

Prehistoric Human Remains from Tam Nai U-Bol, Amphoe Sai-Yok, Thailand

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Abstract Human skeletal remains, probably of the Neolithic period, were found at Tam Nai U-Bol, Wang-Po Tambol Sai-Yok district, Kanchanaburi Province Thailand. They were rather poorly preserved, but some reliable measurements could be taken from the mandibles and their teeth. PENROSE's distance analysis based on those measurement data showed the close affinities of the Tam Nai U-Bol samples with the Neolithic Ban-Kao series and Jomon Japanese.

Introduction

Since VAN HEEKELLEN and his co-researchers worked in the Ban-Kao and Sai-Yok cave sites at Kanchanaburi province, the studies on Thai prehistory have been considerably increased with the discoveries of new sites and materials, as reviewed by REYNOLDS (1990). The excavation at the Ban-Kao site produced considerable Neolithic human skeletons, whereas further findings of the prehistoric human specimens are still expected for the examination of microevolution and population history of the Thai people. Therefore, the present authors coordinated efforts with the Thai-Japanese joint research team for further excavation on purpose to find new specimens of prehistoric human skeletons. In March 1993, we conducted a preliminary survey on the prehistoric limestone cave sites in the Sai-Yok district, Kanchanaburi Province, and found some prehistoric human skeletons, probably of the Neolithic period, at the Tam Nai U-Bol (Nai U-Bol Cave), in Wang-Po Tambol (Fig. 1). This cave is situated in a small valley, where the area all around is a field for plantation. From the foot of the hill up to the cave is rather steep (Fig. 2). The distance is about 20 meters. The entrance of the cave is 1.5 m in width, 1 m in height and about 1 m from the en-



Fig. 1. Locality of the Tam Nai U-Bol (Nai U-Bol Cave).



Fig. 2. View of the Tam Nai U-Bol (Nai U-Bol Cave).

trance down to the globular shape. The floor was disturbed by local people who dug for the fertilization soil which was made by bats in the cave. The size of the disturbed pit is about 10 m². Some human skeletons associated with a stone bracelet made from marble were found on the floor of the pit. The style of stone bracelet (Fig. 3: Plate 1) is very typical of the Neolithic period as seen in those recovered from the Ban-Kao site (VAN HEEREN & KNUTH, 1967). After the field survey in the Sai-Yok district, the human skeletal remains collected from the Tam Nai U-Bol were charged at the Sood SANGVICHEN Prehistoric Museum and Laboratory, Department of Anatomy, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok for cleaning, reconstructing, recording and measurements. This is a brief preliminary report on the anthropological examination of these human specimens.

Description of Human Bones

The human skeletal remains from the Tam Nai U-Bol are all damaged. Their conditions of preservation and physical characteristics are described as follows. The skeletal measurements were taken by the method outlined in Martin's *Lehrbuch der Anthropologie* (MARTIN & SALLER, 1957), and tooth crown diameters were measured according to FUJITA's method (FUJITA, 1949).

Calvariae

Nine pieces remain and all are of adults. The biggest piece is one part of a parietal bone with clear lambda suture which is not fused on both inner and outer surfaces (Fig. 3: Plate 2), giving an estimated age of young mature. The line of the suture is not complex. This parietal bone is rather thick at the thickest point 11 mm.

Table 1. Mandibular measurements of the Tam Nai U-Bol and comparative Thai samples (Males).

		Tam Nai U-Bol Mand. 1	Ban-Kao*		Modern Thai**	
Martin No.		M (mm)	M (mm)	(n, SD)	M (mm)	(n, SD)
65	Bicondylar breadth	(132)	127.6	(6, 7.6)	122.5	(80, 5.9)
65(1)	Bicoronion breadth	(120)	—		—	
66	Bigonial breadth	110	105.4	(7, 9.6)	100.23	(82, 6.6)
67	Mental breadth	55	—		—	
68	Mandibular length	74	—		79.09	(80, 5.1)
69	Symphysis height	34	30.2	(6, 4.0)	31.89	(58, 2.7)
69(1)	Body height	32	—		—	
69(3)	Body breadth	15	—		—	
70	Condylod height	63	60.3	(7, 5.2)	62.46	(82, 4.9)
71	Rumus breadth	37	36.0	(7, 2.0)	33.87	(82, 3.4)
71(1)	Condylod-coronoid	—	—		—	
79	Mandibular angle	128	119.1	(7, 3.9)	118.85	(80, 6.7)

() Value based on the half side; * SANGVICHEN *et al.* (1969); ** SANGVICHEN (1971).

Mandibles

Five mandibles are preserved as shown in Fig. 4. None of the mandibles are complete. The mandibular measurements are given in Tables 1 and 2. Table 3

Table 2. Mandibular measurements of the Tam Nai U-Bol and comparative Thai samples (Females).

		Tam Nai U-Bol			Ban-Kao*		Modern Thai**	
		Mand. 2	Mand. 3	Mand. 4				
Martin No.		M (mm)	M (mm)	M (mm)	M (mm)	(n, SD)	M (mm)	(n, SD)
65	Bicondylar breadth	—	121	—	121.0	(3, 10.8)	116.3	(53, 5.7)
65 (1)	Bicoronion breadth	—	100	—	—	—	—	—
66	Bigonial breadth	—	98	(98)	94.0	(3, 3.4)	93.7	(53, 6.4)
67	Mental breadth	(50)	53	51	—	—	—	—
68	Mandibular length	—	74	72	—	—	76.6	(53, 4.8)
69	Symphysis height	25	25	30	32.3	(3, 3.7)	30.3	(43, 3.4)
69 (1)	Body height	25	24	30	—	—	—	—
69 (3)	Body breadth	9	14	14	—	—	—	—
70	Condylod height	—	55	—	60.7	(3, 7.0)	57.2	(56, 4.4)
71	Rumus breadth	—	35	35	34.0	(3, 2.0)	32.9	(56, 2.7)
71 (1)	Condylod-coronoid	—	35	—	—	—	—	—
	Mandibular angle	—	117	—	120.0	(3, 5.5)	121.7	(54, 6.3)

() Value based on the half side; * SANGVICHEN *et al.* (1969); ** SANGVICHEN (1971).

Table 3. Tooth crown measurements (mm) of the Tam Nai U-Bol mandibles.

		Mandible 1 ♂		Mandible 2 ♀		Mandible 3 ♀		Mandible 5	
		Left	Right	Left	Right	Left	Right	Left	Right
Mesiodistal diameters									
LI1	—	—	—	—	—	—	—	—	—
LI2	—	—	—	6.11	—	—	—	—	—
LC	7.54	—	—	6.16	—	—	—	—	—
LP1	7.48	—	—	6.05	—	—	—	—	—
LP2	—	7.51	—	—	—	—	—	—	—
LM1	12.21	12.03	—	—	12.04	—	11.40	—	—
LM2	10.92	10.78	—	9.27	—	10.17	10.69	—	—
LM3	11.42	11.19	—	10.17	—	—	—	—	—
Buccolingual diameters									
LI1	—	—	—	—	—	—	—	—	—
LI2	—	—	—	5.95	—	—	—	—	—
LC	8.53	—	—	6.95	—	—	—	—	—
LP1	8.86	—	—	7.44	—	—	—	—	—
LP2	—	9.58	—	—	—	—	—	—	—
LM1	11.90	12.04	—	—	10.88	11.10	10.96	—	—
LM2	11.43	11.23	—	8.89	—	9.49	9.78	—	—
LM3	10.37	10.39	—	9.44	—	—	—	—	—

shows the crown measurements of those mandibular teeth.

Mandible 1: It is nearly complete. Only the right condyle is broken off and the chin is destroyed from the center to the left side. The body is rather robust. The muscle attachment surface is well developed with the angle reflected out. A slight mandibular tori is observable. The mental symphysis is somewhat prominently. From these aspects, the sex may be identified as male. The base line of the body is straight. In either side of the body, the bony bridge of mylohyoid groove is absent, and the mental foramen is a single hole. All of the comparable measurements of this mandible exceed the Ban-Kao and modern Thai averages (Table 3). The conditions of tooth preservation are shown in the following dental formula.

8	7	6	5	o	o	o	o		o	o	3	4	o	6	7	8
o: tooth missing but socket present																

The third molars already erupted. The tooth crown surface is slightly worn (BROCA's 1st). Judging from the states of the teeth, the age might be not advanced. Dental caries are observable in the left and right second molars.

Mandible 2: Only the right half of the body of the mandible is preserved. The body is short in length and low in height. The shape is rather gracile. This mandible, therefore, might be from a female. The body has a flat base. No bony bridge is seen on the mylohyoid groove. The mental foramen is single. The following teeth are placed in this mandible.

8	7	o	o	4	3	2	o		o	o	/	/	/	/	/	/
/: tooth lost antemortem																

The third molar already erupted on the right side. The attrition of crown surface is slight (BROCA's 1st). The age therefore must be young mature.

Mandible 3: It is well-preserved although some part of the chin is broken off. The mandibular body is short compared with the ramus which is wider in size. It shows rectangular shape. The body is gracile, and is characteristic of females. Most of the measurements could be taken. The mandible has moderate size compared with those of the Ban-Kao females. In either side of the body, the bony bridge does not exist on the mylohyoid groove, and the mental foramen is single. Only three teeth are preserved as follows.

o	7	6	o	o	o	o	o		o	o	o	o	o	6	o	o
---	---	---	---	---	---	---	---	--	---	---	---	---	---	---	---	---

The third molar already erupted. The crown surfaces are very worn out (BROCA's 3rd). This state of teeth shows the age of this person rather advanced.

Mandible 4: The condyles of both sides and left ramus are lost. All the teeth are missing. Though this mandible is from an adult, the age could not be determined.

The body is slender, gracile and typical of females. The bony bridge of the mylohyoid groove is absent, and the mental foramen is single.

Mandible 5: Preservation is not complete. Both condyles and the ramus are broken. The following teeth are preserved.

x	o	o	o	o	o	o	o	o	o	o	o	6	7	x
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

x: tooth not yet erupted

The occlusal surfaces of the remaining teeth are slightly worn. The third molar does not erupt, estimating the age of subadult. The sex of this individual therefore could not be determined.

Humeri

Two shafts of right humeri and two of left humeri (Plate Nos. 3–6 shown in Fig. 3) were found. One end of each right shaft is sharpened (Plate Nos. 3 and 4 in Fig. 3). It might have been bit by rodents. Only a few reliable measurements could be taken from two shafts, as given in Table 4.

Femora

One right femur and three left ones are preserved as shown in Fig. 3 (Plate Nos. 7–10). All are broken and not complete. Among them, one left femur (Plate No. 8) is of a subadult and others are of adults. Three of those femora could be sexed and measured in shaft dimensions as shown in Table 5. The male femur has a pilastic structure with well-developed linea aspera on the dorsal surface of shaft.

Tibiae

Three right tibiae and one left tibia are preserved as shown in Fig. 3 (Plate Nos. 11–14). Few measurements were obtainable from those shafts (Table 6).

Table 4. Measurements of the Tam Nai U-Bol humeri.

Tam Nai U-Bol Humerus		H1 ♀	H2 ♀
Martin No.		Right	Left
1a	Max. length	—	—
2	Physiol. max. length	—	—
5	Max. diam. at middle	19	22
6	Min diam. at middle	13	15
7a	Circumf. at middle	56	60

Fig. 3. The artifact and human skeletal remains from the Tam Nai U-Bol [1. stone bracelet; 2. parietal bone; 3 & 4. right humerus (H1); 5. left humerus (H2); 6. left humerus (H3); 7. right femur (F1); 8. left femur (F2); 9. left femur (F3); 10. left femur (F4); 11. right tibia (T1); 12. left tibia (T2); 13. right tibia (T3); right tibia (T4)].



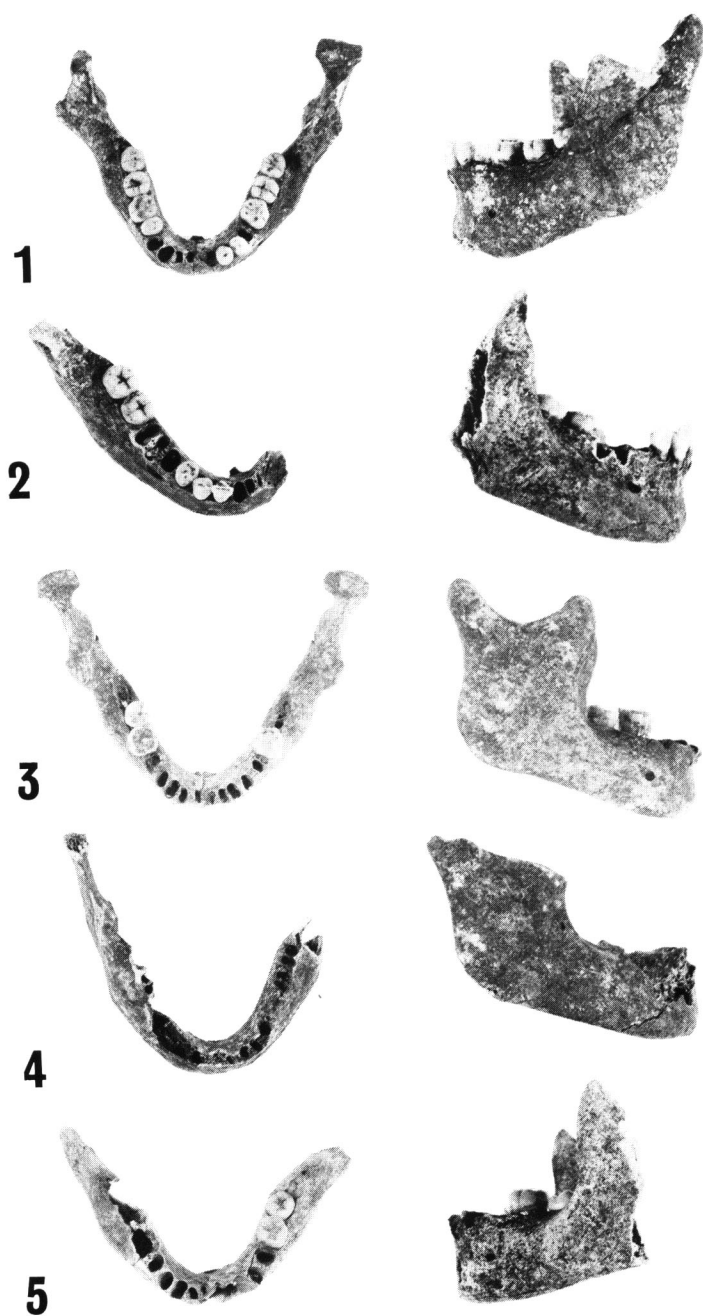


Fig. 4. The human mandibles from the Tam Nai U-Bol (1. Mandible 1; 2. Mandible 2; 3. Mandible 3; 4. Mandible 4; 5. Mandible 5).

Table 5. Measurements of the Tam Nai U-Bol femora.

Tam Nai U-Bol Femur		F1 ♀	F2 ♀	F3 ♂
Martin No.		Right	Left	Left
1	Max. length	—	—	—
2	Physiol. length	—	—	—
6	Sagitt. diam. at diaphysis middle	24	24	—
7	Transv. diam. at diaphysis middle	23	30	—
8	Circumf. at diaphysis middle	75	83	—
9	Prox. transv. diam.	23	—	28
10	Prox. sagitt. diam.	25	—	32

Table 6. Measurements of the Tam Nai U-Bol tibiae.

Tam Nai U-Bol Tibia		T1 ♂	T3 ♀
Martin No.		Right	Right
1	Total length	—	—
1a	Max. length	—	—
8	Sagitt. diam. at middle	30	26
9	Transv. diam. at middle	20	18
8a	Sagitt. diam. at foramen nutr.	—	—
9a	Transv. diam. at foramen nutr.	—	—
10	Circumf. at middle	82	72

Others

Beside the skeletons described above, the following skeletons were recognizable in very poor state of preservation. They are small fragile fragments of vertebrae, ribs, innominate bones, radii, ulnae, fibulae and phalanges.

Distance Analysis

Using comparable mandibular and tooth crown measurements, PENROSE's distance analysis (CONSTANDSE-WESTERMANN, 1972) were performed to examine the affinity of the Tam Nai U-Bol samples with the Ban-Kao series and other several East Asians.

Table 7 gives shape distances computed on the basis of five mandibular measurements: bicondylar breadth (65), bigonial breadth (66), symphysis height (69), condyloid height (70), ramus breadth (71), which were taken from the Tam Nai U-Bol (Mandible 1), Neolithic Ban-Kao (SANGVICHEN *et al.*, 1969), modern Thai (SANGVICHEN, 1971), modern Chinese (ANDO, 1938), modern Japanese (IGARASHI & YAMADA, 1978) and Neolithic Jomon Japanese (KINTAKA, 1928). The Nai U-Bol sample is the closest to the Ban-Kao, whereas it is distant from the modern Japanese and Chinese. Figure 5 shows a two dimensional expression according to the multi-dimensional scaling (MDS) method (TORGERSON, 1958) applied to the distance matrix of Table 7. The Tam Nai

Table 7. PENROSES' shape distances based on the five mandibular measurements.

	Tam Nai U-Bol	Ban-Kao	Thai	Chinese	Jomon
Ban-Kao	0.204				
Thai	0.379	0.557			
Chinese	0.524	0.889	0.068		
Jomon	0.330	0.067	0.674	1.116	
Japanese	0.630	1.331	0.413	0.200	1.700

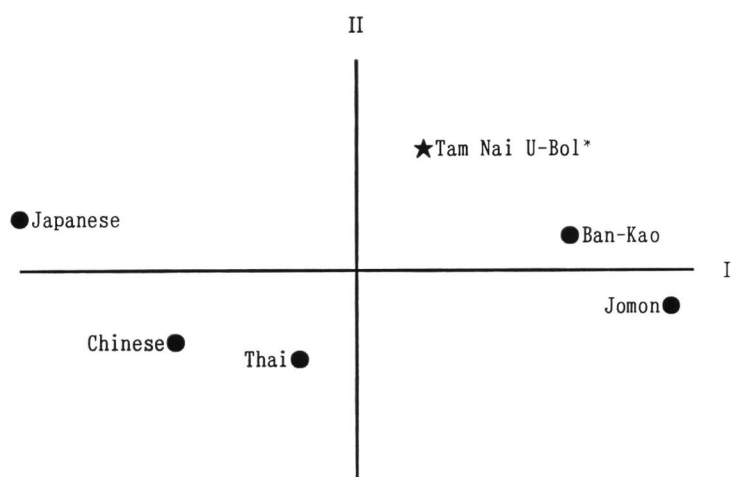


Fig. 5. Two dimensional expression of MDS applied to the PENROSE's shape distances based on the five mandibular measurements. * Mandible 1.

U-Bol is clustered with the Ban-Kao and Jomon Japanese. The modern Thai, Japanese and Chinese are separated from those Neolithic samples as forming another major cluster.

For the calculation of shape distances based on tooth measurements, ten crown diameters (mesiodistal and buccolingual diameters of LC, LP1, LP2, LM1, LM2), which were obtainable from the Tam Nai U-Bol Mandible 1, were used. The data of other population samples were obtained from the Ban-Kao, modern Thai, Chinese, Indonesians, Japanese and Jomon Japanese (MATSUMURA, 1994 & in press). The results are listed in Table 8. Again, a close affinity can be seen between the Tam Nai U-Bol and Ban-Kao. Figure 6 illustrated the results of MDS applied to the distance matrix of Table 8. Three Neolithic samples of the Tam Nai U-Bol, Ban-Kao and Jomon are roughly close to each other, while other modern samples are separated from them.

Table 8. PENROSE's shape distances based on the 10 tooth crown measurements.

	Tam Nai U-Bol*	Ban-Kao	Thai	Thai Chinese	Indonesians	Jomon
Ban-Kao	0.403					
Thai	0.703	0.262				
Thai Chinese	0.510	0.346	0.130			
Indonesians	0.815	0.192	0.083	0.188		
Jomon	0.587	0.159	0.446	0.676	0.455	
Japanese	0.657	0.198	0.075	0.220	0.088	0.352

* Mandible 1.

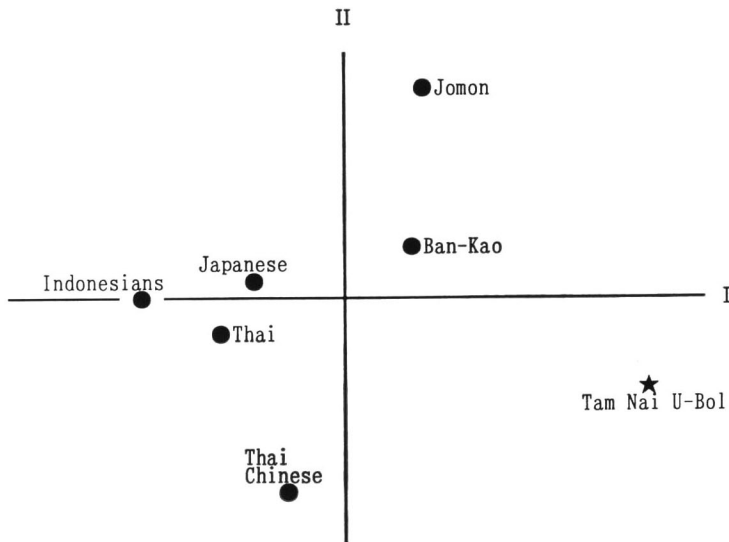


Fig. 6. Two dimensional expression of MDS applied to the PENROSE's shape distances based on the 10 tooth crown measurements. * Mandible 1.

Discussion and Conclusion

The Neolithic human skeletal remains from Tam Nai U-Bol, Tambol Wang-Po, Sai-Yok District Kanchanaburi Province, Thailand were in a rather poor state of preservation. The specimens include at least those of five persons (one adult male, four adult females and one subadult). PENROSE's distance analysis based on the mandibular and tooth crown measurements suggested that in shape components the Tam Nai U-Bol had a close affinity not only with the Neolithic Ban-Kao but also with the Neolithic Jomon Japanese, whereas it had a dissimilarity to the modern Thai and Japanese. In general, there are two factors which cause the differentiation of the mandibular and tooth proportions. One is a nutritional change, and another is an external gene flow. The cause of the discordance between the Neolithic and modern

Thai observed in the mandibular and tooth proportion should be argued from both aspects of their microevolution. Concerning the external gene flow, there are two contrasting theories on the population history of Thailand. It has been generally believed that the Thai people lived in the southern part of China and were driven by Kublai Khan to settle in the territory of the present day Thai Kingdom-Sukhothai dynasty. SANGVICHEN *et al.* (1969), however, who studied the physical anthropology of the Ban-Kao specimens, advocated that the modern Thai mainly originated from the Neolithic indigenous people. To discuss the problem of genetic influence is beyond the aim of this brief paper. Further accumulation of prehistoric human specimens is expected for reliable examination of the microevolution and population history of Thai. According to VAN HECKEREN and KNUTH (1967), the prehistoric Sai-Yok people were not necessarily cave dwellers. They might have lived in the plains near rivers side and used caves as burial sites. The Tam Nai U-Bol will be one of the important sites where prehistoric human skeletons and materials can be recovered by further excavation.

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