Discovery of Fossil *Homo sapiens* from Cho chen in Taiwan

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Abstract. Right and left parietal fragments were found on the river floor of Chai-liao river in Cho-chen, Taiwan. They are considered to be derived from the gravel bed between Tainan formation (middle Holocene) and Kicho formation (middle Villafranchian). They are well fossilized with density of 2.58 (right parietal fragment), brown coloured, lustrous and slightly weathered. The right parietal fragment is thought to have belonged to a young individual, by its thickness (4.1-5.6 mm), weak superior temporal line and opened sagittal suture. The left parietal fragment is thought to have belonged to a full matured individual by its thickness (4.9-6.5 mm) and strong superior temporal line. These two should be attributed to *Homo sapiens sapiens*. The chronological age estimated by fluorine and manganese contents is about 20,000 to 30,000 years B.P.

Cho-chen district along Chai-liao River, east of Tainan, in southwest Taiwan is very famous for rich vertebrate fossils of Villafranchian-late Pleistocene. Different kinds of mammals, reptiles and fishes are found. Middle Villafranchian Cho-chen fauna is represented by *Mammuthus armeniacus taiwanicus*, *Stegodon sinensis*, *S. (Parastegodon) akashiensis*, *Rhinoceros* sp., *Cervus (Depretia) kokubuni*, *C. (D.) syatinensis*, *Capreolus formosanus*, *Elaphurus* sp., *Bubalus* sp., *Sus* sp., *Panthera* sp. and *Tomistoma taiwanicus*, etc. They are derived from beds composed of silty sands, silts and sands in Kicho formation.

TE-LIN KUO and CHANG-WU PAN in Tainan are very ardent fossil hunters of the Cho-chen-Chai-liao area. On 22nd, Nov., 1971, C. C. LING together with WENG-HSUN

SUNG, LIU-YEN, and L. C. CHIN visited KUO's house and were observing his collection, when SUNG discovered a fossil fragment of hominid skull which was obtained earlier by DONG-HUI KUO, a son of TE-LIN KUO, at a point of river floor of Chai-liao River, 100 m west of Cho-qu, Chai-liao. In August of 1973 the KUO's specimen was submitted for study by C. C. LING to T. SHIKAMA when he was staying in Taipei. In January of 1974, T. SHIKAMA visited PAN in his house and the latter submitted another fossil fragment of human skull for study, which PAN obtained earlier at the same point. These two specimens are now stored in the Taiwan Museum in Taipei and called as of the Cho-chen Men.

River cliffs of the Chai-liao River are

composed of the Kicho formation which is overlain with unconformity by sandy sediments of Tainan formation. There is seen a basal gravel bed 1 ± -6 m thick which yields drift woods and *Melanoides* sp. The fossil bones derived from the middle Villafranchian Kicho formation are all much water worn, well fossilized, hard, and dark brown to black coloured. The human fossil fragments in question are not so water worn though brown coloured and heavy. On the other hand, there were some bones obtained at river floor together with the fossils from the Kicho formation; they are not water worn, light and yellowish brown, and seem to be derived from the brown loose sands of the Tainan formation. C. C. LING believes the Tainan formation belongs to the middle Holocene transgression in geohistory; the earliest transgression is dated $6,100\pm400-7,503\pm820$ C¹⁴ y. B.P. C. C. LING and T. SHIKAMA are regarding the human fossils as probably deriving from the basal gravel bed of the Tainan formation exposed at Chai-liao which may be designated as another formation.

The fossils, right and left parietal fragments, are well in preservation and available for anatomical study.

The right parietal fragment extends from the middle part of the sagittal suture to the right parietal tuber (Fig. 1, 2). Its transverse and sagittal diameters are about 8 and 4 cm respectively. It is brown coloured with black dots scattered on the external surface. The lateral two-thirds of the external surface is slightly

weathered, and several narrow grooves radiate from the parietal tuber region, while the medial part and the internal surface are smooth and lustrous. The substance of the fragment is hard and heavy with a density of 2.58.

The sagittal suture is rather simple in form, though its projecting parts have been worn off. It is not closed at all. A weak line observed on the region of parietal tuber is regarded as the superior temporal line. The curve of the fragment in the frontal plane is moderate, increasing its curvature gradually from the sagittal suture to the parietal tuber. The parietal tuber is not so eminent as is typically seen in modern females. The direct length from the parietal tuber to the sagittal suture is about 7.5 cm or more, corresponding with the average value for the Japanese Neolithic males (Table 1).

Larger grooves for the middle meningeal vessels are observed on the internal surface (Fig. 1, 2). Judging from the shape of the branching, they are of the parietal branch arising from the main vessel within the middle cranial fossa. The grooves are not deep relatively, compared to their width. A shallow groove for the superior sagittal sinus is seen along the

Table 1. The direct length from the mid point of the parietal tuber to the sagittal suture. In centimeters.

the right parietal fragment	7.5+
modern Japanese males	7.5
modern Japanese females	7.3
Neolithic Japanese males	7.6
Neolithic Japanese females	7.1

(BABA, H., unpublished data)

Fig. 1. Internal and external aspects of the right parietal fragment. Fractures are arranged around its internal aspect. Natural size.

sagittal suture. The parietal foramen is not visible. A weak depression for arachnoid granulation is seen at the posterior border of the fragment.

Its thickness ranges from 4.1 to 5.6 mm in general. For comparison, points (a, b, c and d) were settled on the fragment after HOSHIBA (1938), (Fig. 2, Table). It is obvious from these data that the fragment falls close to the average value for the modern Japanese males of under 20 years. The thickness of 4.2 mm at the parietal tuber(a) is less than those of late Pleistocene men, and comparable with the value for Japanese early Neolithic men (Table 3).

A sample piece ($2 \times 2 \times 5$ mm) was taken near the point c and cut at about 40 micron by diamond disk after embedding it in bioplastic. The structure of the bone was microscopically observed without staining. The external lamellar layer is

Table 2. The thickness of the right parietal fragment at the settled points compared with those of modern Japanese. In millimeters. (see Fig. 2)

point	a	b	c	d
the right parietal fragment	4.2	5.3	5.0	5.4
young Japanese males	4.2	5.1	5.3	5.6
Japanese males	4.4	5.4	5.4	6.0

(HOSHIBA, M., 1938)

Fig. 2. The contour of the right parietal fragment projected upon the complete right parietal bone of a modern Indian. Internal aspect. About half of natural size. Letters of a, b, c and d indicate the points settled for comparing the thickness with other specimens.

Table 3. The thickness of the right parietal fragment at the parietal tuber(a) compared with those of other specimens. In millimeters.

the right parietal fragment	4.2
Pithecanthropus	12
Sinanthropus	9
Neandertharoid	6-11
Predmosti	6
Hamakita (upper Pleistocene)	7
Mikkabi (upper Pleistocene)	5.5
Hirasaka (early Neolithic)	4
modern Japanese	4.4

(SUZUKI, H., 1966)

well developed in the external table having no secondary osteon (Fig. 5) Most of the cavities of the diploe and part of the havarsian canales are filled with fine silts, which made the specimen heavy. The lacunae and canalicules are stained in black, presumably by manganese compound. In general the microscopic structure of the specimen is completely retai-

ned.

The anatomical characteristics so far suggest that the individual to which the right parietal fragment belonged was very young. It is difficult to determine the sex from these data, but it seems to belong to male rather than to female.

The left parietal fragment occupies the central area of the posterior half of the left parietal bone (Fig. 3,4). It is quadrilateral in shape and about 4×5 cm in size. Its colour is also brown, but a little darker than that of the right parietal fragment.

The medial half area of the external surface is rugged and many little depressions for blood vessels are visible, while the lateral half is rather smooth. The border of these two areas is slightly prominent forming a line from its anterior angle to its posterior angle. This line is regarded as the superior temporal line, which runs about 2 cm medially from the parietal tuber. A rough line observed along its lateral border is referred to as the inferior temporal line.

On its internal surface, grooves for the middle meningeal vessels are visible. They are considered to be of the parietal branch arising from the frontal branch within the parietal bone. The grooves are relatively deeper than those of the right parietal fragment. Cerebral markings are present in the postero-lateral part. There are numerous sharp scraches on the internal surface (Fig. 6). The scraches are also, to a lesser degree, seen on the external surface. They run almost parallel to the sagittal suture from front-medial

Fig. 3. Internal and external aspects of the left parietal fragment. Fractures are arranged around its internal aspect. Natural size.

Fig. 4. The contour of the left parietal fragment projected upon the complete left parietal bone of a modern Indian. Internal aspect. About half of natural size. Letters of b, e and f indicate the points settled for comparing the thickness with other specimens.

to postero-lateral. They are straight, parallel with each other, continuous even in the grooves, and observed all over the internal and external surfaces. But they are not visible in fracture. They are presumed to be made artificially for unknown purpose.

Table 4. The thickness of the left parietal fragment at the settled points compared with those of modern Japanese. In millimeters. (see Fig. 4)

point	b	e	f
the left parietal fragment	5.4	5.4	5.6
Japanese (males and females)	5.7	4.7	5.6

(HOSHIBA, M., 1938)

The thickness of the left parietal fragment ranges from 4.9 to 6.5 mm and the thickness at the settled points (b, e and f) are comparable with those of modern Japanese (Fig. 4, Table 4).

Judging from these evidences, the individual to which the left parietal fragment belonged is fully matured having strong temporal muscles. The sex of the individual is not clear.

These two fragments should be attributed to *Homo sapiens sapiens* by their anatomical characteristics undiffering significantly from those features in the Neolithic and modern Japanese.

The chronological age of the right pa-

Fig. 5. The microscopic structure of the right parietal fragment.

- (1): the external table and the diploe. (3): the silts in the cavities.
 (2): the external lamellar layer. (4): the lacunae and canalicules stained in black.

Fig. 6. Sharp scratches on the internal surface of the left parietal fragment. Natural size.

rietal fragment was estimated by relative age determination methods; the fluorine and manganese contents as follows: the relations between the fluorine and manganese contents of bones from Taiwan and

Japan and the age determined by geological, archaeological and carbon-14 methods give smooth curves on sheets of log. paper (Fig. 7, 8). These relations are also indicated by the experiment using calcium phosphate in a dilute solution of fluorine and manganese. The contents of both elements in the bones are useful for the relative age determination, although they are sometimes variable by the condition of the bones or soils in which they were contained.

The fluorine and manganese contents of this specimen are 0.76% and 0.25% respectively. Because the condition is almost the same as that of the bones in Fig.

Fig. 7. The relation between the fluorine content of bones from Taiwan and Japan and their age. (SHIMODA, N. and KITAMURA, T. 1975)

Fig. 8. The relation between the manganese content of bones from Taiwan and Japan and their age. (SHIMODA, N. and KITAMURA, T. 1975)

7,8, the age of this specimen can be estimated, using the curves, at about 20,000 to 30,000 years B.P.

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台湾の左鎮にて発見された頭頂骨片

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右および左頭頂骨片が台湾左鎮郷菜寮溪の河原から発見された。化石化や磨耗の程度から、台湾層（中期沖積世）と崎頂層（ヴィラフランカ階）にはさまれた礫層に由来すると考えられる。

右頭頂骨片は、矢状縫合が閉鎖せず、中硬膜動脈溝が浅く、上側頭線も弱い、また厚径も比較的小さい（4.1～5.6 mm）ことなどから、若い個体のものと推測される（Fig. 1, 2, Table 1, 2）。

左頭頂骨片は、中硬膜動脈溝が比較的深く、上側頭線が顕著であり、厚径も右頭頂骨片より大きい（4.9～6.5 mm）ことなどから、成熟した個体のものと推測される（Fig. 3, 4, Table 3）。この骨片の表面には、多数の鋭い条痕が見られ、人工的に形成された可能性が高い（Fig. 6）。

両骨片の形態学的特徴は、縄文時代あるいは現代日本人と本質的に差異がない。従ってこれらは *Homo sapiens sapiens* に属すると考えられる。

右頭頂骨片のフッ素およびフンガンの含有量から推定された年代は、約二万年前から三万年前である（Fig. 7, 8）