of both anterior and posterior borders as 53 mm. The anterior border of the ramus runs anteriorly and slightly medially to the coronoid process, the apex of which is 78 mm above the base of the mandible. The vertical, plate-like part of the process is buttressed on its inner surface by a crest of bone, the crista endocoronoidea. This sweeps backwards and upwards from the lingual aspects of  $M_3$  and extends to blend with the apex of the coronoid process, inclining anteriorly as it does so. The anterior border of the ramus, though sharp inferiorly, broadens superiorly to a width of 5.0 mm. The inner side of this broader area is in the form of a crest which blends with the anterior border at a roughened area immediately posterior to the apex of the coronoid process. This buttressing relates to the attachment of temporalis, the marking for which extends down the anterior border of the ramus as far as the level of the occlusal surface of  $M_3$ . Between the superior part of the crista endocoronoidea and the mandibular notch (*incisura mandibulae*) is a triangular excavated area, presumably also part of the attachment of temporalis. The base of the lingula is preserved and is 28 mm behind the anterior border of the ramus. On the more complete left ramus the margin of the mandibular notch is damaged, but it is intact on the fragment of the right ramus that includes the lingula which is 21 mm below the undamaged notch. The loss of bone from the floor of the extra molar sulcus between the anterior border of the ramus and the base of the crista reveals the distal root and part of the mesial root of  $M_3$  — both broken and with their pulp cavities exposed. Matrix obscures the po-

sition of the mandibular canal on the left, but on the right it is seen on the fractured surface 10 mm below the alveolar margin.

The incisor teeth are represented by the crown and broken root of the left lateral incisor. Unequal wear of its occlusal surface has left the mesial side higher than the distal; the mesio-lingual and disto-lingual ridges have lost enamel after fossilization and there is a short, shallow, distal buccal groove. The left canine lacks the disto-lingual quadrant, but the right is complete. Both canines have been worn at the tip in an oblique manner — more so distally — exposing an area of dentine that is widest in the middle of the tooth and tailing off mesially and distally. Mesio-lingual and disto-lingual marginal ridges lead up from the gingival eminence, and there are mesial and distal buccal grooves. The crowns of the  $P_3$ 's are set obliquely in the tooth row. They have subequal cusps, buccal larger than lingual, with well-marked, equal-sized, anterior and posterior fovea, and dentine exposure on the buccal cusp. The cusps of the  $P_4$ 's are more symmetrical, but the buccal is still the larger of the two. The lingual cusp is situated mesially in the tooth, making the posterior fovea larger than the anterior. Dentine is exposed on both cusps. There are small contact facets between  $P_3$  and  $P_4$  and extensive facets between  $P_4$  and  $M_1$ .

The molar teeth are all in wear.  $M_1$  has dentine exposed on all cusps,  $M_3$  has no dentine exposure, and  $M_2$  has some. The five main cusps are present, in a Y pattern. There is a single lingual groove, most pronounced on  $M_1$ , and three buccal grooves: the middle deepest in  $M_3$  and the distal one in  $M_1$  and  $M_2$ . The  $M_3$ 's taper distally, the right bearing a proto-stylid adjacent to the mesio-buccal cusp, near the facet for  $M_2$ . The left  $M_3$  has a cingulum alongside the mesio-buccal cusp. The cingulum lies obliquely, and its posterior part is in the form of a proto-stylid.

The buccal surface of the pre-molar and first and second molar teeth show areas of hypoplasia. The situation of these areas on the teeth, nearest the occlusal surface in  $M_1$  and furthest in  $M_2$  indicate a single

TABLE 2

*Tooth measurements of KNM-ER992 in millimetres*

		Right					
Tooth		C	P <sub>3</sub>	P <sub>4</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>
M/D		9.3	9.2	8.6	11.9	13.2	13.0
B/L		9.3	11.2	11.1	10.7	12.5	12.1
		Left					
Tooth		I <sub>2</sub>	C	P <sub>3</sub>	P <sub>4</sub>	M <sub>1</sub>	M <sub>2</sub>
M/D		7.0	9.0	9.5	8.4	12.0	13.0
B/L		6.9	8.1	11.1	11.1	10.9	12.3

hypoplastic episode affecting the teeth at different stages in their development. The tooth row shows a pronounced curve of Spee with no evidence of canine projection. Wear is concentrated on the buccal side of the crowns, following a helicoidal curve. Radiographs (see plate 3A) emphasize the long roots of the teeth; for example, those of P<sub>4</sub> extend to within 9 mm of the base of the mandible. As is seen on the exposed left M<sub>3</sub> roots and also on the radiographs, the apices of the M<sub>3</sub> roots are not yet closed. Tooth dimensions are given in table 2.

#### KNM-ER820 (Plate 1, D, E; plate 3, B)

This specimen consists of a juvenile mandible with a well preserved body and dentition. Of the rami, the left is the more complete with the inferior border, up to, but not including the angle; the anterior border; most of the crista endocoronoidea and the inner aspect of the ramus inferior to the lingula preserved. On the right little is preserved, apart from the base of the ramus adjacent to the body and the inferior border extending posteriorly to the angle.

Bone is missing on the outer aspect of the left side of the body 10.0 mm posterior to the symphysis. The missing area is averagely 5.0 mm wide, and extends from the alveolar margin between I<sub>2</sub> and dC, vertically, down to the base, exposing the tooth germ of the permanent canine. The following teeth are in place in the mandible; four permanent incisors; two deciduous canines; four deciduous molars and two permanent first molars. The mandibular body is low and relatively wide, filled as it is with tooth germs. Depth and thickness measurements are given in table 3. The mental aspect of the symphysis is marked by a low keel which fades into a

TABLE 3

*Measurements of mandibular body of KNM-ER820<sup>1</sup>*

		Right					
Tooth		I <sub>1</sub>	I <sub>2</sub>	dC	dM <sub>1</sub>	dM <sub>2</sub>	M <sub>1</sub>
Depth		26	(25)	(25)	24	22	19
Thickness		16	(15)	(16)	15	14	17
		Left					
Tooth		I <sub>1</sub>	I <sub>2</sub>	dC	dM <sub>1</sub>	dM <sub>2</sub>	M <sub>1</sub>
Depth		26	24	24	22	21	18
Thickness		16	15	15	15	15	17

<sup>1</sup> All measurements in millimetres. Depth measured from the alveolar margin to the base on the outer surface. Thickness measured at right angles to the long axis of the body. Estimates given in parentheses.

shallow fossa at the base. On each side of this midline fossa are low, but distinct, tubercles. Together, the midline keel and the tubercles constitute a mental trigone. On the inner aspect of the symphysis there is a small depression in the bone some 3.5 mm above the base. This depression is overhung by a weak inferior transverse torus from which a median crest runs superiorly for 4.0 mm. On each side of this crest, which probably represents sagittal mental spines, are roughened depressions and small fossae for the attachment of the genial muscles. Superior to the fossae is a very slight superior transverse torus. The inner aspect of the symphysis thus rises vertically to 15 mm above the base, but above this point the surface slopes superiorly and anteriorly at an angle of 140° towards the alveolar margin. At the symphysis the maximum thickness of the bone is 16.5 mm and the depth is 27 mm.

The axis of the body is intersected by the tooth row as in KNM-ER992, but the juvenile mandible lacks the marked convex projection at the base of the anterior border of the ramus. The mental foramina

are at the level of the distal root of  $dM_1$ , 12 mm below the alveolar margin and 10 mm above the base. Each is directed antero-superiorly with a rounded anterior border. Major accessory foramina are present on both sides; on the left 5.0 mm antero-superior, and on the right 7.8 mm postero-inferior, to the main foramen. Inferior to the right lateral incisor there is a distinct impression on the mental aspect of the body. This is separated by a low ridge from a second impression, inferior to the first, and antero-superior to the mental tubercle. The base of the right part of the body shows a roughened digastric fossa extending 12 mm laterally from the symphysis; the left body is damaged in this area. The inner aspect of the right part of the body bears a mylo-hyoid line, extending from 4.0 mm posterior to  $M_3$  and sloping inferiorly to fade out at the level of  $dM_2$ . The line crosses a particularly thickened area of bone on the lingual aspect of the roots of  $M_1$ . Inferior to the mylo-hyoid line at the level of the distal edge of  $M_1$ , and 12 mm below the alveolar margin at that point, is a distinct tubercle approximately 2.5 mm in diameter. A second lower tubercle lies 5.0 mm anterior to it; radiographs indicate the projections may be due to the lingual roots of  $M_1$ .

The outer aspect of the left ramus is marked by a shallow masseteric fossa, leading anteriorly onto a convex swelling immediately posterior to the root of the anterior margin. The inferior margin of the ramus indicates that the mandibular angle would have been at a slightly lower level than the posterior part of the body. On the inner aspect of the ramus, the mandibular foramen is 17 mm above the estimated inferior border. Leading antero-inferiorly from it is a distinct mylo-hyoid groove, 13 mm long and 1.5 mm wide. The triangular area between the damaged base of the crista endocoronoidea and the bony ridge leading posteriorly from the buccal aspect of  $M_1$  to blend with the crista, is perforated by the gubernacular canal for  $M_2$ . The opening of the canal is 4.5 mm by 3.5 mm and is partly filled with matrix. Postero-lateral to it is the canal for  $M_3$ , much enlarged by damage to expose the matrix-filled crypt. The right ramus is broken through the  $M_3$  crypt.

The angle of the ramus is estimated at  $110^\circ$ – $115^\circ$ , and the estimated width between the mandibular angles is 70 mm.

The dental arcade is parabolic. The distances between the lingual aspects of the molar teeth are as follows:

Dimension	mm
$M_1$ – $M_1$	30
$dM_2$ – $dM_2$	27
$dM_1$ – $dM_1$	25

The permanent incisors are shovelled, with gingival eminences, from which run low mesio- and disto-lingual marginal ridges. The central incisors sit vertically in the mandible with contact facets between them. Wear on their incisal surface is greater distally. The lateral incisors are tilted anteriorly with their incisal surfaces ahead of those of the central incisors. The worn mesial part of the incisal surface is uniform, but the less worn distal part is lower and the mamelons are still distinct. There is chipping of the enamel of the incisors at their incisal margin; this is probably ante-mortem and is best seen on the right lateral incisor. Midway up the buccal surfaces of all the incisors, and extending neither to the mesial or distal margins of the teeth, are areas where the smooth enamel surface has been lost. These areas are palpably depressed, with irregular margins, and bases having the furrowed appearance of perikymata. There is a similar area on the enamel of the buccal surface of the mesio-buccal cusp of the left  $M_1$ . This, combined with the fact that the damaged areas on the incisors do not lie in a horizontal line across their buccal faces, for the mid-point on the lateral is below that on the central teeth, indicates that the lesions of the enamel are more likely to be due to hypoplasia, than to erosion or abrasion.

The crown of the left deciduous canine is badly damaged; the exposed root is 13 mm long and is beginning to be resorbed ahead of the developing permanent canine. The crown of the right deciduous canine is broken off, but the root is retained. Lingual to the broken root is the gubernacular canal of the permanent canine. Both deciduous first molars are well worn, wear being concentrated on the buccal side, and with crowns that

narrow distally. There is a distinct lingual groove, and contact facets for both the deciduous canine and the  $dM_2$ . On the lingual side of the  $dM_1$ 's, between the mesial and distal roots, are gubernacular canals for  $P_3$ .

The second deciduous molars are five-cusped teeth arranged in a Y pattern, with strong wear on the mesial and buccal aspects. There are three buccal grooves, the middle and distal are deeper than the mesial, and there is a single lingual groove. The right permanent  $M_1$  is complete, the left having lost enamel on the disto-lingual aspect of the tooth. They have five cusps, arranged in a Y pattern, with additional central cusplets. Wear is concentrated on the mesio-buccal cusp. There are two lingual grooves and three buccal, the distal of which is the deepest. Tooth dimensions are given in table 4. Radiographs, see plate 3B, reveal that the  $M_2$ 's are developing in their crypts and there is already a well defined crypt for  $M_3$  which, together with the pattern of erupted teeth, indicate an age of between 8–9 years, using eruption and tooth development in modern mandibles as a guide.

#### KNM-ER806 A–F

This is a collection of mandibular tooth crowns, found within a small area, and presumably from the same individual. Dimensions of the teeth are given in table 5.

TABLE 4  
Tooth measurements of KNM-ER820  
in millimetres

Tooth	Right				
	$I_1$	$I_2$	$dM_1$	$dM_2$	$M_1$
M/D	6.1	7.5	9.1	11.0	12.2
B/L	6.4	6.7	7.7	9.4	10.8
Tooth	Left				
	$I_1$	$I_2$	$dM_1$	$dM_2$	$M_1$
M/D	6.0	7.3	9.0	10.7	12.3
B/L	6.2	6.9	7.9	9.4	10.7

#### KNM-ER806 A

This tooth is a permanent left  $M_3$ . The crown tapers distally, and has a contact facet for  $M_2$ . The enamel is well preserved and has five main cusps arranged in an X fashion. This basic pattern is complicated by fissuring, with cusplets on the lingual border and subdivision of the distal cusp. Multiple grooves associated with the fissuring are seen on both buccal and lingual enamel surfaces. The tooth is moderately well worn, wear being concentrated on the buccal side.

#### KNM-ER806 B

This tooth is a permanent left  $M_2$ , with contact facets for  $M_1$  and  $M_3$ . It has five cusps, arranged in a Y pattern, with a large cusplet between the mesial and distal lingual cusps. There is a deep middle buccal groove, and three lingual grooves. Adjacent to the mesio-buccal cusp the cingulum is arranged as a protostylid, the enamel of which is pitted. The buccal side is worn more than the distal.

#### KNM-ER806 C

This specimen is a permanent left  $M_1$ , with contact facets for  $P_4$  and  $M_2$ . There are six cusps, the additional cusp being a well demarcated seventh cusp. The fissure pattern is complicated by the extra cusp and a cusplet on the distal aspect of the mesio-lingual cusp, but it is a basic Y pattern. Multiple lingual grooves are associated with the additional cusps, and there is a particularly deep middle buccal groove. Wear is concentrated on the buccal side.

The excellent coaption of the contact facets for KNM-ER806 A–C indicates their derivation from the same mandible. The wear pattern follows a helicoidal curve, and there is little difference in the amount of wear on  $M_1$  and  $M_2$ .

#### KNM-ER806 D

This specimen is a permanent right  $M_3$ . There are five cusps arranged in a + pat-

TABLE 5  
Tooth measurements of KNM-ER806 in millimetres

Tooth	Left				Right	
	$P_3$	$M_1$	$M_2$	$M_3$	$P_3$	$M_3$
M/D	9.2	13.7	14.3	14.7	8.6	14.0
B/L	10.8	12.6	13.1	12.1	11.2	12.2

tern, and although the hypoconulid is large the tooth narrows distally. The enamel on the lingual surface is marked by an oblique line, running up near to the occlusal margin at its mesial end. There are multiple buccal grooves, and at the junction of the distal and buccal surfaces there is a small protostylid.

#### KNM-ER806 E/F

These are respectively right and left lower  $P_3$ 's. Both have damaged distal enamel shelves, and the right has a chip in the enamel of the mesial shelf. The buccal cusps are larger than the lingual, and are worn to expose the dentine; the left is worn more than the right. On the distal end of the buccal cusp is a small cusplet, separated from the main cusp by a groove. A ridge connects the buccal and lingual cusps, and there are contact facets for c and  $P_4$ .

#### KNM-ER807 (Plate 2, E)

This specimen is a fragment of the body of a right maxilla, including the posterior part of the alveolar process (*processus alveolaris*) with  $M^2$  and  $M^3$  and the adjacent postero-lateral part of the palatine process (*processus palatinus*).

The alveolar process bears the complete  $M^3$  and the damaged roots and distal half of the crown of  $M^2$ . The enamel of the crown of  $M^2$  is worn, but there is no exposed dentine. Part of the fissure separating the mesial and distal buccal cusps is preserved, as is the slightly deeper fissure delineating the distal lingual cusp. These fissures connect with their respective mesial and distal buccal grooves; there are shallower grooves delineating the disto-buccal cusp, and a single lingual groove. The enamel is discoloured on both lingual and buccal aspects, with small hypoplastic areas on the buccal aspect, related to the mesial buccal groove.

Although matrix now separates  $M^2$  and  $M^3$ , there are smooth areas of enamel on the contiguous surfaces of the teeth which indicates they were in contact. The two buccal roots of  $M^2$  are seen in the floor of the maxillary sinus and are broken at their tips to expose the pulp cavity. The more distal root diverges postero-laterally from the mesial root; the lingual root is not exposed. The tooth crown is too frag-

mentary to make a useful estimate of the mesiodistal length; the bucco-lingual width is approximately 14 mm.

The crown of  $M^3$  is complete, and smaller than that of  $M^2$  and measures 11 mm mesio-distally and 13 mm buccolingually. Only two main cusps are well defined, the mesio-lingual and mesio-buccal. Fissures in the enamel isolate a central cusp, and the distal shelf of enamel is in the form of six cusplets, with associated multiple distal grooves. The closed tips of the two buccal roots of  $M^3$  can be seen in the floor of the maxillary sinus (*sinus maxillaris*), and are directed slightly posteriorly. Both teeth have fracturing of the enamel above the neck; this is probably due to prolonged post-mortem exposure of the teeth before fossilization. The crowns of both teeth are worn more on the lingual side, but the disto-lingual part of the  $M^3$  crown shows no wear facet, just minute pitted areas.

Posterior to the  $M^3$  is a large maxillary tuberosity (*tuber maxillae*), damaged at its tip, but extending at least 12 mm behind the distal root of  $M^3$ . Supero-medial to the tuberosity is the articular surface for the perpendicular plate of the palatine bone. Anterior to this is the maxillary margin of the opening of the greater palatine canal (*sulcus palatinus major*). The canal is 3.5 mm in diameter and leading anteriorly from it, and marking the body of the maxilla, is a distinct groove for the greater palatine vessels. A smaller, shallower groove marks the adjacent part of the palatine process. The palate is deep; the vertical height from the surface of the palatine process to the level of alveolar margin at  $M^3$  is 17 mm. Anterior to  $M^2$ , the bone of the alveolar process is damaged, and replaced by matrix; there is no sign of the roots of  $M^1$ .

#### KNM-ER808 A-G

This collection of teeth, found at one

TABLE 6  
Tooth dimensions of KNM-ER808  
in millimetres

Tooth	Left		Right		
	dI <sup>1</sup>	dI <sup>1</sup>	P <sup>3</sup>	J <sup>2</sup>	M <sup>1</sup>
M/D	5.0	5.7	8.7	7.9	(13.2)
B/L	4.8	4.9	12.5	7.7	13.0

site, are part of the maxillary dentition of an immature individual. Dimensions of the crowns are given in table 6.

#### *KNM-ER808 A and B*

These specimens are the worn crowns, and part of the roots, of deciduous left and right central incisors. The incisal surfaces slope upwards in a mesial direction. On the buccal surface of the right tooth, just inferior to the cervical line, are areas of damaged enamel. The mesio-distally flattened roots are broken to expose the pulp cavity.

#### *KNM-ER808 C*

This is the crown of an unerupted P<sup>3</sup>.

#### *KNM-ER808 D*

This is the complete crown of an unerupted permanent right lateral incisor. The crown is shovelled, with prominent mesio-lingual and disto-lingual marginal ridges that meet near the base of the crown; between them is a mid-line groove. The incisal surface is inclined so that the crown is deeper mesially than distally.

#### *KNM-ER808 E*

This is the distal half of the crown of an unerupted permanent left lateral incisor.

#### *KNM-ER808 F*

This is a flake of enamel from the buccal surface of an unerupted permanent central incisor.

#### *KNM-ER808 G*

This is the incomplete crown of a permanent right first molar; the enamel between the two mesial cusps is missing. There is wear on the lingual aspect of the distal cusps, and on the undamaged part of the mesio-lingual cusp. A ridge connects the mesio-lingual and the disto-buccal cusps.

There are other fragments, one of which may be part of the crown of a deciduous molar.

#### *KNM-ER809*

This is a collection of tooth fragments found in close proximity. They include part of the buccal surface of a lower incisor, a badly damaged lower molar crown

and KNM-ER809 A, the crown of a lower molar.

#### *KNM-ER809 A*

This crown of a permanent lower left M<sub>1</sub> is missing the distal part of the enamel. The remaining four cusps are arranged in a Y pattern; and have undergone moderate wear, leaving the mesio-lingual cusp prominent. A contact facet for P<sub>4</sub> can be seen, and there are small areas of enamel hypoplasia and chipping on the mesial, lingual and buccal aspects of the enamel. The estimated mesio-distal length is 12.5 mm and the bucco-lingual breadth is 12.7 mm.

#### *KNM-ER813 (Plate 2, A, B, C, D)*

This material consists of a right talus and a fragment of right tibial shaft that were found in association.

*Talus.* This specimen is a nearly complete right talus. The major damaged areas are the infero-medial aspect of the head (*caput*) and the postero-lateral part of the body (*corpus*), where both the posterior tubercle (*processus posterior tali*) and parts of the lateral and trochlear articular surfaces have been lost.

The dorsal aspect of the body of the talus is covered by the trochlear articular surface, which does not extend onto the neck (*collum*) of the talus. The medial and lateral margins of the trochlear surface blend with the respective articular surfaces, and are curved, convex laterally. The medial margin extends posteriorly to the medial tubercle; the posterior part of the lateral margin is damaged and where cortical bone is lost, trabeculated bone is exposed. The anterior width of the trochlear surface is 23 mm and its length measured at the mid-point of the anterior border is 31 mm. The surface is convex from before backwards and concave from side to side. The antero-posterior groove is centrally placed, so the medial and lateral margins are symmetrical, in contrast to their relative asymmetry as seen, for example, in Olduvai Hominid 8.

The medial surface is covered on its superior part by a comma-shaped articular surface for the medial malleolus. Although the anterior margin of this surface is damaged, it does not appear to have extended onto the neck. It flares out from the body,

but has no concave anterior facet as seen in the anthropoid apes. Inferior to this articular surface the bone anterior to the medial tubercle is roughened, and slightly elevated, for the attachment of the deltoid ligament.

The lateral surface of the body is smooth for articulation with the lateral malleolus. This articular surface is damaged at its anterior and posterior angles, and the tip of the lateral process is missing. The surface is concave from above downwards, and slightly convex from before backwards. The estimated maximum projection of the intact lateral process is 8.0 mm.

The posterior surface is damaged; the posterior tubercle and the bone crossed by *M. flexor hallucis longus* are missing.

The inferior surface of the body is covered by two articular surfaces, separated by the sulcus tali. The roof of the obliquely lying sulcus is marked by vascular foramina, and becomes shallower posteriorly, to end by blending with the articular surface. The complete posterior calcaneal articular surface runs in a postero-medial direction across the base of the body. It is 24 mm long and 18 mm wide, and concave in its long axis. The articular surface antero-medial to the sulcus extends onto the inferior surface of the neck and is continuous with the articular surface of the head. Its medial part is missing, as are the medial aspects of the head and neck of the talus. Though there is continuity between the articular surfaces of the head and the anterior and middle calcaneal articular surfaces, they do not form a continuous curve but are angulated at their junctions.

The neck of the talus projects medially, making an angle of  $14^\circ$  to the long axis of the body. The head of the talus is covered by articular surface convex in both its long and short axes, and though incomplete, the angle of torsion can be estimated at  $49^\circ$ .

The morphology of the talus is entirely compatible with it belonging to a form that was habitually bipedal; indeed, the bone is similar in many ways to modern *Homo tali*.

*Tibia.* This is the distal section of a right tibial diaphysis. The specimen is cracked but has been reconstructed with the minimum of residual distortion. Much

of the subperiosteal bone is damaged but some morphological details remain.

The proximal fractured surface is a section of tibial shaft just below its midpoint. The section shows a parabolic anterior border separating the medial and lateral surfaces. Though damaged proximally, the medial border is represented distally by an irregular ridge of bone. The posterior surface is subdivided by the very distal extension of the vertical line, which marks the attachment of the aponeurosis covering *M. tibialis posterior*. The interosseus border is seen only at the proximal end of the fragment as a slight roughening of the subperiosteal bone. The dimensions of the bone at its proximal end are:

	A/P	M/L
Shaft	30 mm	21 mm
Medullary cavity	10 mm	9.0 mm

The broken distal end has an irregular surface; within the outer compact bone cancellous bone is visible indicating proximity to the distal epiphysis. The anterior border and the medial surface incline medially at the distal end of the fragment; this flaring is presumably related to the medial malleolus. The length of the fragment is 12 cm, and though there is slight antero-posterior bowing, there is no detectable torsion.

#### KNM-ER817 (Plate 2, F, G)

This specimen is part of the left side of a mandibular body, containing the roots of two teeth and the alveoli for three more. It is weathered, with loss of the compact bone of the bodies, and damaged, especially at the alveolar margin, making the identification of the sockets and remaining root elements very difficult.

The anterior surface of the specimen is broken between the canine and the lateral incisor. The fractured surface shows an inferior transverse torus, and a convex mental border, which is incomplete due to the damaged alveolar margin. The trabeculated bone exposed at the fractured surface is filled with matrix; the maximum thickness of the bone at the broken surface is 19 mm. The posterior broken surface is an oblique fracture through the level of  $M_2$ . The mandibular canal is exposed, partially filled with matrix, and situated 10.0 mm above the base and

equidistant from the outer and inner surfaces of the body.

The outer aspect of the body is perforated by a single mental foramen, situated between the socket of  $P_4$  and  $M_1$ . The foramen is directed superiorly with a rounded superior border, and its centre is 14 mm above the base. Posterior to the mental foramen the outer aspect of the body flares laterally, away from the line of the tooth row, so that the long axes of this part of the body and the tooth row diverge posteriorly. The base of the mandible, below the mental foramen, is marked by two transverse grooves, anterior to which the bone of the base is more prominent and roughened. On the inner aspect of the mandible, between this roughened area of the base and the inferior transverse torus, is a digastric fossa.

The damaged alveolar margin bears the roots of  $M_1$ , the broken root of  $M_2$  in a matrix filled cavity and the alveoli for  $P_4$ ,  $P_3$  and canine. The alveoli of these latter teeth are incomplete, as the buccal side of the alveolar margin is missing. They were filled with matrix, except for the alveolus for  $P_3$  which still retains some root at its apex. The alveolus for  $P_4$  is the most complete; it is oval in section, flattened mesio-distally and directed slightly mesially. The mesial and distal roots of  $M_1$  are seen in section as dumb-bell shaped, the grooving being more marked on the distal surface of the mesial root and the mesial surface of the distal root. They measure approximately 9.0 mm bucco-lingually, and are not parallel, the distal root lying obliquely so its lingual end is closer to the mesial root. The root of  $M_2$  is incomplete; the loss of its buccal component exposes a fractured surface. The remaining lingual component of the root is dysplastic; it is short with a swollen, curving tip that is directed posteriorly. It is not clear why there should be a matrix-filled cavity around the  $M_2$  root. Depth and thickness measurements in millimeters are:

Tooth	$P_3$	$P_4$	$M_1$
Depth	30	30	29
Thickness	16	18	18

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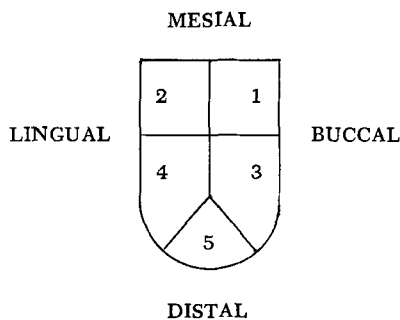
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#### APPENDIX

Molar teeth have been described in this paper using the following system.

- (1) Cusps have been numbered so:



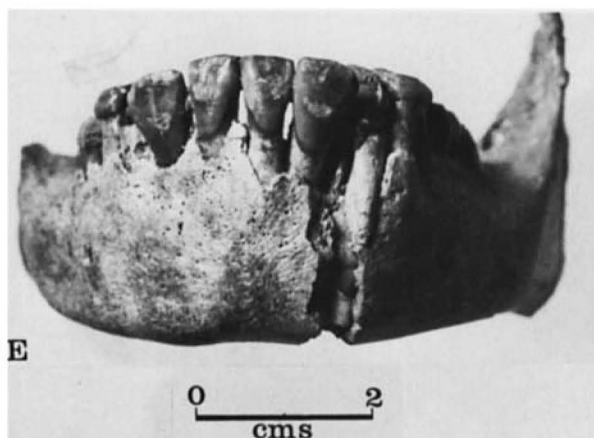
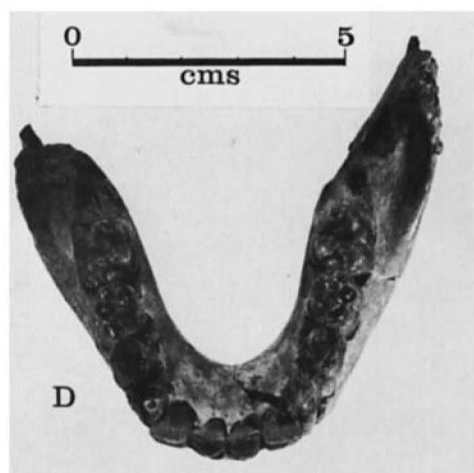
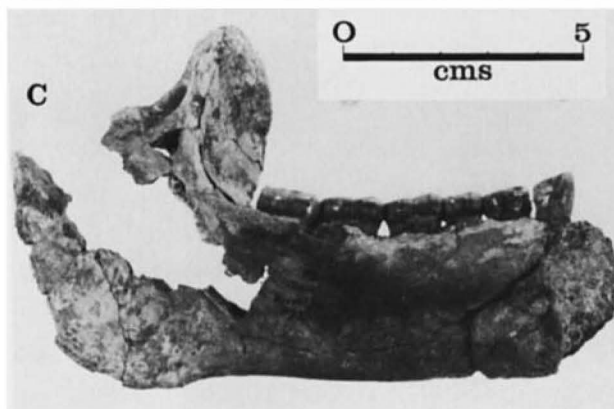
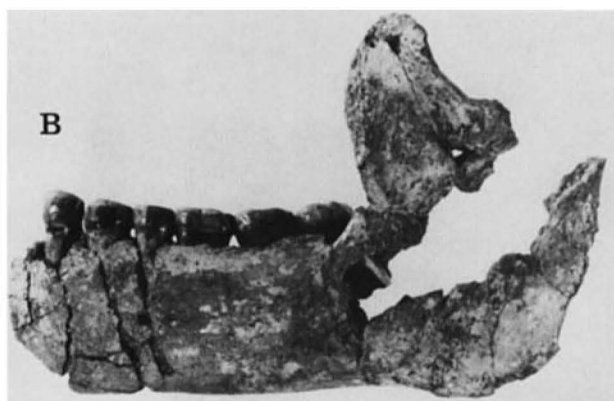
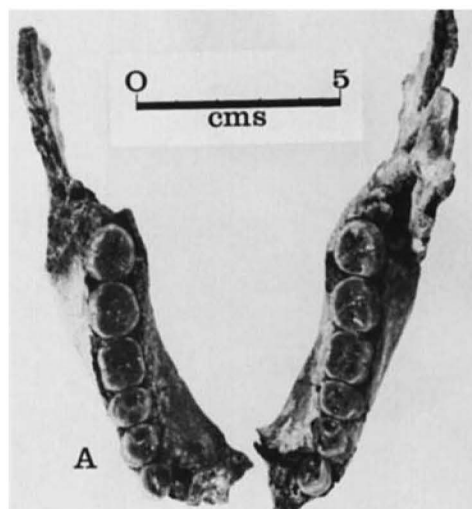
- (2) Additional distal and lingual cusps are numbered 6 and 7 respectively.

- (3) Cusp pattern:

+, cusps 1, 2, 3 and 4 all are in contact

Y, cusps 2 and 3 are in contact

X, cusps 1 and 4 are in contact



EXPLANATION OF FIGURES

A-C Occlusal, left lateral and left medial views of mandible KNM-ER992.

D-E Occlusal and anterior views of mandible KNM-ER820.

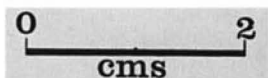
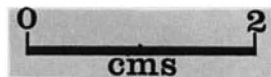
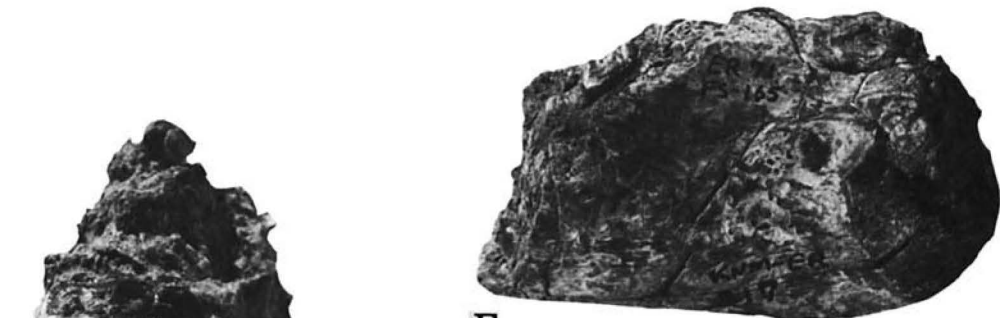
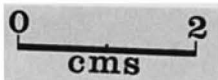
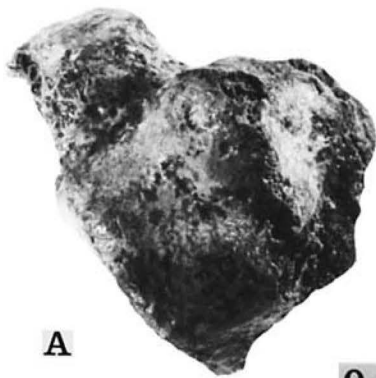
PLATE 2

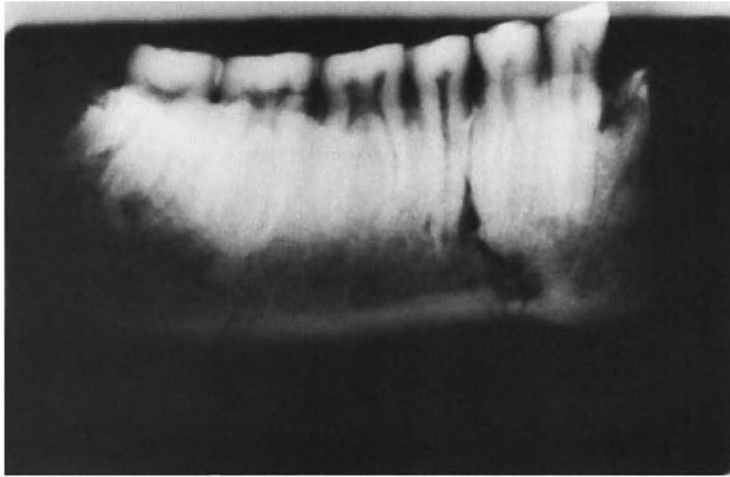
EXPLANATION OF FIGURES

A-D Superior, inferior, lateral and distal views of talus KNM-ER813.

E Occlusal view of maxilla KNM-ER807.

F-G Medial and lateral views of mandible KNM-ER817.





EXPLANATION OF FIGURES

- A Radiograph. Lateral view of right side of mandibular body of KNM ER-992.
- B Radiograph. Inner oblique view of left side of mandibular body of KNM ER-820.