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A New Discovery of The Upper Pleistocene Child's Skeleton from Hŭngsu Cave (Turubong Cave Complex), Ch'ŏngwŏn, Korea

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청원 "두루봉 흥수굴"에서 발굴한 후기 홍적세 어린아이뼈 연구

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ABSTRACT

The first well-preserved an immature fossil skeleton of Pleistocene age in South Korea was found at the quarry of Hŭngsu cave which consists of the Turubong Cave Complex, Ch'ŏngwŏn, " Korea. This fossil remain has been designated as "Hŭngsu Cave Child". Associated with the individual were a small number of stone artifacts. While a precise date for this site is not available yet, the presence of fauna would suggest a warm period of an Upper Pleistocene date.

Metric and non-metric methods are used for the description of the Hungsu child's skeleton. This fossil has been assigned a developmental age of 5 years, but can be considered to be the range of 4 to 6 years. Estimated cranial capacity ranged from 1,260 to 1,300 CC and the estimated stature from 110 to 120cm. The Hŭngsu child is differentiated by the superiority in size of skull, cranial length and height, and, most significantly, its greater parietal arc.

On the basis of comparison of the total cranical characteristics of Hŭngsu child and other samples including hominid fossils and modern man of East Asia, it is assumed that Hŭngsu child can currently, be classified as "an anatomically modern man or anatomically *Homo sapiens*".

요 약

두루봉 흥수굴에서 홍적세 시기에 속하는 어린아이뼈 화석이 남한에서는 처

음으로 발굴되었다. 이 화석은 홍수아이로 이름지어졌고, 몇 개의 돌연모가 함께 발굴되었다. 유적지의 정확한 연대는 아직 밝혀지지 않았으나 동물화석에 따르면 후기 홍적세 따뜻한 시기로 여겨진다.

홍수아이뼈들의 크기를 측정하고 해부학상 특징을 밝혔다. 이 아이는 약5살로 여겨지고, 머리부피는 1260cc에서 1300cc 사이에 속하며, 키는 약 110에서 120cm 정도이다. 머리뼈는 길이와 높이가 아주 크며, 특히 위머리뼈의 굽은길이는 매우 길다.

홍수아이의 머리뼈는 동북 아시아에서 발굴된 화석인류 및 현대 인류와 비교되었는데, 홍수아이 화석은 "해부학상 현대인 또는 해부학상 슬기사람"으로 분류된다.

INTRODUCTION

Research on the Korean Pleistocene was initiated in the early 1960s. Since that time thirteen caves and fifteen open-air sites on the Korean Peninsula have been or in the process of being excavated. Of these, six cave sites and one rock shelter have yielded hominid fossils. Presently, only preliminary reports on these hominid remains have been published as part of excavation reports (Table 1).

The Turubong Cave Complex is one of the most important archaeological/paleontological site of the Middle/Upper Pleistocene age in South Korea. This complex is located 159 km southeast of Seoul (E 127° 32′21″, N 30° 31′, Fig. 1) and has been known since 1976. Excavation have been carried out from 1976 to 1982 through the efforts of Professor Sohn Pokee and especially, Professor Lee, Yung-jo, director of the Chungbuk National University Museum. The cave complex was formed in a Palaeocene limestone basement during the Lower Pleistocene. The area has been mined for limestone since the 1930s, resulting in the destruction of many of the interwoven cave channels (Fig. 2). In the Turubong complex, cave No. 2, No. 9 and Hungsu cave are of the greatest importance (Lee, 1981, 1984, 1986).

In December, 1982, fragments of a skull were found by a workman at the quarry of Turubong cave. Intensive excavation of the Up-

Table 1. Pleistocene Sites Yielding Hominid Fossils in Korea

Site	Type	Phase	Auther
North Korea			
Sungni Mts.	cave	M/U	Inst. of Arch., 1978
Mandal-ri	cave	U	Kim, et al., 1985a
Yok'po-ri	cave	U	Kim, et al., 1985b
Yonggok	cave	M/U	Jeon, et al., 1986
South Korea			
Sangsi-ri	rs	M/U	Sohn, 1984; Sohn, 1988
Hungsu (Turubong)	cave	U	Sohn, 1983; Lee, 1986
Kumgul	cave	L/M/U	Sohn, 1985, 1987

Abb. rs = Rockshelter L = Lower Paleolithic, M = Middle, U = Upper

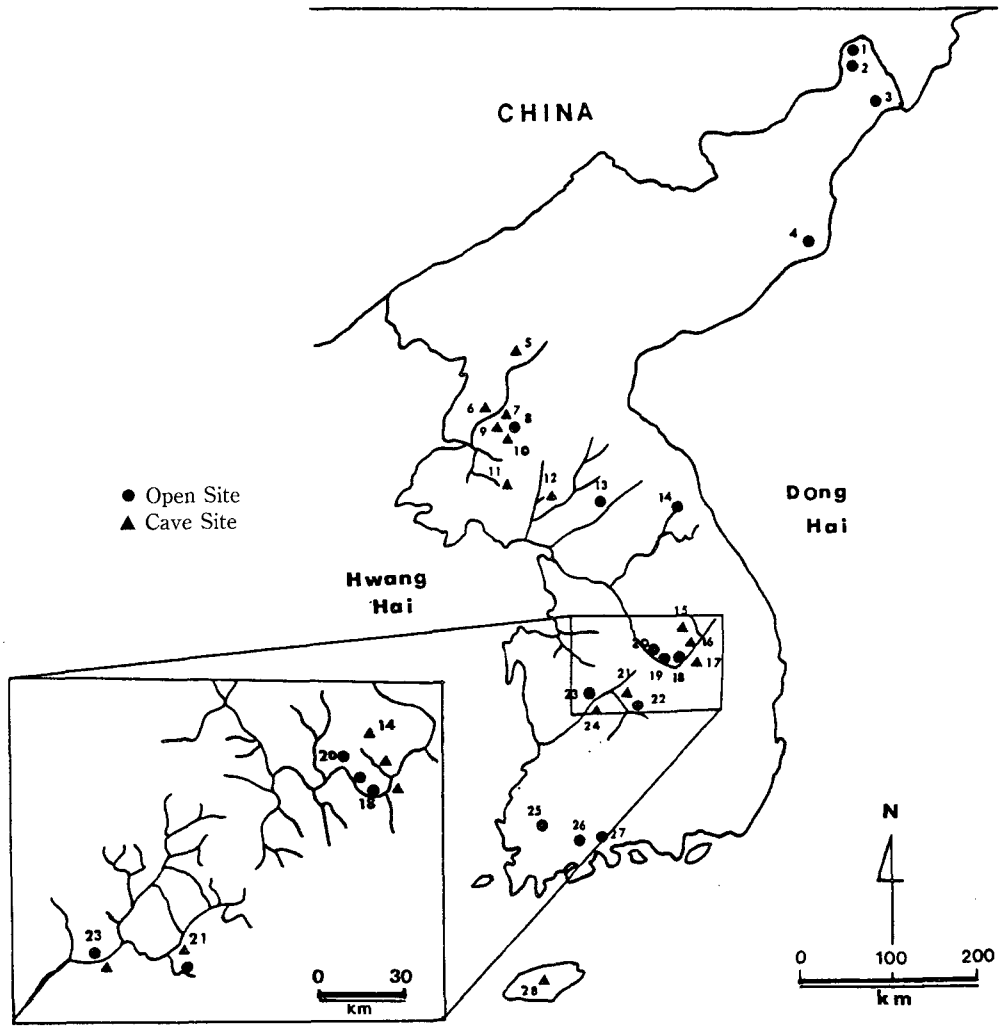


Fig. 1. Distribution of the Paleolithic Sites in Korea

1. Chikyong-dong	7. Komunmoru	13. Chongok-ni	19. Ch'angnae	24. Maam-ni
2. Tonggwan	8. Hwach'on-dong	14. Sangmuryong-ri	20. Kungilga	25. Kumpyung
3. Kul'po-ri	*9. Mandal-ri	*15. Yong-gul	*21. Turubong	26. Taejon
4. Changduk-ri	*10. Yonggok	*16. Sangshi-ri	22. Saemgol	27. Kogch'on
*5. Tockch'on	11. Ch'ongch'ong-am	17. Kum-gul	23. Sokchang-ni	28. Billemot
6. Taehyon-dong	12. Haesang-ni	18. Suyanggae		

*: Sites yielding Upper Pleistocene hominid fossils

per Pleistocene deposits of Hungsu cave resulted in the discovery of the first two immature fossil skeletons of Pleistocene age in South Korea. One of the remains (No. 1) has since been designated "Hungsu Cave Child" (Park and Lee, 1990).

Hungsu cave deposits are devided into two depositional layers. The upper layer is reddish silt-clay and the lower is yellowish silt-clay. The child's skeleton were found *in situ* in the reddish layer. Associated with the individual were a small number of stone artifacts. While a precise date for this site is not available, a relative date can be obtained by biostratigraphic

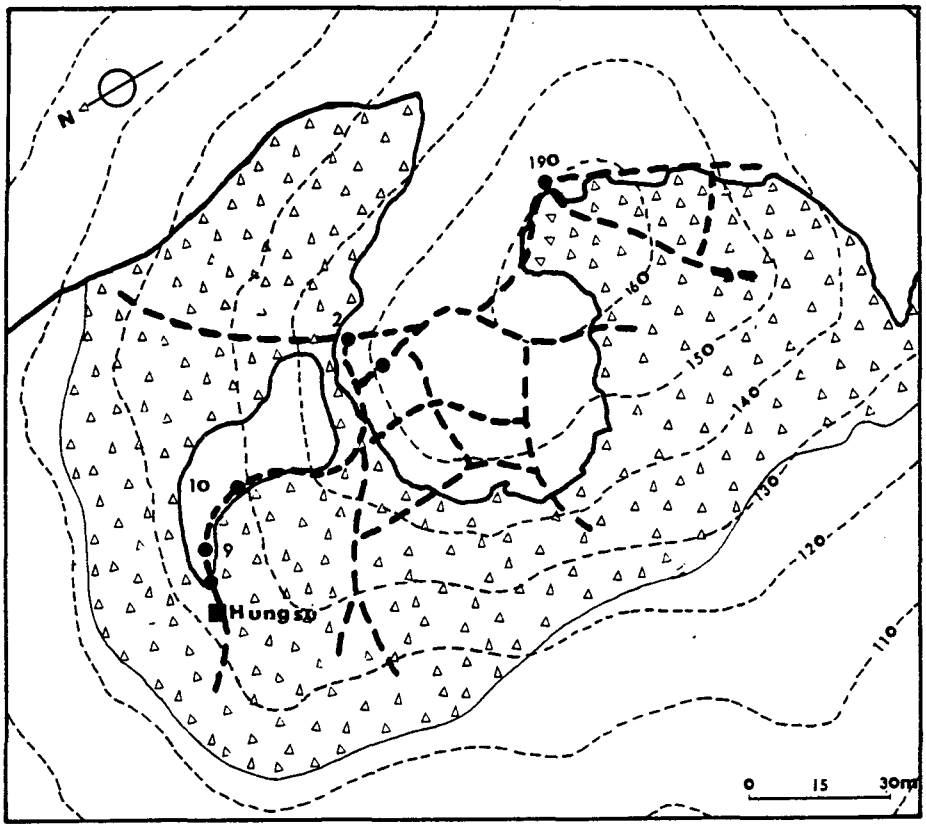


Fig. 2. The reconstruction of Turubong area. Marked area was destroyed by mining (Modified from Sohn, 1983)

correlations and stone artefacts' comparison with those of other regions. The presence of fauna would suggest a warm period of an Upper Pleistocene date.

MATERIALS AND METHODS

In this paper the study is focused on No. 1 skeleton. Mineralization of the remains is incomplete due to chemical and physical conditions of the limestone cave deposits. Although the remains comprise almost 60% of the skeleton, the cranium consisted of several fragments on initial discovery. Proximal and distal parts of the long bones, clavicles, ribs, and vertebra were missing. Most of the scapulae and os coxae were not recovered while metacarpals, metatarsals and phalanges were completely crushed. Some important craniometric points (e.g. nasion and basion) and some missing parts of the skull (e.g. orbital region and ascending ramus of the mandibula) were reconstructed by means of the ratio diagram dimension method (Simpson, 1943, Fig. 3) and other ways (Broadbent, 1931, 1937; Brodie, 1941; Hellman, 1927, 1935; Schultze, 1955; Solow, et al., 1976).

Metric and non-metric methods are used for the description of the Hungsu child's skeleton; Measurements have incorporated several craniometric techniques (Martin, 1928; Bass, 1971; Howell, 1973; Brothwell, 1981; Ding, 1983; Table 2). Cranial angles were computed by reference to cosine law. All measurements were recorded in millimeters. The left side was measured when possible. Twenty-two dimensions were used for comparison. Linea

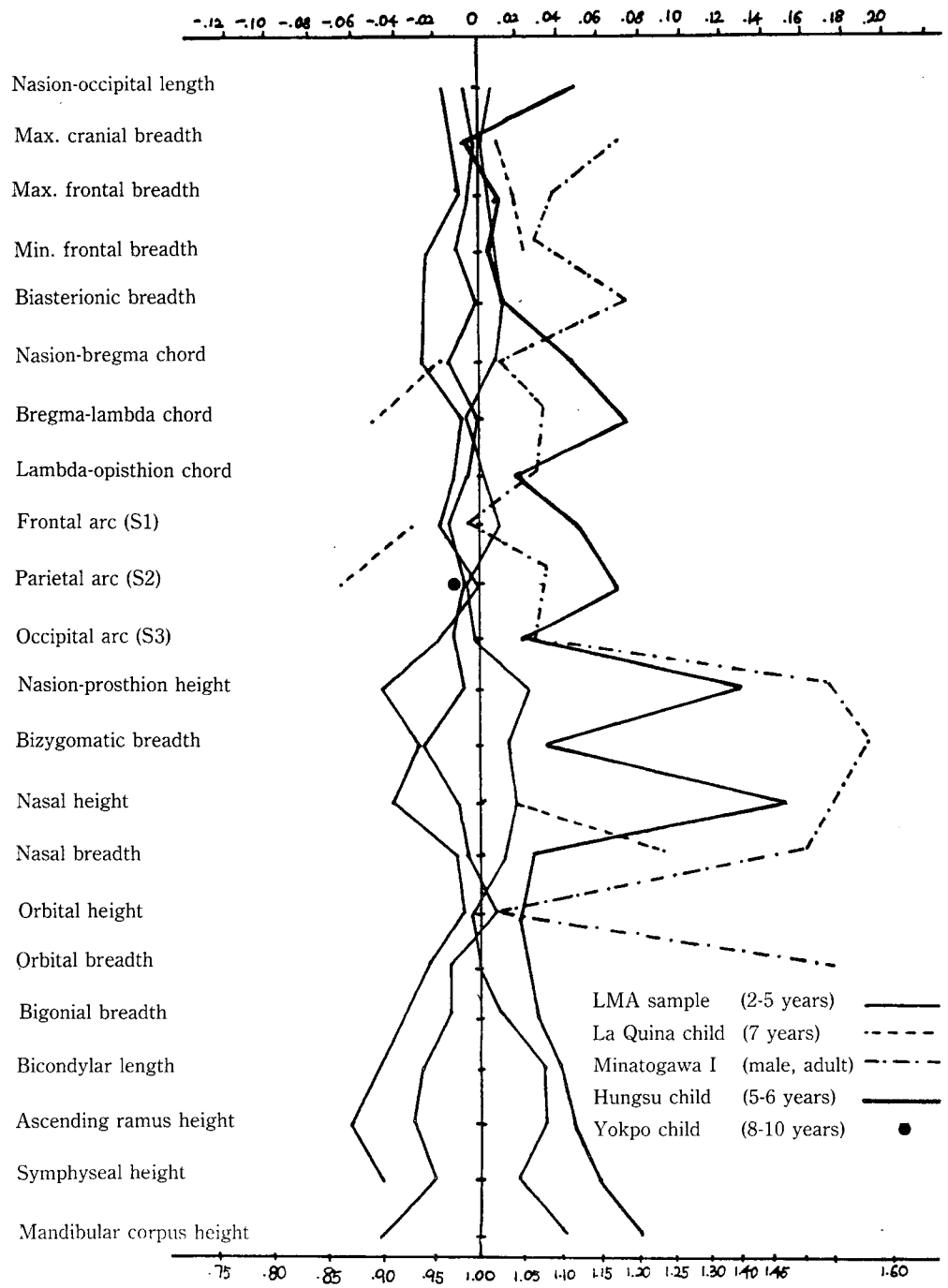


Fig. 3. Ratio diagram of dimension of the Hungsu child's skull, LMA sample, La Quina, Yokpo, and Minatogawa I.

Table 2. List of the Cranial Measurements

Cranial Measurements			Length (m/m)
GOL (M1)	:	Glabello-occipital length	1760?
NOL (M1d)	:	Nasio-occipital length	1720?
GIL (M2)	:	Glabella-inion length	1690
NIL (M2a)	:	Nasion-inion length	1620
GLL (M3)	:	Glabella-lambda length	1720
M5	:	Basion-nasion length	880???
BoNL	:	Bolton-nasion length	1060???
BoBH	:	Bolton-bregma height	1420???
BoVH	:	Bolton-vertex height	1430???
BoPL	:	Bolton-prosthion length	1030???
XCB (M8)	:	Max. cranial breadth	1260
WFB (M9)	:	Min. frontal breadth	850
XFB (M10)	:	Max. frontal breadth	1070
AUB (M11b)	:	Biauricular breadth	1030?
ASB (M12)	:	Biasterionic breadth	1010
M17	:	Basion-bregman height	1360???
M18	:	Basion-vertex height	1400???
M20	:	Porion-bregma height	1250???
M21	:	Porion-vertex height	1200?
M22	:	Calvalia height from NIL	1090
M22b	:	Vertical height from GLL	730
Schwalbe's height from GIL			1040
FRC (M29:S1')	:	Frontal chord (na-br)	1100
FRS	:	Frontal subtense (na-br)	230
FRF	:	Nasion subtense fraction	600
S1 (M26)	:	Frontal arc (na-br)	1300
PAC (M30:S2'):		Parietal chord (br-la)	1220
PAS	:	Parietal subtense (br-la)	290
PAF	:	Bregma subtense fraction	640
S2 (M27)	:	Parietal arc (br-la)	1380
OCC (M31:S3')	:	Occipital chord (l-o)	960
OCS	:	Occipital subtense (l-o)	260
OCF	:	Lambda subtense fraction	530
S3 (M28)	:	Occipital arc (l-o)	1160
MDH	:	Mastoid height	190?
MDB	:	Mastoid width	200?
M40	:	Basion-prosthion length	850???
ZYB (M45)	:	Bizygomatic breadth	1050???
NGH (M47)	:	Total facial height	980???
NPH (M48)	:	Upper facial height	570???
OBB (M51a)	:	Orbit breadth, left	340???

Table 2. Continued

Cranial Measurements		Length (m/m)
OBH (M52)	: Orbit height, left	310???
NLB (M55)	: Nasal breadth	200?
NLH (M55)	: Nasal height	420???
ZHB	: Bimaxillary breadth	780???
EKB	: Biorbital breadth	860???
DKB (M49a)	: Interorbital breadth	200???
GLS	: Glabella projection	040??
Palatal length, external		360???
Palatal breadth, external		520???
Cranial Angles		
Frontal angle (m-g-op)		72.0°
Inclination angle of frontal squama (br-g-i)		63.0°
Frontal inclination angle I (br-na-i)		65.0°
Frontal inclination angle II (br-na-o)		82.0°
FRA (M32.5): Frontal curvature angle (br-m-na)		135.0°
OCA	: Occipital curvature angle (l-i-o)	129.0°
Occipital inclination angle (g-i-l)		88.0°
Inclination angle of whole occipital (na-o-l)		106.0°
Occipital inclination angle (na-i-l)		93.0°
Occipital inclination angle (na-i-o)		36.0°
PRA (M72.5)	: Upper facial triangle (ba-pr-na)	78.0°??
NAA	: Upper facial triangle (pr-na-ba)	63.0°??
BAA	: Upper facial triangle (na-ba-pr)	38.0°??
SSA	: Zygomaxillary angle (zm-ss-zm)	120.0°??
PAA	: Parietal angle	129.0°
Mandibular Measurements		Length (m/m)
M65	: Intercondylar width	1020??
M66	: Bigonial breadth (go-go)	760??
M67	: Bimental foramen diameter	400
M69	: Symphyseal height	270
M70	: Ascending ramus height (Coronid CrH, right)	410
M71	: Min. ascending ramus breadth	300???
Mandibular corpus height (mid-point of dM2)		210
Mental foramen-alveolar border height		110
Mental foramen-lower mandibular depth		120
Thickness of corpus at mid-point of dM2		168
Thickness of corpus at mental foramen		120, L
Thickness of corpus at symphyseal portion		124

Short Names (e.g. GOL): Howells (1973), M: Martin (1928)

Table 2. Continued

Cranial Angles
S1, S2, S3: Brothwell (1981), Angles: Ding (1983)
The Bolton point (Bo): Richards (1985)
??? : measurements taken after reconstruction
?? : measurements still allowed a direct estimate
? : dissatisfaction with the state of the craniometric points, but allow high accuracy of the measurements.

measurements, arcs, and chords were used for size estimates while indices (e.g. chord/arc index), subtenses and computed angles used for shape estimates.

DESCRIPTION

Based on the visual observations of the dental formation and eruption pattern of modern humans and radiographic analysis of the unerupted teeth, this child's fossil has been assigned a developmental age of 5 years, but can be considered to be in the range of 4 to 6 years. Estimated cranial capacity ranged from 1,260 to 1,300 cc and the estimated stature ranges from 110 to 120cm.

The characteristic features of the Hungsu child's skeleton can be summarized as follows (Figs. 4, 5, 6, 7, 7.1, 7.2).

The cranium: Vertically, narrow or long skull; almost symmetrically ovid. Laterally, skull is hypsicranic; well-curved sagittal contour as a whole; slightly inclined forehead; greatly lengthened parietal arc; mesognathous facial profile. From the posterior view, flattening of the vault; a small depression instead of an external occipital protuberance. In frontal view, narrow face; narrow nasal aperture; narrow orbits.

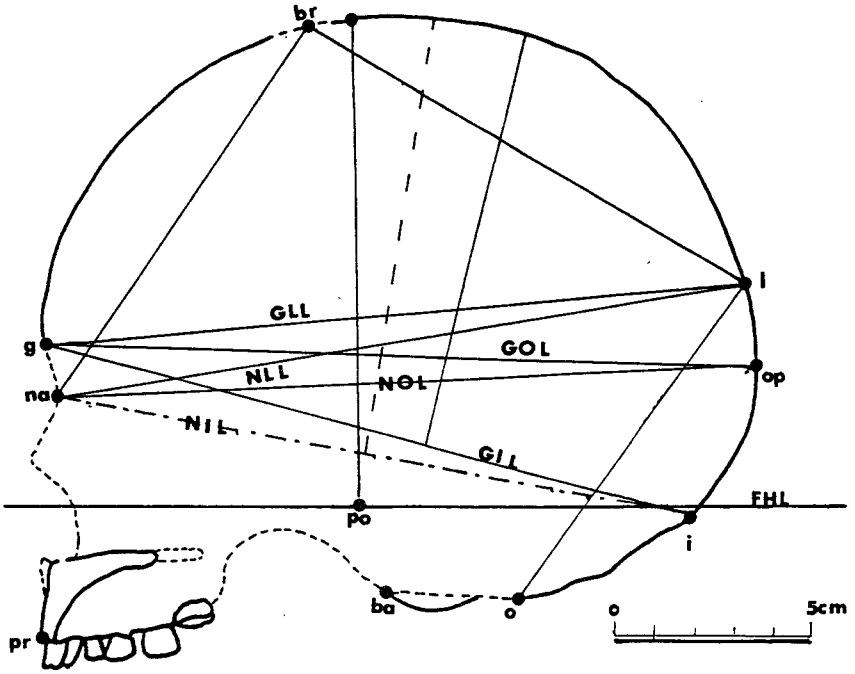
The mandible: Pronounced eminence on the lateral surface; well- developed "trigonum mentale"; raised and thickened symphysis on the labial surface. Anteriorly, marked "mental spine"; prominentia alveolaris" in the lingual surface of the anterior part; robust condylar process.

DISCUSSION

Metrical comparisons of the Hungsu skeleton are mainly based on a series of American Indian children skeletons (2-5 years). This sample (LMA) was compiled from 69 archaeological sites in Northern California and is housed in the Lowie Museum of Anthropology, University of California, Berkeley (Richards, 1985). Metrics of 101 individuals ranging in age from 2 to 5 years of age were used for comparative purposes.

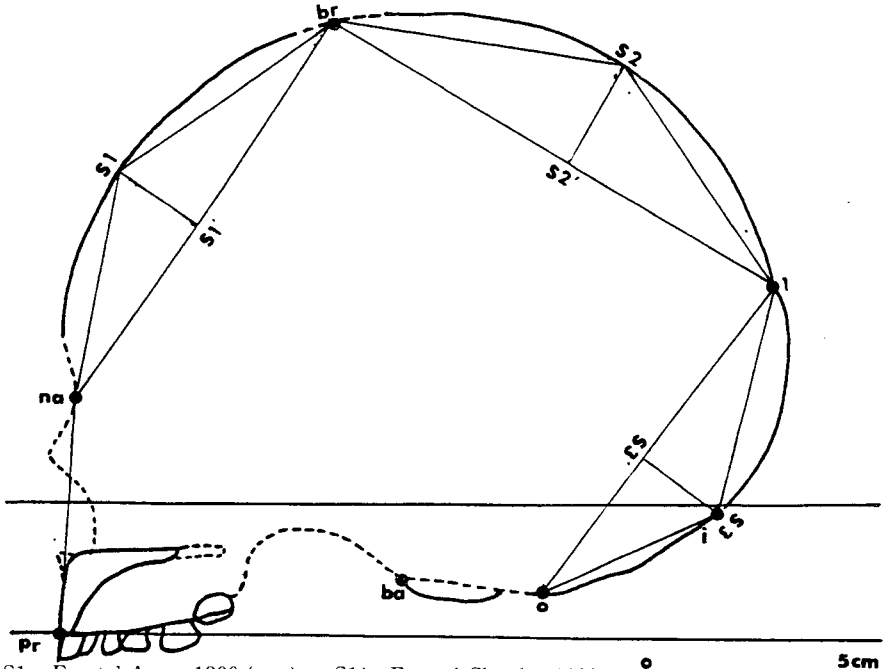
La Quina neanderthal child's skull and prehistoric human skulls including modern man in East Asia are also used for comparaison.

The comparison of the Hungsu child's skull and mandible with the normal range of growth of the LMA child's sample show that they are similar in many respects. The Hungsu individual is only differentiated by the superiority in size of skull, cranial length and height, and, most significantly, its greater parietal arc. Robustness of the corpus of the mandible and massive condylar process are also striking characteristics. This features are regarded as primitive. When



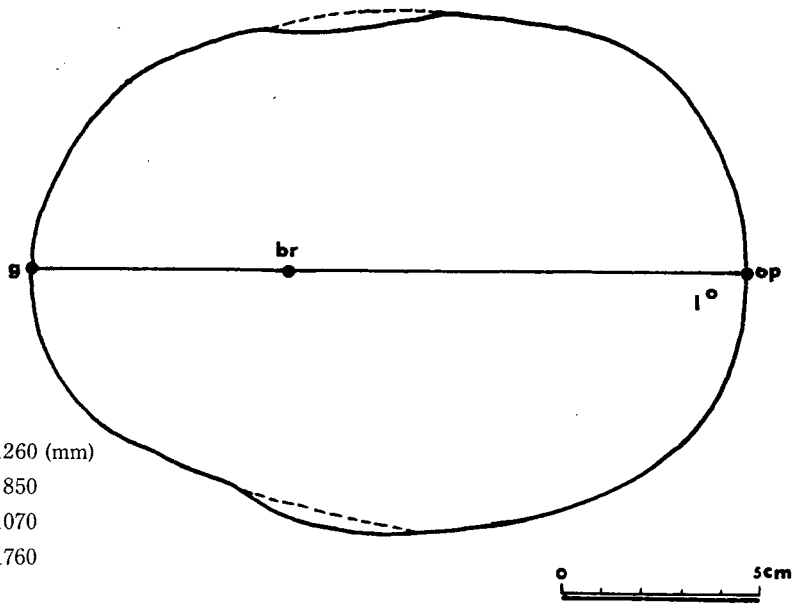
ba	: Basion	na	: Nasion	GIL	: 1690 (mm)	CrH : 1200	Schwalbe's Height
br	: Bregma	o	: Opisthion	GLL	: 1720	Calvarial Height from	: 1040
g	: Glabella	op	: Opistocranion	GOL	: 1760	NIL : 1200	FHL : Frankfort Line
i	: Inion	po	: Porion	NOL	: 1720	Vertical Height from	------- : Reconstructed Line
l	: Lambda	v	: Vertex	NIL	: 1620	GLL : 1090	

Fig. 4. Sagittal Contour of the Hungsu Child's Skull



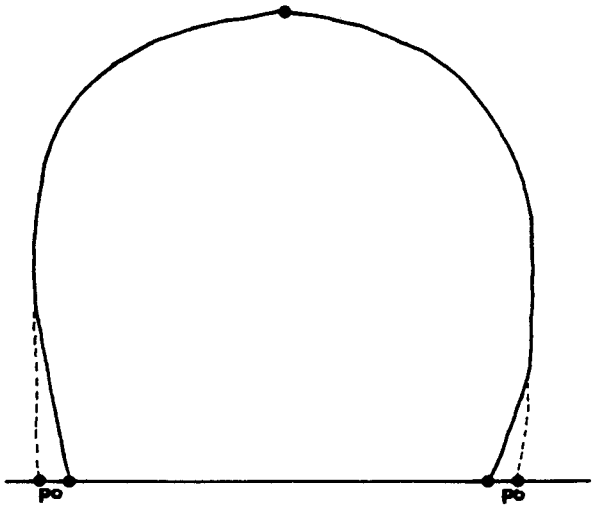
S1 : Frontal Arc : 1300 (mm), S1' : Frontal Chord : 1100
S2 : Parietal Arc : 1360, S2' : Parietal Chord : 1220
S3 : Occipital Arc: 1160 S3' : Occipital Chord: 960

Fig. 4.1. Sagittal Contour of the Hungu Child's Skull



Max. Cranial Breadth : 1260 (mm)
Min. Frontal Breadth : 850
Max. Frontal Breadth : 1070
Max. Cranial Length : 1760

Fig. 5. Horizontal Contour of the Hungsu's Child Skull



Max. Cranial Breadth: 1260 (mm)
Biauricular Breadth : 1030
Biansterionic Breadth: 1010

Fig. 6. Transverse Contour of the Hungsu Child's Skull

the parietal arc of the Hungsu skull is compared with that the La Quina neanderthal child and that of the Yokpo child, the Hungsu one is significantly longer than the latter, and its arc is almost the same as tha tof Mandal adult skull.

The maximum lengths of long bones (e.g. femur and tibia) are related to those of a 3.5 year child's sample. Some retardation in the growth of long bones is suggested, or such short-stature could have been one of the main physical characteristics of the Upper Pleistocene hominid stock in Korea.

Abbreviations:
idi : infradentale inferius
gn : gnathion
mh : lines mylohyoidea
sm : spine mentalis
pa : processus alveolaris
fs : fossa sublaveolaris

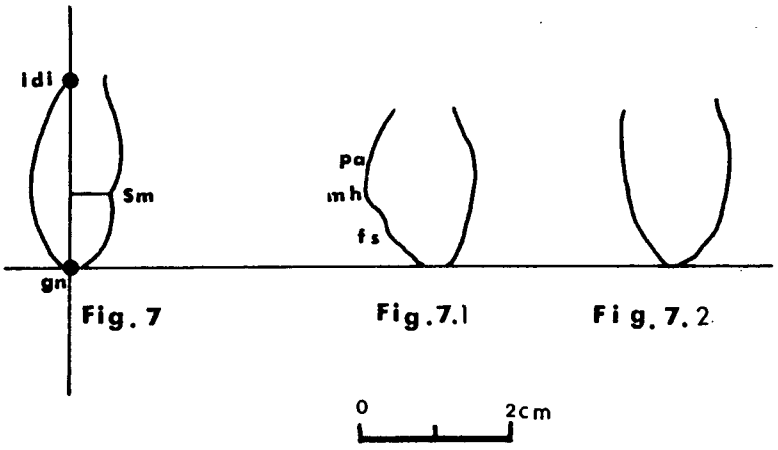


Fig. 7. Sngittal Section through the Mandibular Symphysis oriented in the Alveolar Plane.
Fig. 7.1. Cross Section through the right side of the Mandbular Body between dM2/M1.
Fig. 7.2. Cross Section through the right side of the Mandibular Body behind M1.

Table 3. Distribution of Samples Compared with Hungsu Child's Skull (From Park & Lee, 1990)

Upper Paleolithic	Neolithic	Ancient	Modern		
			China	Japan	Korea
La Quina child	Jomon	Sungri Mts	Hobien	Kanto	Male
Minatoga	Kansu/Honan	Ung-gi	Peiking	Kinki	Female
Upper Cave	Baoji	Hwangsuk-ri	Fushan		
Lukiang	Huashien	Achisum (Jodo)			
Niah	Zhenpiyan	Nakrang			
Mandal	Lang-Cuom	Yean-ri			
Yonggok	Bankao	Anbyun			
Yokpo child	Hwoyryong	Haeju			
	Ung-gi				

RESULTS

On the basis of comparison of the total cranial characteristics of Hungsu child and other samples, it is assummed that Hungsu child can currently, be classified as "an anatomically modern man or anatomically *Homo sapiens*" which might have been derived from the stock of the African origin. Probably, this individual might have got relationships with the later groups that would have the microlithic cultures spreading widely in East Asia during the last glacial period.

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