NEW DISCOVERIES ABOUT *SINANTHROPUS PEKINENSIS* IN CHOUKOUTIEN*

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I. Introduction

From the beginning of the Choukoutien excavation in 1927 to 1937 when it was stopped by the outbreak of the Anti-Japanese War, teeth, pieces of skulls, fragments of femur, humerus, clavicle and lunate bone of hand belonging to *Sinanthropus pekinensis* had been recovered. But all the fossil materials were lost during the War.

Soon after the liberation of Peking in 1949, the long-stopped excavation in Choukoutien was resumed through the support and encouragement of the People's Government. In 1937 the Choukoutien site was explored to the bottom of level 29 and a layer of subsequent débris of some 30 cm in thickness had to be removed before getting the surface of level 30. In September 1949, in removing the deposits three teeth of *Sinanthropus* were found in them, a first and a second lower molar, and an upper medial incisor. Judging from the nature of the loose deposits and the state of fossilization of the teeth, we think that the specimens were apparently embedded originally in level 27 which remains in the south-east part of the site of excavation. In 1951 an upper premolar was excavated in level 30. In the same year, in searching the bone fragments of Choukoutien materials collected before the War, we found two fragments of humerus and tibia. In 1953 one more upper premolar was recovered in the loose materials formerly excavated. It was not found in its original site. But from the state of fossilization of the specimen and the separate placement of all the deposits excavated in Choukoutien, we can be sure that the tooth belongs also to *Sinanthropus.*

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*First published in Chinese in *Acta Palaeontologica Sinica*, Vol. II, No. 3, pp. 267-288, 1954.

Since the restoration of the Choukoutien excavation in 1949, 5 teeth and two fragments of humerus and tibia have been obtained so far. The present paper is a description based on these materials.

II. Description of Material

A. *Teeth*

The tooth types are given in abbreviations by selecting the first letter of the name. The numeral following the letter designates the order of the tooth within its group. The numeral placed at the upper or lower corner of the letter stands for the upper or lower tooth. For instance, M_1 stands for a first lower molar. Teeth of the right and left sides are designated by abbreviations rt and lt respectively.

The 'height' of the crown is the distance between the tip or the cutting edge of the tooth and the lowest boundary of the enamel on the buccal surface. In lower molars it is the distance between the tip of the protoconid and the neck line. In case of roots, 'height' expresses the distance between the apex and the neck line. The 'length' is the medio-lateral diameter in incisor and the antero-posterior diameter in premolar and molar. The 'breadth' represents the bucco-lingual diameter.

The five teeth were all found in isolated conditions being not connected with jaw fragments. All teeth bear human characters and undoubtedly belong to *Sinanthropus pekinensis*. The state of preservation of all the tooth specimens is excellent, with the exception of one which is a little damaged. None of the specimens shows any indication of decay. Weidenreich[9] divided the *Sinanthropus* teeth into two types. The large type belongs to male individual and the small, to female. It is probably right by recalling that there is an enormous size discrepancy between the males and females of gorillas and orang-utans, though the difference is reduced in the chimpanzee. Of the present five tooth specimens, the incisor and the molars belong to the large type and hence are of male sex, and the other two premolars belong to the small type and hence are of female sex. Judging from the size and shape of the crown and root, the degree of attrition of the occlusal surface and the site of recovery, we can assure that the left medial upper incisor and the left first and second lower molars belong to one individual, while the right upper first and second premolars belong to another individual. The teeth are listed in table I according to their types.

Table 1. Teeth of *Sinanthropus pekinensis*

Catalogue no.	Type	Side	Sex	Age	Degree of attrition	Individual
AN. 519	I^1	lt	♂	Adult	Moderate	Same individual
AN. 517	M_1	lt	♂	Adult	Moderate	
AN. 518	M_2	lt	♂	Adult	Moderate	
AN. 520	P^1	rt	♀	Adult	Moderate	Same individual
AN. 521	P^2	rt	♀	Adult	Moderate	

1. *Left medial upper incisor* (Fig. 1; pl. I, 1)

The tooth specimen is well preserved with its chewing surface moderately worn off. Though the tooth was found in isolated condition, yet the characteristics of its form made it possible for its correct determination. It is the left medial upper incisor belonging to the large type and hence pertaining to male individual.

The medial incisor is characterized by its large crown. The buccal surface is strongly convex in both sagittal and transversal directions. The lingual surface is strongly shovel-shaped due to the sides being not only strongly thickened but also folded around lingualward. The crown ends in a slightly curved cutting edge instead of a fairly straight one as in recent man. The lateral and medial borders are meeting together on the lingual surface by a strong median eminence, the so-called basal tubercle (tuberculum dentale). This tubercle slopes towards the middle pit of the surface and its free border toward the cutting edge is divided into several finger-like prolongations which gradually end in the pit. The lateral border continues to the cutting edge in a distinctly outward curved line, while the medial border is relatively more straight and meets the edge nearly at a right angle. The right and left teeth can thus be distinguished.

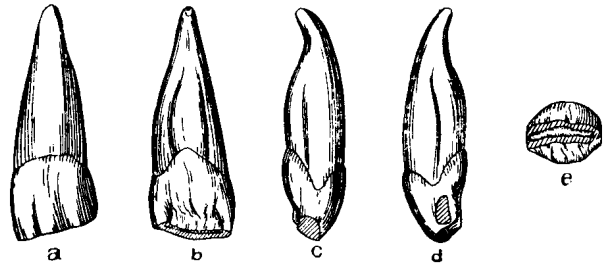

Fig. 1. *Sinanthropus*, left medial upper incisor, 1/1.
a. buccal view, b. lingual view, c. medial view,
d. lateral view, e. occlusal view.
(lingual side downward).

The root of the medial upper incisor is conical in shape. It is thick and round and gradually tapers towards the tip. But before reaching the tip it abruptly constricts. Each side of the root bears an indication of a longitudinal shallow furrow, being more marked on the lateral side. The neck part of the root is wide but slightly flattened on its bucco-lingual direction. It continues almost directly into the crown without any constriction. The boundary between the crown and the root lies at the same level on both the buccal and the lingual sides.

The longitudinal axis of the root and that of the crown of *Sinanthropus* are almost in a straight line, while in recent man they form an obtuse angle. This feature is probably connected with the prognathism of the upper jaw. Because of the strong prognathism in *Sinanthropus,* the crown of the incisor does not recede lingualward as in recent man, thus bringing the biting surfaces of the upper and the lower incisors into proper relation.

Table II. Measurements of the left medial upper incisor

	Height (mm)	Length (mm)	Breadth (mm)
Crown	(10.7)*	10.7	8.1
Root	24.0	8.3	7.7

*Numerals within brackets refer to crown which is partly worn off. Weidenreich[9] gave the height of the crown of an unworn tooth as 13.3 mm.

The left medial upper incisor of *Sinanthropus* when compared with that of recent man reveals other characteristic differences. Both crown and root are larger; the crown is higher and longer, but the breadth is about the same; the neck line is less marked; the root is higher and more robust in all dimensions. The distinct shovel-shape of the lingual surface of the medial upper incisor of *Sinanthropus* is much more like that observed in recent Mongolian race than in recent European types.

In recent man the lingual tubercle projects more or less at its base but its finger-like prolongations toward the deepened lingual surface vary considerably.

Weidenreich[9] thought that pronounced lingual tubercles with finger-like prolongations represent primitive characters of hominid medial incisors and that these features undergo a gradual reduction until they are almost completely lost in the course of human evolution.

In the medial incisor of all great apes such as gorilla, orang and chimpanzee, the lingual surface shows a shovel-shaped appearance. The lingual tubercle is especially strongly developed in gorilla and its finger-like prolongations extend to the cutting edge. In orang and chimpanzee, the tubercle is usually more simple. Thus, the lingual tubercle in the special

form as in *Sinanthropus* is a characteristic feature of the anthropoid incisor. It has the tendency to reduce in the course of human evolution together with the general reduction of the size of the whole tooth.

2. *Right upper premolars*

In recent man the upper premolars may be distinguished from the lower ones chiefly by the differences in the outlines of their chewing surfaces, those of the former being rounded and of the latter, more oval. In *Sinanthropus* the premolars can also be distinguished in this way. Both premolars dealt with here are small in size and hence belong to female individual. The two premolars correspond perfectly in size and shape of their crowns as well as of their roots and in the degree of attrition, surfaces of contact, tint and degree of mineralization, it can thus be certain that they belong to the same individual.

(1) Right upper first premolar (Fig. 2; Pl. I, 2)

The right upper first premolar of *Sinanthropus* is characterized by its great size and robustness of both crown and root. The crown is much more developed in bucco-lingual direction than in antero-posterior one and is divided by a deep longitudinal furrow into a larger buccal and smaller lingual moiety, both of which carry large cusps. The lingual cusp is smaller and lower than the buccal and inclines more toward the anterior. When viewed from the anterior or posterior side, it may be seen that both buccal and lingual surfaces strongly incline toward the tip of their respective cusp. The buccal half of the occlusal surface is mitral in shape while the lingual one is triangular. The enamel of the crown reaches further upward on the buccal side than on the lingual. The entire basal part of the buccal side projects and continues into a triangular swelling, the apex of which merges with the tip of the buccal cusp. Each of the sides of the swelling is bordered by a faint depression, and these again are bounded by ridges. The lingual surface is globular. There are no depressions or bordering ridges. On the occlusal surface there are two main ridges running on each side from the tips of the two cusps downward and toward the intermediate longitudinal furrow. They represent the cutting edges of both cusps. The slopes of the buccal and lingual cusps face each other. They are uneven and are covered by two or more secondary ridges descending from the tips of the cusps.

Table III. Measurements of the right upper first premolar

	Height (mm)	Length (mm)	Breadth (mm)
Crown	(9.0)	8.7	11.9
Root	16.6	5.9	12.0

The root of the premolar is short and broad. It is strongly developed in bucco-lingual direction. The root is clearly divided into two branches on the posterior side except its basal part. But on the anterior side it is divided only in the apex, the remaining portion showing a shallow wide longitudinal furrow, indicating the tendency of dividing into buccal and lingual branches. The two branches are about equal in size. Their tips bend slightly toward each other. The root as a whole is very stout and bulges a little above the middle of its height in both buccal and lingual directions. The neck is slightly constricted. The enamel reaches considerably further upward on the buccal than on the lingual side, thus the neck line is convex downward on both the anterior and the posterior sides.

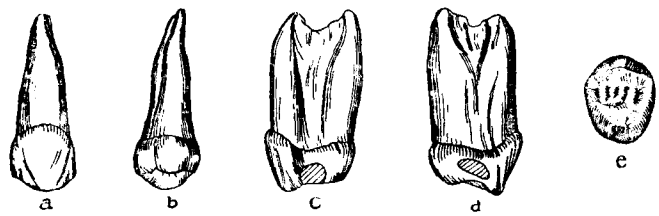

Fig. 2. *Sinanthropus,* right upper first premolar. 1/1.
a. buccal view, b. lingual view, c. medial view,
d. lateral view, e. occlusal view.
(lingual side downward).

When compared with the specimen of recent man, the upper first premolar of *Sinanthropus* is much more robust in size. Its crown is higher, longer and broader. The chewing surface of the first upper premolar in the average European races is very smooth and regular, being separated by a small longitudinal groove. In recent Chinese the chewing surface is mostly smooth, but in a small number of cases, the buccal moiety of the occlusal surface may present a marked median transverse ridge, extending from the buccal cusp to the longitudinal groove. On both sides of the ridge there is a secondary ridge, thus the occlusal surface roughly resembles that of *Sinanthropus.* The root of the upper first premolar of recent man is lower, narrower and a little shorter than that of *Sinanthropus.*

There are no principal differences between the upper first premolar of the *Sinanthropus* and that of anthropoids except the greater size and height of the crown of the latter. The general shape of the teeth, the development of the cingulum, the special pattern of the chewing surface and the arrangement of the branches of the root are practically the same.

(2) Right upper second premolar (Fig. 3; pl. I, 3)

The right upper second premolar is a little smaller than the first. The

lingual cusp is not so inclined to the anterior as that of the first premolar. The occlusal surface is about oval in shape. The triangular swelling on the buccal side of the crown is in the median position and does not shift to the anterior as that of the first premolar. The cingulum on the buccal side extends down to the cutting edge.

The general pattern of the occlusal surface is similar to that of the first premolar. A median ridge is present in the bucco-lingual direction, and thus dividing the occlusal surface into an anterior and a posterior moiety. The arrangement of the secondary ridges is also similar to that of the first premolar. The only difference is that the secondary ridges of the first premolar are mainly in the transversal or bucco-lingual direction, while those of the second are mainly in the longitudinal or antero-posterior direction.

Table IV. Measurements of the right upper second premolar

	Height (mm)	Length (mm)	Breadth (mm)
Crown	(7.3)	8.2	11.7
Root	17.7	5.4	11.5

The root is divided into two branches at its apex. On each of the anterior and posterior surfaces there is a longitudinal shallow groove, separating the root into two nearly equal parts, a buccal and a lingual portion.

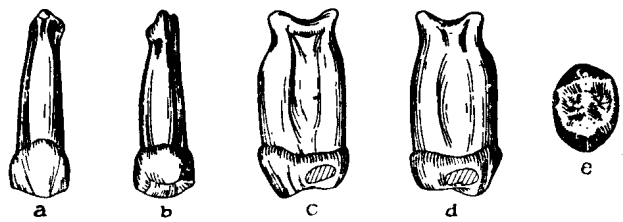

Fig. 3. *Sinanthropus*, right upper second premolar. 1/1.
a. buccal view, b. lingual view, c. medial view,
d. lateral view, e. occlusal view
(lingual side downward).

When compared with recent man, the crown of the upper second premolar of *Sinanthropus* is much larger, longer and broader. The cingulum is not present in recent man and the ridges of the occlusal surface are always entirely lacking or are very much simplified. The root of recent man tapers off on all sides from the neck to the apex equally and it is not so wide as in *Sinanthropus*. The root is not divided, but there are shallow grooves on both

the anterior and the posterior sides, indicating the tendency of dividing into buccal and lingual branches.

Since the right upper first and second premolars are quite similar, the difference between the first premolar of *Sinanthropus* and that of anthropoids holds good for the second premolar too.

(3) Left lower first and second molars (Figs. 4, 5; pl. I, 4, 5)

In recent man the left second lower molar is smaller in size and simpler in pattern than the first. But in *Sinanthropus* the two lower molars closely resemble, and thus they are described together. Though the present tooth specimens were found isolated, yet by considering their size and shape, degree of attrition, state of mineralization and the coincidence of the facets of their contact surfaces, they can be assigned as the left first and second lower molars of the same individual.

The crown of the first or second molar of *Sinanthropus* is characterized by its lowness in relation to its length and breadth. Combined with this peculiarity is the marked convexity of all four outer surfaces of the crown, especially of the buccal surface.

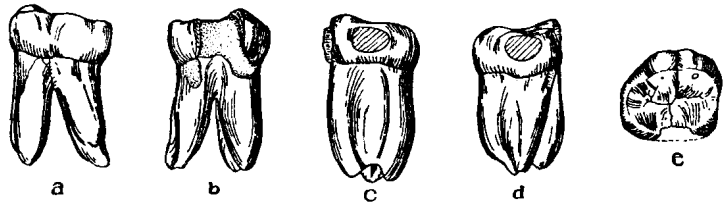

Fig. 4. *Sinanthropus*, left lower first molar. 1/1.
a. buccal view, b. lingual view, c. medial view,
d. lateral view, e. occlusal view.
(lingual side downward).

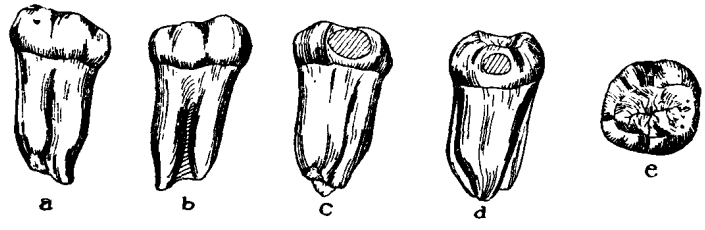

Fig. 5. *Sinanthropus*, left lower second molar. 1/1.
a. buccal view, b. lingual view, c. medial view,
d. lateral view e. occlusal view.
(lingual side downward).

Weidenreich[9] reported that the trigonid of the lower molar is broader than its talonid. In the present first molar the trigonid breadth cannot be measured due to the injury on the lingual side, while in the second molar the trigonid is equal to talonid in breadth as seen in table V.

Table V. Measurements of the left first and second lower molars

Crown

	Height	Length	Breadth	Length-breadth index	Trigonid breadth	Talonid breadth	Trigonid index	Talonid index
M_1	(6.0)	12.7	(12.0)	—	—	(11.6)	—	—
M_2	(6.0)	12.3	11.8	96.4	11.8	11.8	95.8	95.8

Root

	Height		Length			Breadth		
	Anterior	Posterior	Total	Anterior branch	Posterior branch	Total	Anterior branch	Posterior branch
M_1	15.1	14.1	10.6	4.9	5.0	10.8	10.8	9.5
M_2	16.1	17.0	10.8	4.4	4.8	10.9	10.8	9.4

Though both molars are of considerable attrition, yet the complicated pattern of the wrinkles of each cusp can still be seen. Both molars have five cusps and belong to the "Dryopithecus pattern". All five cusps encircle an oblong inner area, the chewing surface proper. There is no tubercle 6. The inner slopes of all cusps are covered by wrinkles, i.e., by accessory ridges and furrows. Each cusp has usually three or three groups of wrinkles, the middle one being the largest, while those on either flank are smaller.

It may be seen from Table V that the first and second molars are similar in size.

The root of the molar is very strong. The root of the first molar is composed of an undivided portion forming the neck part of the root and a divided portion represented by two branches, an anterior and a posterior. The two branches of the second molar are fused together on the buccal side only with a median shallow depression indicating the tendency of branching, but on the lingual side, greater part of the root is divided into an anterior and a posterior

branch. The anterior branch is shorter but broader than the posterior one (Table V). The anterior branch bifurcates into two separated tips, whereas the posterior one ends in a single blunt apex.

The *Sinanthropus* molars show distinct anthropoid characters, such as the presence of a cingulum on the buccal surface, the enamel descending deeper on the lingual side, the arrangement of the cusps in a Dryopithecus pattern, the inner slopes being covered with wrinkles, etc.

When the *Sinanthropus* molars are compared with those of recent man, the striking point of the latter is the disproportionally large and stout crown with small and feeble root, while in *Sinanthropus,* the root shows the same degree of development in all dimensions as the crown. The crown in recent man is relatively high. There is no cingulum. The number of cusps reduces to four and the chewing surface is smooth.

B. *Extremity bones*

1. *Humerus* (pl. II)

The present specimen is a small fragment of the middle portion of the shaft of a right humerus. It is 107 mm long. The breakages at both ends are very irregular and apparently occurred prior to mineralization. The robustness of the bone and the sharpness of the contours suggest a male individual.

The proximal and distal ends of the fragment (pl. II) show a marked discrepancy in robustness. The proximal end is stout and nearly round in outline, while the distal end is slender and nearly triangular. There is a marked radial groove. Based on a fragment of a left specimen Weidenreich[10] asserted that the most characteristic feature of the shaft of *Sinanthropus* humerus is the size and form of the deltoid tuberosity. It is represented by a long and narrow triangular projection of the antero-lateral surface, the medial border of which is formed by an elongation of the crest of the great tubercle, while its apex continues into the anterior border of the shaft. Two crest-like elevations border the triangular projection and outline its contours. The two crests unite at the apex and continue jointly into the anterior border of the shaft. Between the two crests, the surface is groove-like. In the present specimen there is a well developed deltoid tuberosity but with no crest-like elevations. At the midshaft level, the contour of the bone is oval. Its antero-posterior diameter is 21.6 mm, transverse diameter 17.8 mm, midshaft circumference 62.0 mm and the index 82.4 (Table VI). Of the left humerus, Weidenreich[10] gave the antero-posterior diameter as 20.7 mm, the transverse diameter 15.4 mm, the midshaft circumference 59 mm, and the index 74.4 (Weidenreich mistook it for 73.5). The present specimen is thus a little bigger than that reported by Weidenreich (Table VI).

Table VI. Measurements of the shaft of humerus

Type	Author	Side	Sex	No.	Midshaft		
					Transverse diameter	Ant.—post. diameter	Index
Sinanthropus	Present	rt	♂	1	17.8	21.6	82.4
Sinanthropus	Weidenreich	lt	♂	1	15.4	20.7	74.4
Düsseldorf (cast)	Weidenreich	rt	♂	1	19.3	24.5	78.8

Compared with recent man, the *Sinanthropus* humerus shows no peculiarity either in size or in shape, the bulkiness and special pattern of the deltoid tuberosity being rarely found in recent Europeans or Chinese. The only true difference between the *Sinanthropus* humerus and that of modern man lies in the inner structure. The medullary cavity of the shaft is much narrower and the walls considerably thicker than they appear in modern man. According to Weidenreich[10], the diameter of the cavity at the narrowest place amounts to only 22% of the entire transverse diameter of the shaft against 50% in modern man. Although the cavity dilates noticeably toward the proximal end, its diameter increasing to 64% of that of the shaft, it still remains narrower than in modern man for whom the diameter occupies 71% of that of the shaft. The present specimen is only a small fragment of the middle third of the shaft, the cavity of the distal end occupying about 46% and that of the proximal, 61%.

Compared with the stout humerus of the Neanderthal group, the *Sinanthropus* humerus is straighter and slimmer (Table VI). A comparison with the humerus of the anthropoids shows that the *Sinanthropus* humerus is as different from it as the humerus of modern man. Not a single feature does *Sinanthropus* reveal a true anthropoid character.

2. *Tibia* (pl. II)

The present specimen is a small fragment of the lower middle portion of the shaft of a left tibia with a length of 83 mm. The general form and proportion and the particular character of its surface allow no other conclusion than that the fragment is human, as these features are completely different not only from the corresponding parts of the great apes but also from all other animal humeri found in Choukoutien.

Owing to the smallness of the fragment, a brief description can only be made here. The anterior and medial borders of the specimen are well preserved, but the lateral border and its neighboring medial and posterior surfaces are somewhat damaged by the biting of carnivora. Both ends of the fragment are about equal in robustness. Judging from the anterior border,

the fragment corresponds to that portion of the modern tibia where the anterior border deviates medialward at both ends, that is, the lower part of the S of the S-shaped anterior border. The medial border is mostly complete, being smooth and rounded. Though the lateral border is somewhat damaged, yet it can still be seen that there is no marked interosseus crest. This agrees with the blunt anterior and medial borders. The medial surface is smooth and slightly bulging. About the midshaft level, the antero-posterior diameter is 27.0 mm, the transverse diameter, 21.0 mm, the circumference, 178.0 mm, and the index, 77.8 (euryknem type), as shown in Table VII.

Compared with recent man, the tibia of *Sinanthropus* differs greatly in its blunt anterior border from the sharp S-shaped shin crest of modern human bones. The cross-section of the shaft is also prismatic in shape, but due to the convexity of the medial surface and the indistinctness of the borders, it is much more blunt than that of modern man. Apart from these features, one of the most striking characteristics of *Sinanthropus* tibia is the extraordinary thickness of the walls and the narrowness of the medullary cavity. The present fragment of tibia is almost entirely occupied by the spongy bony tissues with only a trace of the medullary cavity at its proximal end. In modern man, the walls are very much thinner and the cavity is correspondingly wider. The cavity in recent man extends greater part of the shaft of the tibia except at both ends where are filled with spongy bony tissues.

It is known that the width of the medullary cavity depends on age to a certain extent. Individuals of advanced age may have larger medullary cavities than younger persons due to the progressing reduction of the spongy substance and the constant diminishing of the inner layer of the compact tissues. But even in the tibia of modern child the cavity is proportionally much larger and its walls are much thinner than those of *Sinanthropus*. It is interesting to note that this characteristic feature was shared by the humerus as mentioned above and also by the femur as reported by Weidenreich[11]. The present authors incline to think it to be a special primitive character and will deal with the problem in another paper.

The tibiae of Neanderthals are short and strong. The shape of the tibial shaft in Neanderthal man is reminiscent of apes in that the sharp S-shaped shin crest of modern human bones is but slightly developed or absent, and the cross-section of the shaft is oval instead of prismatic. In *Sinanthropus* the S-shaped curvature of the anterior border is present though not well developed, the tibial shaft is slender and its cross-section is bluntly prismatic. Thus the tibia of *Sinanthropus* is quite different from that of Neanderthals.

The most interesting point is that the tibia of *Sinanthropus* closely resembles that of Solo Man found in Ngandong, Java. Oppenoorth[7] reported that the right tibia excavated on Ngandong terrace is slender and straight. The shape of its shaft in the middle is primitive and the sharp shin crest of

modern man is undeveloped. Weidenreich[11] concluded that the Ngandong skulls resemble those of *Pithecanthropus*. Since *Pithecanthropus* and *Sinanthropus* are closely related, the conspicuous likeness in the tibiae of *Sinanthropus* and Solo Man shows a similar conformity.

Table VII. Measurements of the shaft of tibia

Type	Side	Age	Midshaft		
			Transverse diameter	Ant.—post. diameter	Index
Sinanthropus	lt	Adult	21.0	27.0	77.8
Solo Man (cast)	rt	Adult	22.7	28.0	81.1
H. mousteriensis (cast)	lt	Young	23.0	25.5	90.0
Spy Man (cast)	lt	Adult	26.7	31.0	86.0
Modern Chinese	lt	Adult	19.6	27.0	72.6
Modern Chinese	rt	10 yr.	14.5	15.0	96.7
Gorilla	rt	—	26.0	22.3	116.6
Orang	lt	—	16.0	16.0	100.0
Chimpanzee	rt	—	10.4	12.5	83.2

A comparison of the tibia of *Sinanthropus* with the anthropoids shows marked difference. The tibia of the latter is oval or rounded in cross-section and presents no S-shaped sharp anterior border.

It is very interesting to note that a discrepancy exists thus between the humerus and the tibia of *Sinanthropus* as regards congruity with the limb bones of modern man. Whereas the humeri of both *Sinanthropus* and modern man are, but for the inner structure, almost identical, the tibia, though much like a human one in appearance, possesses some peculiarities which definitely distinguish it from that of modern man.

III. The Congruity of the Results of the Study of *Sinanthropus Pekinensis* and Engels' Theory of the Transition from Ape to Man

Engels[3] in the introduction of his famous work "Dialectics of Nature"

writes: "When after thousands of years[1] of struggle the differentiation of hand from foot, and erect gait, were finally established, man became distinct from the monkey . . . " Here Engels clearly points out that the specialization of the hand causes the differentiation of hand and foot. Again Engels says that "step by step with the development of the hands went that of the brain". Thus the development of the brain closely follows the differentiation of hand and foot.

The results of the study of *Sinanthropus pekinensis* by the present authors and others[1, 9, 10, 11] agree completely with Engels' theory of the transition from ape to man. The upper extremity of *Sinanthropus* is represented so far only by humerus, clavicle and os lunatum. The humeri of *Sinanthropus* and modern man are almost identical except its inner structure. The clavicle and os lunatum bears surprising similarity to those of modern man[10].

The *Sinanthropus* femur does not differ in length and robustness from that of modern man. The linea aspera, indicative of the erect posture, is present. However, it possesses some peculiarities. It is slightly bent, with the apex of the bend below the middle of the shaft at the place of smallest circumference, while in modern man the constriction of the femur usually occurs at, or fairly near, the midpoint of the shaft. It also shows marked front-to-back flattening in the subtrochanteric region (upper fifth of the shaft). In consequence of the pronounced platymeria of this region, both the medial and the lateral borders of the *Sinanthropus* femur shaft assume the shape of fairly prominent cristae. This platymeria is somewhat reminiscent of the conditions in the great apes. The femur shaft of *Sinanthropus* shows in its upper half a distinct medial convexity of the medial border, as the same in chimpanzee femur. The extraordinary thickness of the walls and the relative narrowness of the medullary cavity is only approached by the femur of orang-utan. Some of these peculiarities may also be found individually in modern man, but their combination is characteristic of *Sinanthropus*. The tibia of *Sinanthropus* also conforms to the femur. It is definitely human in form and appearance, but possesses also some primitive characters as mentioned above.

There are even greater differences in teeth and skulls between *Sinanthropus* and modern man. Teeth of *Sinanthropus,* whether crowns or roots, are much bigger than those of modern man. The cingulum persists in the two canines and in all premolars and molars. In premolars and molars, the chewing surfaces are covered with complicated wrinkles. These are anthropoid characters. In modern man, the cingulum and the wrinkles

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1) The geological time-scale is longer than was believed some seventy years ago. "Millions of years" would be more correct.

mostly disappear and the teeth are greatly simplified and much more smoother.

The skull of *Sinanthropus* possesses many primitive features. The greatest breadth of the skull vault is low down on the side walls of the skulls, just above the ears. The forehead is receding. The cranial sutures appear to close at an earlier age than in modern man. All these are ape-like characters. There are marked sex differences between the jaws and teeth, and skulls of *Sinanthropus*. Big teeth, heavy jaws, and very thick skull parts belong to males; and the thinner, more fragile bones and small teeth, to females. In modern large anthropoids, there is an enormous size discrepancy between the males and females. The average cranial capacity in *Sinanthropus* is 1075 cc which is considerably smaller than that of modern man. However, the skull of *Sinanthropus* as a whole possesses more primitive human characters than anthropoid ones.

From the results of the study of the *Sinanthropus pekinensis* mentioned above, it can be clearly seen that the upper extremity bones are almost identical with those of modern man; the lower extremity bones are in general similar to those of modern man but also possess some distinct primitive characters; and the teeth and skulls are much more primitive than those of modern man, the cranial capacity being much smaller. The upper extremity or hand, due to labour, differentiates first and foremost toward the direction of modern man. Owing to the operations of the hands, the upper extremity differentiates from the lower one and hence the latter lags behind the former in development toward the direction of modern man. The differentiation of the extremities is followed by the development of the brain and the brain case and thus the skulls and jaws and teeth still retain many primitive characters. The studies of *Sinanthropus pekinensis* therefore further enrich Engels' theory of the transition from ape to man and testify to the truth that "labour created man himself".

IV. Summary

1. The present paper is a description based on *Sinanthropus* materials including 5 teeth and two fragments of humerus and tibia recovered since the restoration of the Choukoutien excavation in 1949.

2. The *Sinanthropus* teeth are divided into two types. The large type belongs to male and the small, to female. Of the present 5 tooth specimens the incisor and the molars belong to the large type and hence are of male sex, and the other two premolars belong to the small type and hence are of female sex.

3. Teeth of *Sinanthropus,* whether crowns or roots, are much bigger than those of modern man.

4. The left medial upper incisor bears well-developed basal tubercle on the lingual surface. The lingual surface is strongly shovel-shaped.

5. The upper premolars are robust in size. Their chewing surfaces are covered with wrinkles of special pattern.

6. The crown of the first or second lower molar is characterized by its lowness in relation to its length and breadth. Pronounced cingulum presents on the buccal surface of the crown. Their roots are very strong.

7. The humeral shaft is almost identical with that of modern man. The only true difference is that the medullary cavity of the shaft is much narrower and the walls considerably thicker than they appear in modern man. Besides, it shows bulky deltoid tuberosity.

8. The tibial shaft is slender. The anterior border is blunt. The cross-section of the shaft is bluntly prismatic. The walls are extraordinarily thick and the medullary cavity is very narrow. The tibia is quite different from that of Neanderthals, but it closely resembles that of Solo Man.

9. The results of the study of *Sinanthropus pekinensis* by the present authors and others clearly show that the upper extremity bones of *Sinanthropus* are almost identical to those of modern man; the lower extremity bones are definitely human in form and appearance, but possess also some primitive characters. The teeth and skulls bear many primitive features. The cranial capacity is considerably smaller than that of recent man. It formulates that due to labour, due to the operations of the hands, the upper extremity differentiates from the lower one. The differentiation of the extremities is followed by the development of the brain and the brain case. These results further enrich Engels' theory of the transition from ape to man and testify to the truth that "labour created man himself".

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