Vol. III, No. 3 VERTEBRATA PALASIATICA Sept., 1959

HUMAN FOSSILS FOUND IN LIUKIANG, KWANGSI, CHINA

Woo Ju-kang

(*Institute of Vertebrate Paleontology, Academia Sinica*)

I. Discovery and General Observation

In the middle of September, 1958, while digging for phosphorus fertilizer, workmen of the Sinhsing Farm discovered a fossil human skull and a part of the postcranial skeleton in the Tungtienyen Cave of Liukiang District, Kwangsi Chuang Autonomous Region. The cave is in a hill located about 16 kilometers southeast of Liuchow, by the west side of the Liuchow-Shilung Highway.

Mammalian fossils found in the same cave in association with the human remains include a nearly complete skull of *Ailuropoda melanoleucus*, a complete skull of *Hystrix* and teeth and fragments of limb bones of *Rhinoceros sinensis*, *Stegodon orientalis*, *Megatapirus*, *Sus*, *Ursus* etc. as identified by Dr. Pei Wen-chung.

No artifact was found in the cave.

Informed by the authority of the Farm about the important discovery, the Institute of Vertebrate Paleontology sent Messrs. Lin Yi-pu and Li Yiu-heng for surveying the site.

According to the report of Li, the human fossil was found near the entrance of the cave, close to the locality where the complete skeleton of *Ailuropoda* was discovered. At the time of surveying, only a small part of the fossiliferous deposits in the cave was remained. It is mainly composed of loosely cemented limestone breccia intercalated with sands and clays and is of grayish brown color.

The human skull was embedded in the deposits of unconsolidated breccia which is markedly different from the hard yellowish deposits containing abundant vertebrate fossils usually found in caves of Kwangsi.

Vertebrate fossils associated with the human fossils belong to the *Ailuropoda-Stegodon* fauna commonly found in South China caves. They are generally considered to be Middle Pleistocene age before. Recently, Pei suggests that the vertebrate fossils of the South China caves may be divided into three different geological ages, i.e. Early, Middle and Late Pleistocene. As the skull of *Ailuropoda* was found in a site in close proximity to that of the human skull and both were adhered with reddish matrix which is different from the consolidated yellowish deposits yielding the other vertebrate fossils, it seems reasonable to assume that the fossil human skull together with that of *Ailuropoda* are later than Middle Pleistocene. As the fossil human skull is definitely

fossilized and of *Homo sapiens* type, it can be assumed that it is of late Pleistocene age.

The human skull is nearly complete except parts of the zygomatic arches on both sides. The mandible is missing. The axial skeleton preserved consists of the lower four thoracic vertebrae, all the five lumbar vertebrae to which were adhered five segments of ribs in different lengths, and also the sacrum. All are of grayish white color and moderately fossilized. The appendicular skeleton is composed of a fairly well-preserved right hip bone except the pubic portion, also of grayish white color and two fragments of the right and left femur bones which are of darker color than the other human fossils and mixed with dark patches of different shape and size.

All main sutures on the skull are moderately closed. The teeth are well worn. It represents an individual of about 40 years old.

The skull is fairly big. It had fairly big brow-ridges and slightly receding forehead. The glabella region is thick. Both frontal and parietal eminences are not marked. The muscular ridges are weak. The mastoid portions are massive but with small mastoid processes. In the whole, the skull seems to belong to a male individual.

The vertebrae are relatively small. The sacrum is medium in width. Its upper part curves slowly, but its lower one does more abruptly. Its auricular surface extends downward to the level of the third sacral vertebra. This also indicates its male sex.

The hip bone is also small and smooth. The acetebulum distinctly faces forward. The iliac portion is relatively spreading, but the iliac fossa is rather shallow. The auricular surface of the hip bone coincides with that of the sacrum. It indicates that they belong to the same individual of male sex.

The femur fragments are slender. Their sex is not certain.

As the axial skeletons and the hip bone were found together with the skull, and their color and state of fossilization are quite similar, we may assume that they represent one individual. The femur fragments are darker in color. Whether they belong to the same individual as the skull and the axial skeletons is hard to determine. But judging from the fact that all fossil human materials came from the same locality and there is no duplication of any bone, we may assume that they all belong to one and the same individual of male sex and middle age.

II. Description of the Human Fossils

1. The skull

The skull is ovoid in shape when viewed from above. The widest part lies at the posterior one third. Both the parietal and the frontal eminences are not prominent. The skull vault is not gable-roof shaped. The occiput bulges behind and above it is a flattened area. The mastoid process is diminutive and nipple-shaped on the right side.

Above the process is a well defined supramastoid groove and a definite supramastoid crest. The mandibular fossa is shallow.

The skull is 189.3 mm long, 142.2 mm wide; the cranial index (75.1) is mesocranic. The basion-bregma height (134.8 mm) is medium.

The length of the frontal arc is 136.5 mm. It is much longer than 1/3 (374.0/3= 124.7 mm) of the total median sagittal arc from nasion to opisthion, which is 374.0 mm in the Liukiang skull. This shows that the position of bregma of the Liukiang specimen is more posterior than that of modern man in which it lies at about the junction of the anterior and the middle 1/3 of the whole arc.

The Liukiang specimen has a calvarial height index of 42.9, a bregma position index of 44.2, a bregma angle of 45° and a frontal angle of 76.5°. It is seen from Table 1 that the Liukiang skull is more primitive than the Tzeyang skull found in Szechuan Province.

Table 1 Comparison of Skull Measures of Different Human Fossil Types

(All after Kroeber, except the Tzeyang and Liukiang skulls)

Groups	Calvarial height index	Bregma position index	Bregma angle	Frontal angle
Living races	51—59	——	——	——
8 Cro-Magnon	46—55	28—37	46—57°	74—90°
Tzeyang	45.3	41.8	47.5°	81°
Liukiang	42.9	44.2	45°	76.5°
9 Neandertal	33—43	33—40	38—49°	50?—74°
Sinanthropus 2, 3, 10, 11, 12	35—41	37—42	38—45°	56—63°
Pithecanthropus 1, 2	33—37	36—43	38—43°	48—55°

The facial portion of the Liukiang skull shows many characteristics. The face is broad (bizygomatic breadth 136.0 mm) and short (upper facial height 65.9 mm).

The orbits are broad and low. The orbital breadth from the maxillo-frontale point is 42.0 mm on the left and 43.1 mm on the right. The orbital height is 28.7 mm on the left and 29.0 mm on the right. Thus the orbital index is 68.3 on the left and 67.3 on the right. Both belong to the chamaeconch type. The orbits are obtuse-angled and differ from the round-angled ones of modern Mongoloids.

The measurements of the facial flatness follow Woo and Morant.

The internal bi-orbital breadth between the right and the left fronto-malare orbitales of the Liukiang skull is 98.8 mm which is larger than the modern male Chinese (96.1 mm). The subtense of the nasion from the chord is 15.5 mm. Thus the frontal

index of facial flatness is 15.7. The angle between the lines joining the nasion and the right and left fronto-malare orbitale points is 143.5°. According to Roginsky and Levin this angle has marked racial differences. It is 135—137° in average in the Europoid race, 140—142° in the Australo-Negroid race and 145—149° in the Mongoloid race. By this angle, the Liukiang skull is intermediate between the Mongoloid and the Australo-Negroid races.

The nose is low and wide. The nasal length is 45.8 mm, the nasal breadth, 26.8 mm and the nasal index 58.5. It belongs to the hyperchamaerrhine type.

The nasal bones are large and broad and the nasal bridge is slightly concave.

The simotic chord of the Liukiang skull is 10.6 mm and the simotic subtense, 3.0 mm with the simotic index 28.3. The magnitude of the simotic chord exceeds any living races. The simotic subtense of the skull is higher than that of the modern Chinese (male 2.4 mm and female, 1.8 mm).

The simotic index is considered to be a racial character. It is 20—45 in the modern Australo-Negroid race, 31—49 in the Mongoloid race and 46—53 in the Europoid one. It is interesting to note here that this index (28.3) of the Liukiang skull falls within the range of the Australo-Negroid group.

However, the nasal bones of Mongoloid nose are generally very flat at the root and broad. The bridge is also low and the nasal profile is predominantly concave. The lack of any depression at nasion is also a Mongoloid feature.

The lower borders of the piriform aperture are not sharp but guttered. The prenasal fossae are shallow as in many Mongoloids. The anterior nasal spine is rather small.

There are only traces of the canine fossae.

The cheek bones are fairly large and protruding, although not nearly as prominent as in most Mongoloids.

Alveolar prognathism is moderate.

The palate is of ordinary size. It is short, broad and shallow and horseshoe-shaped. The shortness of the palate is in part due to the fact that the third molars have not erupted. The teeth are of ordinary modern dimensions. As they are well-worn, whether the upper right middle incisor is shovel-shaped or not is not known, but the upper lateral incisors have clear indications to show their shovel-shaped characters.

2. The axial and appendicular skeleton

The axial skeleton preserved is the lower four thoracic vertebrae to which were adhered four fragments of ribs in different lengths, the whole five lumbar vertebrae and the sacrum. The rib fragment adhered to the right side of the last thoracic vertebra is the posterior half of the 12th rib. It can be ascertained from it that the last rib is of considerable length.

The lower four thoracic vertebrae and the first lumbar vertebra were still kept in

meric index (73.7) is hyperplatymeric.

According to Weidenreich the average platymeric index of *Sinanthropus* is 67.85, that of the Neanderthalians, 75.6 and that of modern North Chinese, 80.2. It is seen that this index of the Liukiang specimen is close to that of the Neanderthalians.

At the mid-shaft level of the right femur shaft, the transverse diameter is 22.5 mm, the sagittal diameter, 26.2 mm, and the circumference, 80.0 mm. The pilastric index is 83.3.

The left femur fragment is 122.5 mm long and corresponds to the upper half of the shaft. At the mid-shaft level, the transverse diameter is 22.0 mm, the sagittal diameter, 26.2 mm, and the circumference, 80.0 mm. The pilastric index is 84.0.

As the specimen is broken off close to the middle of the shaft, the medullary canal is clearly exposed and it is thus afforded to examine the proportions between the thickness of the wall and the caliber of the medullary canal.

In Table 2, the index of the robusticity of the left femur fragment of the Liukiang specimen is given and is compared with that of Upper Cave specimens of Choukoutien and of *Sinanthropus* femurs given by Weidenreich and with that of the Hsiatsaohwan fossil human femur fragment of late Pleistocene reported by Woo and Chia. It is seen from the Table that the Liukiang specimen has its indices smaller than those of the Upper Cave and the Hsiatsaohwan femurs, but larger than those of the *Sinanthropus* specimens. The smaller the index, the greater the relative narrowness of the medullary canal. The relative thickness of the walls and the narrowness of the medullary canal of the femur are considered to be a primitive character and thus the Liukiang specimen clearly shows its primitiveness in this respect.

Table 2 Index of robusticity of the femur wall

Type	Trans. diam. of		Sag. diam. of		Index of the	
	the canal	entire shaft	the canal	entire shaft	trans. diam.	sag. diam.
Upper Cave of Choukoutien (average)	11.3	23.8	15.8	33.6	46.9	47.0
Hsiatsaohwan	11.0	25.5	10.9	22.6	43.1	48.2
Liukiang	8.0	22.0	10.0	26.2	36.4	38.2
Sinanthropus (average)	8.13	28.3	8.68	24.4	32.9	37.6

The linea aspera on either the right or the left femur fragments is more concentrated and marked.

The right femur shaft bends forward with the vertex of the curvature at its middle part, as in modern man. The medial borders of the proximal parts of both the right and the left femur fragments appear edged, though not so prominent as in *Sinanthropus*.

articulated condition. The ventral heights of the centra of thoracic vertebrae are as follows (in mm):

T.9 20.0, T.10 20.5, T.11 21.0, T.12 22.5. It is seen from these measurements that the heights increase from above downward.

The lower four lumbar vertebrae and the sacrum were kept in normal articulated position. The ventral heights of the centra of the lumbar vertebrae are as follows (in mm):

L.1 23.6, L.2 24.5, L.3 21.0, L.4 25.0, L.5 25.0. The total length of the lumbar vertebrae is 119.1 mm. In general, the heights of the centra increase from above downwards except the third lumbar vertebra.

The upper 2/3 of the ventral surface of the sacrum is fairly flat, but its caudal part is markedly curved forward. This is characteristic for male sex.

The ventral length of the sacrum is 92.2 mm, the ventral breadth 86.5 mm, so the sacral index (93.8) is dolichohieric. The foramina, as seen from the ventral surface, are large, in contrast to their appearance on the dorsal surface.

The dorsal surface of the sacrum is strongly convex and rough. The sacral hiatus at the termination of the sacral canal extends upward to the middle of the third sacral vertebra while in modern man, it generally extends upward to the fifth and sometimes to the fourth sacral vertebra.

The position of the sacro-iliac auricular surface corresponds to the sides of the first, second, and third sacral bones. This surface is 56 mm long and 32 mm across at its widest part on the left side, and 54 mm long and 31 mm wide on the right side. The highest point of the wing of the sacrum rises considerably above the promontory.

The Liukiang skull is fairly big as mentioned above. It seemed to require a more robust vertebral column than that just described. It is of interest to note here that Rhodesian Man of South Africa had a big skull with a small sacrum.

The right innominate bone is fairly well-preserved. Only the superior and inferior rami of the pubis and the inferior ramus of the ischium are broken off.

The anterior border of the hip bone is sinuous. It is 187.0 mm high. The height of the anterior superior iliac spine from the acetabular border is 59 mm. The maximum width of the great sciatic notch is 48.0 mm.

The area of the auricular surface is large. Inasmuch as this auricular surface fits well with the sacrum just described, we may assume that these are parts of the same skeleton.

Two fragments of the femur shaft are preserved, one right and one left.

The right fragment is 214.0 mm long. It corresponds to the upper 3/4 of the shaft. Its upper end is broken below the level of the lesser trochanter.

At the subtrochanteric level of the right femur fragment, the transverse diameter is 28.5 mm, the sagittal diameter, 21.0 mm, and the circumference, 83.0 mm. So the platy-

III. Discussion and Conclusion

The Liukiang skull is mesocranic (75.1), but verges to the extent of dolichocranic. The position of bregma is much more posterior than that of modern man. The brow-ridges are fairly big and the forehead is slightly receding.

The face is broad and short with corresponding broad and low orbits. It is interesting to note that most of the Upper Palaeolithic specimens found in many parts of the world, such as the Keilor skull of Australia, the Wadjak skulls of Java, the Cro-Magnon skulls of Europe, the Asselar skull of Africa and the Upper Cave skulls of Choukoutien are characterized with broad and low faces in which are naturally implanted low and broad orbits. For if the face is broad and low, the orbits are necessarily of similar proportions. In Neanderthalians, the faces are generally high and the orbits are correspondingly so. However, according to the reconstructions of Weidenreich, *Pithecanthropus* and *Sinanthropus* had short faces and low orbits.

The Liukiang skull has the angle (143.5°) between the lines joining the nasion and the right and left fronto-malare orbitale points intermediate between the Mongoloid and the Australo-Negroid races. Its simotic index (23.9) is very low and falls within the range of the Australo-Negroid group.

On the whole, however, the Liukiang specimen shows clearly its Mongoloid racial affinities.

The skull is mesocranic. The cheek bones are fairly large and protruding. The nasal bones are flat and broad. The nasal bridge is slightly concave and there is not any depression at nasion. The lower borders of the piriform aperture are not sharp but guttered. The prenasal fossae are shallow. The anterior nasal spine is rather small. There are only traces of the canine fossae. Alveolar prognathism is moderate. The upper incisors are shovel-shaped. All these are Mongoloid features.

The femur of the Liukiang Man had much thicker wall and narrower medullary canal than those of modern man and approaches the condition of the Neanderthalians.

Judged from the morphological features of the skull, from the values of the calvarial height index and the bregma index, the bregma angle and the frontal angle, the Liukiang Man represents an early form of *Homo sapiens*, more primitive than the Upper Cave people of Choukoutien and also the Tzeyang people of Szechuan. Thus Liukiang Man is the earliest fossil representative of modern mankind so far found not only in China, but also in East Asia.

Based on the above analysis, it is concluded that the Liukiang Man was a primitive form of *Homo sapiens* of an early type of evolving Mongoloid.

This new discovery of the Liukiang human fossils with such primitive Mongoloid features in Kwangsi of South China as well as the Tzeyang skull uncovered in 1951 in the southwest Szechuan Province seems to indicate that South China might be a part of the birthplace where the Mongoloid race was originated and also to show that

the Mongoloid group was in the process of formation and differentiation at Late Pleistocene.

IV. Summary

1. The Liukiang human fossils consist of a well-preserved skull, the lower four thoracic vertebrae and all five lumbar vertebrae, the sacrum, the right hip bone and two femur fragments.

2. Chronologically, they are Late Pleistocene in age.

3. The human fossils belong to a male individual of middle age.

4. Judged from the morphological characters the Liukiang Man represents an early form of the evolving Mongoloid and is the earliest fossil representative of modern mankind so far found in China.

Appendix: Measurements and Indices of the Liukiang skull

Abs. Measurements (in mm)	
1. Max. cranial length (g-op)	189.3
2. Glabella inion length (g-i)	172.0
3. Max. cranial breadth (eu-eu)	142.2
4. Auricular height	114.5
5. Bas. bregma height (ba-b)	134.8
6. Bas. vertex height (ba-v)	134.0
7. Porion bregma height (po-b)	114.8
8. Sagittal arc (n-op)	374.0
9. Frontal arc (n-b)	136.5
10. Parietal arc (b-l)	132.0
11. Occipital arc (l-o)	105.5
12. Frontal chord (n-b)	117.2
13. Parietal chord (b-l)	119.2
14. Occipital chord (l-o)	91.5
15. Min. frontal breadth (ft-ft)	95.2
16. Foramen magnum length (ba-o)	36.9
17. Foramen magnum breadth	30.5
18. Basis length (ba-n)	103.5
19. Profile length (ba-pr)	100.0
20. Mid-profile length (ba-ss)	95.0
21. Max. bizygomatic breadth (zy-zy)	136(?)
22. Upper facial height (n-pr)	65.9
23. Orbital breadth from mf.	R. 43.1 L. 42.0
24. Orbital height	R. 29.0 L. 28.7
25. Nasal height (n-ns)	45.8
26. Nasal breadth	26.8
27. Palat. length (ol-sta)	45.0(?)
28. Palat. breadth	36.0
29. Palat. height	9.5
30. Internal biorbital breadth (IOW. fmo-fmo)	98.8
31. Sub. IOW	15.5
32. Simotic chord (SC)	10.6
33. Simotic subtense (SS)	3.0
34. Bimalar breadth (GB) (zm-zm)	97.1
35. Sub. GB	31.5
36. Interorbital breadth (mf-mf)	21.2
37. Sub. mf-mf.	6.2
38. Mid-orbital breadth	53.8

Angles	
1. Facial profile angle (n-pr-FH)	86.0
2. Nasal profile angle (n-ns-FH)	89.0
3. Alveolar profile angle (ns-pr-FH)	75.0
4. Frontal profile angle (g-m-FH)	74.0
5. Glabella-bregma angle (g-b-FH)	46.0
6. Naso-malar angle (fmo-n-fmo)	143.5
7. Zygomaxillary angle (zm-ss-zm)	138.0

Indices		
1. Cranial index	$100\times3/1$	75.1
2. Length height index	$100\times5/1$	71.2
3. Length auricular height index	$100\times4/1$	60.5
4. Breadth height index I	$100\times5/3$	94.8
5. Breadth height index II	$100\times4/3$	80.5
6. Cranio-facial height index	$100\times22/5$	48.9
7. Cranio-facial breadth index	$100\times21/3$	95.6
8. Jugo-frontal index	$100\times15/21$	70.0
9. Sup. facial index	$100\times22/21$	48.5
10. Facial prognathic index	$100\times19/18$	96.6
11. Orbital index	$100\times24/23$	R. 67.3 L. 68.3
12. Nasal index	$100\times26/25$	58.5
13. Palat. index	$100\times28/27$	80.0
14. Foraminal index	$100\times17/16$	82.7
15. Frontal index	$100\times31/30$	15.7
16. Simotic index	$100\times33/32$	28.3
17. Premaxillary index	$100\times35/34$	32.4
18. Maxillo-frontal index	$100\times37/36$	29.2
19. Frontal chord-arc index	$100\times12/9$	85.9
20. Parietal chord-arc index	$100\times13/10$	90.3
21. Occipital chord-arc index	$100\times14/11$	86.7

References

[1] Kroeber, A. L.: 1948. *Anthropology.* Harcourt, Brace & Co., New York.
[2] Martin, Rudolf: 1928. Lehrbuch der Anthropologie. 2nd ed., Jena.
[3] Stewart, T. D.: 1947. Hrdlička's Practical Anthropometry. 3rd ed., Wistar Inst. Anat. and Biol., Philadelphia, U. S. A.
[4] Weidenreich, Franz: 1939. On the Earliest Representative of Modern Mankind Recovered on the Soil of East Asia. *Peking Natural History Bulletin,* **13,** part 3, 161—174.
[5] ————: 1941. The Extremity Bones of *Sinanthropus pekinensis. Palaeont. Sinica,* New ser. D, No. 5.
[6] Woo, Ju-kang and Chia, Lan-po: 1955. Fossil Human Femur Fragment of Hsiatsaohwan. *Acta Palaeontologica Sinica,* **3,** 67—68.
[7] Woo, Ju-kang: 1957. *Tzeyang Paleolithic Man.* Inst. Vert. Paleont., *Memoir No. 1.*
[8] Woo, T. L. and G. M. Morant: 1934. A Biometric Study of the Flatness of the Facial Skeleton in Man. *Biometrika* **26,** 196—250.
[9] Рогинский, Я. Я., М. Г. Левин: 1955. Основы Антропологии. Изд. Московского Университета.

EXPLANATION OF PLATES

Liukiang Human Fossils

PLATE I. SKULL, × 1/3.

1. Vertical view, mostly embedded in matrix.
2. Vertical view, cleared.
3. Frontal view.
4. Back view.
5. Lateral view.
6. Basal view.

1

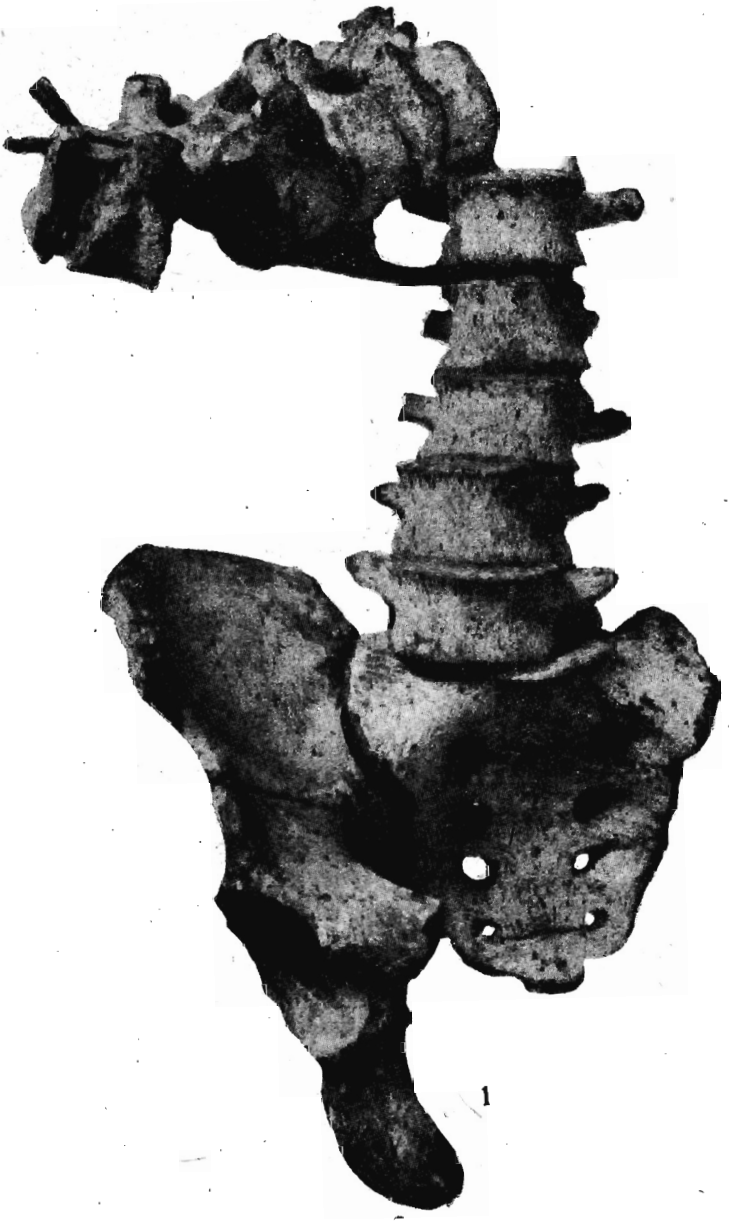
2

3

4

5

6



1

2

3

PLATE II. AXIAL AND APPENDICULAR SKELETON, ANTERIOR VIEW. × 1/2.

1. Axial skeleton and right hip bone.
2. Right femur shaft × 1/2.
3. Left femur shaft × 1/2.

Plate III.

Lumbar vertebrae and sacrum. × 1/2. 1. Lateral view, 2. Posterior view.

Right hip bone, × 1/2. 1. Medial view, 2. Lateral view.

1

2

3

4