On Some Choukuotien Mammals from Isa, Yamaguchi Prefecture, Japan

By

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When the writers reported the spelean stratigraphy of Akiyoshi limestone plateau in 1958, they divided Isa beds into upper (J_2) and lower (J_1). Akiyoshi brown clay bed (J_3) overlying Isa beds widely covers the karst plateau of that area. From these beds they reported many vertebrate fossils. In 1958 the senior writer visited the Akiyoshi area, having been informed by the junior writer of the occurrence of large sized Panthera from Hinotsu quarry, about 5.6 km north of Isa-chô. It is said that the skull of Panthera was found on August 7th, 1958 from the red earth covering the limestone karren of the quarry. On September 30th, 1958 two teeth of small sized Panthera were found from red clay covering karren of Isa quarry of Ube Kôsan Company and on October 1st, 1958 a tooth of *Stegodon* from the same bed.

It is very noteworthy that all these fossils occurred from rather hard compact red clay covering karrenfeld and that they are of Choukuotienian in ag. So in the Akiyoshi area it becomes necessary to distinguish red hard clay and Akiyoshi brown clay which often covers the stalactite cave deposits. The writer treates the red clay as the lower part of Isa beds, hence in the Akiyoshi area the spelean deposits of Isa beds are also divided into three, i.e., lower, middle and upper, as in Kuzuü beds, and the lower Isa bed is correlated to the lower Kuzuü bed.

Here the writers extend their hearty thanks to Mr. H. MITO for his

Geochronology of the spelean deposits in Akiyoshi area.

Age	Fissures			Caves	Fossil beds	Remarks
K	Black earth					
	Mukôyama bed			Chôgatsubo bed	*Sus* bed	Koziki cave
J_3	Akiyoshi brown clay bed				*Canis familiaris* bed	
J_2	Isa bed	Up.	Gravelly clay	Hûsenana bed	*Anourosorex-Sinomegaceroides* bed	Small cave Cave terrace of Syuhô cave
J_1		Mid.	Sand & gravel Travertine			Transgression of ground water Syuhô cave
I		Low.	Red clay		*Stegodon-Felis* bed	Residual clay Karrenfeld

efforts to facilitate their studies and also to Mr. Y. HASEGAWA for his kind help during the course of this study.

Panthera youngi (PEI), 1934

(Pl. II, figs. 1-5)

1934 *Felis youngi* PEI Pal. Sin., ser. c, vol. 8, fasc. 1, pp. 133-135, pl. 23, figs. 1, 4.

Specimens: Upper and lower jaws with teeth.

Upper jaw

Rostrum of large size preserved with right and left I^1-I^3, C, P^2 and P^3; premaxilla entirely and maxilla largely preserved. Sutures and cavities of bones filled with hard calcareous red clay; surface of bones greyish whith to yellowish brown in colouration. Anterior portion of right palate and posterior inner portion of left palate cracked to anterior palatal foramen; in palatal view, cracks run from posterior of right I^3 through the foramen to middle of left palate; jaw anterior of these cracks deformed owing to pressures in anterio-posterior direction. Anterior portion of left premaxilla in better preservation than that of the right one, while posterior portion of the former poorer than that of the latter. Right rostrum bearing I fractured and dislocated backward. Posterior portion of maxilla broken and anterior portion of it, anterior of infra-orbital foramen, preserved; portion just anterior and inferior of orbit unpreserved.

Premaxilla and maxilla rather like those of *P. tigris* and *P. pardus* in general outline. Palate moderately depressed.

Dimensions follow.

Median longitudinal length of palate as preserved	67.0 mm
Width of right half of palate just behind of C	50.0
Width of left premaxilla posterior of I_3	26.0
Height of left premaxilla just anterior of C	41.0
Median longitudinal length of rostrum anterior of palatal foramen	38.0
Maximum width of upper jaw as preserved	111.0
Maximum height of right side of ditto	74.0
Length of right maxilla as preserved	75.0
Dimensions of left anterior palatal foramen	25.0+×11.0±

Upper teeth

Incisors

I^1 smallest and I^3 largest. I^1 tubiform, longer than wider in anterio-posterior direction and with long root. Crown sectoral expanding distally in anterior view; distal margin of crown of left I^1 a little concave upward. Anterior surface of crown gently convex anteriorly while interior surface of ditto nearly flat. In inner view, tooth gently curved posteriorly and crown subtrigonal with convex anterior- and posterior margins; posterio-distal margin

strongly notched. Median transverse depression of grinding surface tolerably sharp and subcrescentic in palatal view. I^2 like I^1 in general outline; crown of ditto a little wider and tolerably longer than in I^1. Distal margin of crown projected downward in anterior view. Median transverve depression of grinding surface very distint and irregularly pendulate in palatal view. I^3 much longer than I^2 and much projected downward. In anterior view, crown subtrigonal with nearly straight outer- and convex inner margins. In outer view, crown trigonal with convex anterior- and nearly straight alveolar- and posterior margins. Median transverse depression of elongate oval runs from median inner corner to posterio-outer corner; main cusp and accessory posterior cusp lie on inner point of both borders of depression: tip of main cusp broken in right tooth; borders of depression very sharp; outer crest of the anterior border of depression runs almost vertical to alveolar margin. Basal cingulum moderate.

	I_1		I_2		I_3	
	Right	Left	Right	Left	Right	Left
Anterio-posterior length.....	8.4	8.6	8.9	9.2	13.2	14.7 mm
Transverse width.....	7.0	6.8	7.2	7.3	11.0	11.7
Height of crown	9.0	9.3	10.0	9.8	12.8+	16.9

Canine

Tooth largesized but unpreserved except in alveolar sheath. Root of right C about 73 mm long along anterior border as preserved. Diameters of left C at base of crown 33.5×23.8 mm and enamel wall of ditto about 5 mm thick at inner side and 4.5 mm at outer side. Transverse section of tooth suboval and inner margin more convex than outer.

Premolars

P^2 very small and rudimentary; a part of root preserved in right tooth but left tooth unpreserved and only alveolar sheath visible, oval in cross section and 9×6 mm in diameters. Crown of P^3 totally unpreserved in right tooth and largely in left tooth, of which only anterio-inner corner preserved. Root long and anterior cusp relatively low and trigonal in lateral view. Left tooth about 22 mm long and 11 mm wide at crown base.

Lower jaw

Symphysial portion and anterior half of left ramus preserved while right ramus largely unpreserved. Mandibule large, dense, thick and stout. Left ramus 105 mm long as preserved, 49.5 mm high, 19.5 mm thick at a portion just before P_3, 42.0 mm high and 22 mm thick before M_1. Lower margin of ramus almost straight but slightly convex at a portion just below C; upper margin of ramus also nearly straight and a little bent backward. Diastema between C and P_3 23.3 mm long and carries a sharp crest which runs near interior. Upper outer surface below cheek teeth runs almost vertical to a gnawing plane, while that of inner slopes interiorly. In inner view, line of

alveolar sheath gently curved convex exteriorly. Inferior dental foramen oval, 9.0×5.0 mm and situated below anterior end of P_3 and a little higher than middle height of ramus: a shallow groove runs from the foramen to posterior of C and gently concaves upward at right ramus. Lower border of ramus strongly curved at symphysial portion and convex anteriorly. Symphysis broad and long; symphysial surface nearly flat, 51 mm long and 40.7 mm wide. Anterior surface a little rugose and carries two small foramens at a portion interior of C.

Left P_3, P_4 and M_1 well preserved but both I and C all broken with their crowns unpreserved. Root of I elongate oval in section, setting their longer axis vertically.

Diameters of right I_1	10.0×4.0 mm
Ditto of right I_2	9.5×4.0
Ditto of right I_3	10.0×4.5

C large, gently curved and oval in cross section. Root of right C 30.8× 18.0 mm in diameters of anterior portion. Inner wall a little thicker than the outer, 4 mm thick anteriorly and 2 mm thick posteriorly. Exterior surface a little more convexed than interior.

Cheek teeth

United length of P_3-M_1 69.3 mm. P_3 relatively large and low with bluntly projected main cusp and well developed anterior cusp; posterior cusp relatively low and long; basal cingulum well developed. Tooth quadrate in upper view with almost straight inner- and outer margins. P_4 proportional in size and outline to P_3; main cusp distinctly projected with sharp edge; anterior edge a little longer than posterior. Anterior cusp larger than posterior also with sharp edge. Basal cingulum especially well developed posteriorly. In upper view, tooth subquadrate and becomes broader posteriorly; outer margin almost straight while inner moderately curved.

M_1 blade like with sharp edge and two distinct cusps; alveolar margin distinctly convexed downward in outer view, but slightly curved in inner view; anterior cusp a little lower than the posterior; posterior edge of anterior cusp shorter than anterior edge of posterior cusp; anterior edge of anterior cusp a little bent backward while posterior edge of posterior cusp almost vertical to alveolarg margin. Median inner surface of crown distinctly depressed and valley like. Tooth subcrescentic in upper view with almost straight inner- and gently curved outer margins.

	P_3	P_4	M_1
Anterio-posterior length	18.7	24.5	27.8 mm
Maximum transverse width	10.0	13.2	14.0
Maximum height of crown	11.6	15.7	17.0

Remarks:

This large *Panthera* may belong to *youngi* reported by PEI from Choukuo-

tien cave (*Sinanthrops* formation); although it is smaller than the Choukuotienian specimen, the stout and well developed symphysis of lower jaw is very much like that of the latter.

Panthera sp. cf. *pardus* (L.)

(Pl. II, figs. 6–11)

Specimens: Upper left C and upper right P^4, occurred in September, 1958 from red clay of Isa quarry.

Description:

P^4. Teeth well preserved except tips of roots; crown light yellowish brown, root yellowish white in colouration. Blade long with distinct main cusp which is sharply projected and trigonal in lateral view; hind cusp subtrigonal in a same view with undulated edge; alveolar margin below hind cusp much convexed and edge of blade between main- and hind cusps eminently notched; interior surface of blade flat and almost vertical to palatal surface, while exterior surface is much depressed and valley like at just outside the notch. Parastyle and deuterocone eminent, rugose and nodular. Basal cingulum moderately well developed at outer side. Tooth 35.5 mm long and 14.2 mm wide; main cusp 13.5 mm high.

Canine. Tooth broken in tip of root which is yellowish white in colouration while crown is yellowisn brown. Crown elongate trigonal in lateral view with strongly curved anterior- and posterior margins. In anterior view, alveolar margin slopes interiorly and inner margin of crown runs from interio-proximal- to exterio-distal corners. Posterior surface of crown carries a sharp edge. Basal cingulum indistinct. Crown 24.6 mm high, 14.0 mm long and 10.6 mm wide, while tooth including root 51 mm high.

Premolar is rather like that of *Panthera pardus* (L.) in general aspect and size. *P. teilhardi* (PEI) is smaller than this species, while *P. tigris* (L.) and *P. youngi* (PEI) may be larger.

Stegodon orientalis OWEN, 1870

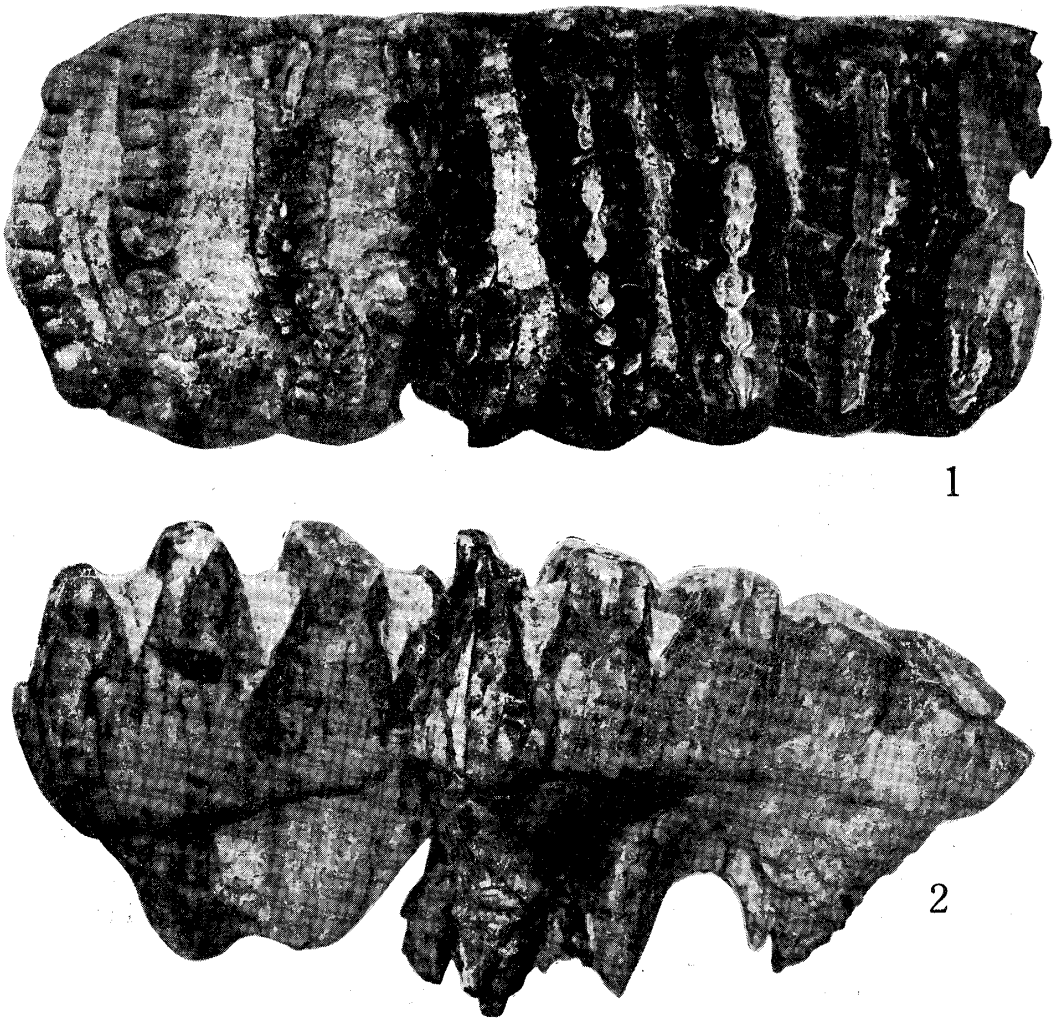
(Text-figs. 1, 2)

1870 *Stegodon orientalis* OWEN: Quart. Jour. Geol. Soc. London, vol. 26, pp. 421–422, pl. 28, figs. 1–4.
1929 *Stegodon orientalis grangeri* OSBORN: Amer. Mus. Nov., no. 393, pp. 16–17.
1938 *Stegodon orientalis* OWEN, TAKAI: Jap. Jour. Geol. Geogr., vol. 15, nos. 1–2, pp. 70–72, pl. 5, figs. 1, 2, text-figs. 1, 2.
1949 *Stegodon orientalis* OWEN, SHIKAMA: Sci. Rep. Tôhoku Univ., ser. 2, vol. 23, pp. 71–73, pl. 5, fig. 1, pl. 32, fig. 43.

Specimen: Upper left M^2 belongs to Ube Kôsan Company.

Description:

Tooth 165 mm long and 69.8 mm wide at penultimate ridge at base, where



Text-figs. 1 and 2. *Stegodon orientalis* OWEN. Upper left M^2 from Isa-quarry, Ube Kôsan Comany. 1: Grinding surface. 2: Buccal side.

it is broadest; nine ridges with a talon preserved, of which anterior six worn; dentine islets exposed. Median and interior portion of first ridge, posterior half of sixth ridge and ground surface of seventh ridge much broken; inner corners of ridges from third to seventh and their outer corners from fourth to eighth broken. Tooth elongate quadrate in palatal view with almost straight inner- and outer margins, the latter which a little flared in posterior half; posterior margin slightly convexed posteriorly.

First and second ridges confluent with one another and strogly worn, the former being very narrow; posterior wall of inner half of first ridge a little crenulated and runs oblique to inner margin of tooth. Posterior wall of second ridge notched at its median portion and distinctly projected anteriorly. Enamel walls of second to fifth ridges tolerably thick and intensely crenulated, 5 mm thick at third ridge and 4 mm at fourth ridge. Both inner and outer corners of second ridge semicircular, while those of third ridge almost straight.

Anterior wall of third ridge irregularly crenulated and dentine islet elongate-quadrate. Third and fourth ridges a little convergent outward, making an angle of 8° with each other. Posterior wall of second ridge and anterior wall of third ridge closely set, while succeeding ridges become wider in separation from each other. Anterior and posterior walls of fourth ridge moderately crenulated while those of fifth ridge nearly straight. Five dentine islets exposed on fourth ridge, of which the innermost one is the largest and the second one from outer the smallest; the former elongate quadrate and the latter subcircular; inner four islets unseparated. Six dentine islets exposed on fifth ridge well separated from one another and the innermost one the largest and elongate subquadrate; second one from outer the smallest and circular. Seventh and eighth ridges much wavy and their outer half shifted anteriorly with a valley between them wider than eighth ridge. Eighth ridge has above eight mammillae unworn, of which fifth one from inner is the largest. Ninth ridge not so wavy as eighth, with nine unworn and uneven mammillae, of which the innermost and outermost ones are the largest. Talon small, low, narrow, about half the height of ninth ridge; it carries nine uneven mammillae. 39.6 mm long, 3 mm wide and 24.5 mm high.

All ridges taper acutely and are separated by deep valleys. Cement, moderately developed on fourth to seventh valley, without reaching grinding surface of ridges. Basal cingulum well developed on inner side but not so on the outer; tubercles present on first to third valleys of inner margin and seventh valleys of outer margin. In inner lateral view, alveolar margin slightly curved and grinding surface marked an angle of about 10° with anterior alveolarg margin. Enamel surface a little rugose and with many longitudinal grooves and minute transverse striations. Ridge frequency in 100 mm being 6 at anterior-inner base, 5.5 at posterio-inner and outer base, 5 on grinding surface.

Dimensions of ridges as preserved follow.

	1	2	3	4	5	6	7	8	9
									mm
Greatest length at base	50.1	66.1	64.4	67.3	66.2	67.6	67.8	70.5	57.9
Ditto at grinding surface	57.8	64.5	60.6±	65.0±	64.3	—	—	62.1±	54.1±
Inner width at base	—	13.9	19.4	19.6	20.0	17.7	19.5	16.0	11.6
Outer width at base	6.7	16.5	15.3	17.5	18.9	—	22.0±	18.2	15.4
Median width on grinding surface	—	19.7	16.2	13.4	11.3	—	10.6	8.7	6.8
Height at inner side	12.4	16.3	20.5	23.8±	29.4±	—	—	37.0	27.4
Ditto at outer side	15.8	18.2	25.7	32.7	—	33.2±	35.1±	—	40.6
Difference of both heights	3.4	1.9	5.2	8.9	—	—	—	—	13.2

Width of valleys on grinding surface and along the median londitudinal line	1	2	3	4	5	6	7
	2.7	5.6	9.0	11.9	9.1	14.1	7.7

Remarks:

The specimen quite resembles in general outline and size the teeth from

Ôgano and Izuruhara, Kuzuü described by TAKAI and the senior writer. *Stegodon orientalis graneri* OSBORN reported from Sze-Chwan is regarded by COLBERT, H. and HOOIJER, A. as synonymous with *orientalis* OWEN. TAKAI's sample from Ôgano, right M_2 is 159 mm long and carries 9 ridges. COLBERT and HOOIJER consider the ridge number of M_2 in this species to be 8/9, while OSBORN considers it to be $\frac{1}{3}$-8-$\frac{1}{3}$/?-9-$\frac{1}{3}$. Lateral aspect of the ridges and valleys of the specimen now at hand closely resembles that from Sze-Chwan described by COLBERT and HOOIJER.

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Explanation of Plate II

Panthera youngi (PEI)

Fig. 1. Upper jaw from Hinotsu quarry. Palatal side, ×0.77.
Fig. 2. Ditto. Right side, ×0.77.
Fig. 3. Ditto. Anterior side, ×0.77.
Fig. 4. Lower jaw from Hinotsu quarry. Upper side, ×0.85.
Fig. 5. Ditto. Left buccal side, ×0.85.

Panthera sp. cf. *pardus* (L.)

Fig. 6. Upper left C from Isa quarry, Ube Kôsan Company. Buccal side, ×1.
Fig. 7. Ditto. Lingual side, ×1.
Fig. 8. Ditto. Crown side, ×1.
Fig. 9. Upper right P from Isa quarry, Ube Kôsan Company, Buccal side, ×0.84.
Fig. 10. Ditto. Lingual side, ×0.84.
Fig. 11. Ditto. Crown side, ×0.76.

Hasegawa photo