

**Stratigraphic Position of the Chochen Vertebrate Fauna of the T'ouk'oushan Group
in the Environs of the Chochen District, Southwest Taiwan,
with Special Reference to Its Geologic Age**

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1. Introduction and Acknowledgements

The Early Pleistocene deposits called the T'ouk'oushan Group is distributed in the hilly land area of west Taiwan ranging from the southern part of Taipei Prefecture to the Heng-chiung Peninsula. This group is made up mostly of sand, silt, gravel and their alternation and total thickness exceeds one thousand meters and yields abundant land vertebrates, marine and fresh water molluscs, foraminifers and plant fossils. This group has been studied by many authors from the paleontological, geological and magnetostratigraphical points of view (Saito, 1926; Hayasaka, 1929, 1930a-e; Torii, 1932; Lin, 1933, 1935; Tan and Lin, 1934; Tokunaga, 1936; Kaneko, 1941; Shikama, 1937, 1972; Shikama *et al.*, 1975; Huang, 1967, 1975, 1976; Stach, 1955; Otsuka and Shikama, 1978; Ueno, 1978; Liew, 1978; Liu, 1978; Chen *et al.*, 1977; Kanai and Otsuka, 1979).

The vertebrate fauna from the T'ouk'oushan Group includes more than ten kind of animal as monkey, tiger, rhino, wild boar, elephant, deer, wild ox, water buffalo, whale, crocodile, tortoise and pisces etc. By the abundant occurrence of these vertebrate fossils, the T'ouk'oushan Group has been regarded as one of representative Early to Middle Pleistocene deposits in Northeast Asia.

Main fossil localities in Tainan Prefecture are known in the eastern hilly land area situated about 15 km east of Tainan City, especially in the environs of the Ch'ailiao and the Yenshui Rivers, tributaries of the Tsenwen River. Most

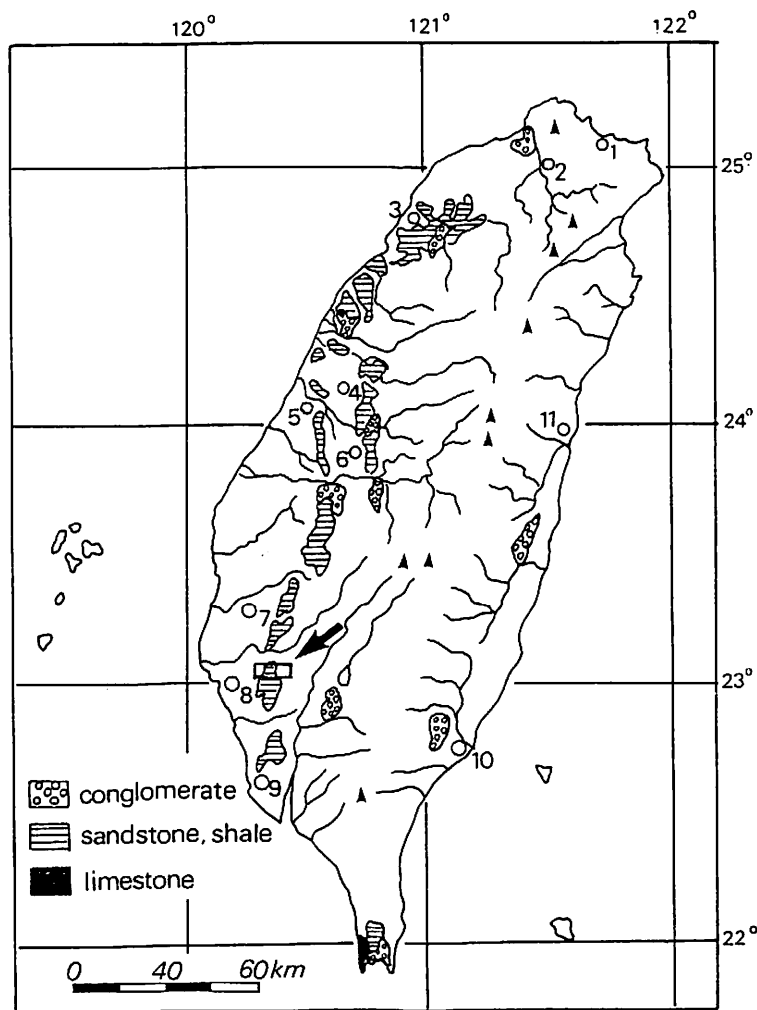
of the vertebrate fossils were collected from the river floor after heavy floods by amateur fossil collectors living in Tainan Prefecture. Therefore, the sources of them, namely, the beds originally containing the vertebrate fossils are hardly confirmed on the available evidences. However, they are presumed to be washed out from the Ch'iting Formation exposed along the river walls (Hayasaka, 1932b, 1932c, 1942; Lin, 1933; Shikama, 1937, 1972; Shikama *et al.*, 1975; Otsuka and Shikama, 1978). Actually, some of the specimens were picked up from debris after heavy rain falls or excavated directly from the beds of the Ch'iting Formation.

In 1974, the late Professor Tokio Shikama, Mr. Yukimitsu Tomida and the writer visited Taiwan and spent several days for field works in the area along the Ch'ailiao River between Chochen Village and Wantan and the Yenshui River. The purpose of field works were to clarify the stratigraphy of the Ch'iting Formation in detail and to reveal the stratigraphic position of mammalian fossil and their vertical distribution. A preliminary reports on the results of this study has already been published by Shikama *et al.*, (1975) and Otsuka and Shikama (1978).

In the present article, the writer described the mammalian beds discriminated in the Ch'iting Formation and discussed the geologic age of the "Chochen vertebrate Fauna".

The present study was initiated and continued under the powerful leadership of the late Professor Tokio Shikama of Yokohama National University, to whom the writer wishes

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Text-fig. 1. Map showing the distribution of the T'ouk'oushan Group (after C. C. Lin, 1963). Arrow indicates the Chochen district. 1: Chilung, 2: Taipei, 3: Hsinchu, 4: Taichung, 5: Changhua, 6: Nant'ou, 7: Chiayi, 8: Tainan, 9: Kaohsiung, 10: Taitung, 11: Hualien.

to express his deepest application.

The writer should like to express his sincere thanks to Mr. Liu Yen, the former director of the Taiwan Provincial Museum, who together with late Mr. Liang-Cheng Chin, enabled the Japanese party to operate in Taiwan in 1974. The writer is deeply indebted to the Japanese Interchange Association for financial support. Acknowledgements are also due to the following persons in Taipei for their kind help and encouragement during the course of this study: Professor Chao-Chi Lin of the National Taiwan University and Min-Nen Cheng in Taipei. The writer wishes to express his cordial thanks to Mr. Chun-Muh Chen in Ch'ailiao, Mr. Te-Lin Kuo and Mr. Chang-Wu P'an in Tainan City for their effective support and assistance in field work and for kindly offering some of the fossil specimens to the writer. Sincere thanks are also due to Dr. Hiroshi Ozaki, Honorary curator of the National Science Museum of Tokyo, Professor Shozo Hayasaka of the Kagoshima University, Dr. Teruya Ueno and Mr. Yukimitsu Tomida of the National Science Museum of Tokyo for their kind advice and encouragement.

II. Stratigraphic Positions of the Vertebrate Fossils in the T'ouk'oushan Group in the Environs of the Ch'ailiao and the Yenshui Rivers, Chochen District

The field works in the environs of the Ch'ailiao and the Yenshui Rivers held in 1974 by the late Professor Tokio Shikama, Mr. Yukimitsu Tomida and the writer have resulted in clarifying the stratigraphy of the Ch'iting Formation in detail and revealing the stratigraphic positions of the vertebrate fossils and their vertical distribution. The result of the field works are as follows:

1. Stratigraphy

(1) Gutink'eng Formation (= Koteiko Formation by Torii, 1933)

In the studied area, the Gutink'eng Formation is exposed along the river side in the east of Chochen. This formation consists mainly

of dark grey sandy shale and the upper part of this formation grades upward into the sandy silt bed of the Ch'iting Formation.

(2) Ch'iting Formation (= Kicho Formation by Torii, 1933)

The Ch'iting (= Kicho) Formation, typically exposed in the area along the Ch'ailiao River between Chochen and Ch'ailiao, is composed mainly of thick sand and silt beds and yields abundant marine molluscs, foraminifers and vertebrates. The bed strikes $N10^{\circ}-30^{\circ}W$ and dips 10° to $25^{\circ}W$. This formation is lithologically divided into two members, the lower and the upper (Torii, 1933; Shikama *et al.*, 1975). Furthermore, the lower member is subdivided into four and the upper into six lithologic units (KL1 - KL4, KU1 - KU6) (Shikama *et al.*, 1975; Otsuka and Shikama, 1978) (Table 1 and Text-fig. 3).

The Lower Ch'iting Formation by Shikama *et al.* (1975) almost corresponds to the Upper Gutink'eng Formation by Stach (1955) discriminated in the Ch'isan section, southeast of Chochen. This formation is well exposed in a limited area along the river side near Chochen. Lithofacies of each unit are given in Table 1.

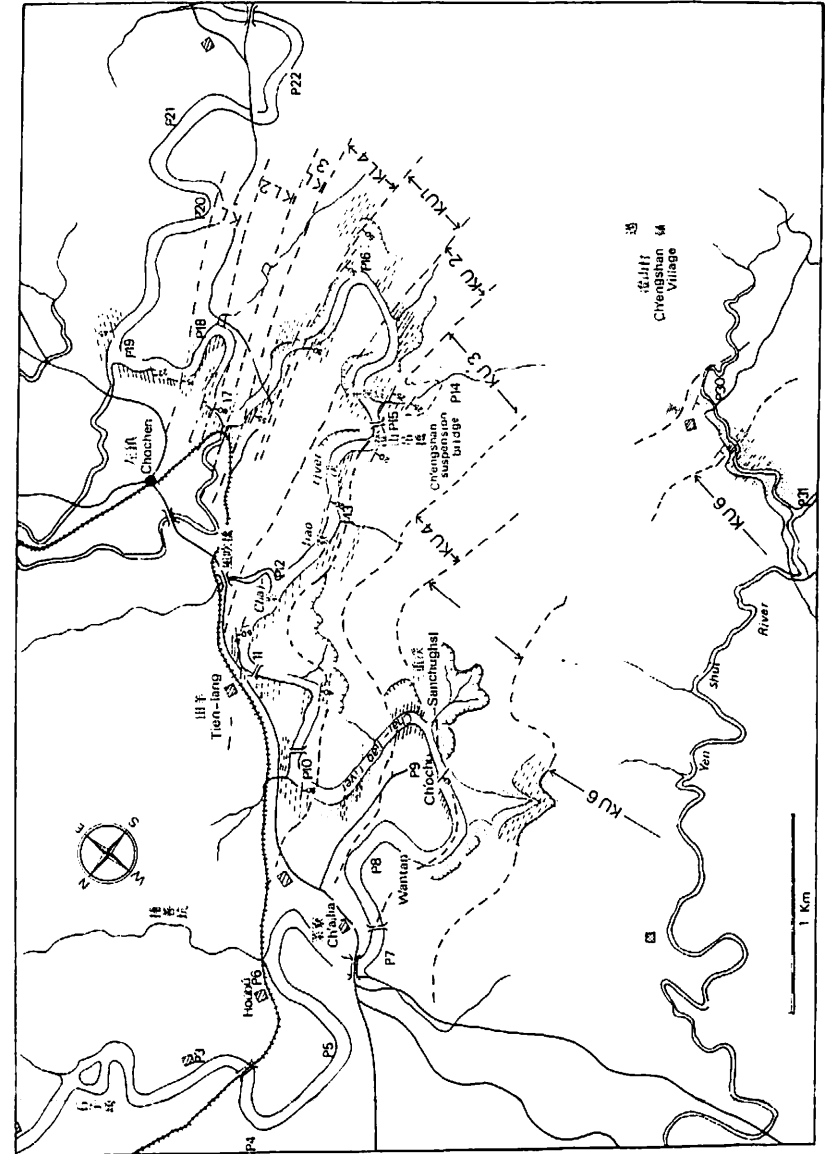
The Upper Ch'iting Formation is composed mainly of coarse-grained sand with thick silt layers and is subdivided into six lithologic units (KU1 - KU6). The Upper Ch'iting Formation is distributed in the environs of the Chengshan village. Especially there are a few large exposures of the beds along the Yenshui River where the formation is composed mainly of sand with frequent intercalations of silt. The bed strikes $N25^{\circ}$ to $30^{\circ}W$ and dips 10° to $15^{\circ}SW$. The Upper Ch'iting Formation in the present paper almost corresponds to the Erchungchi Formation by Stach (1955). The uppermost part of this formation is not distributed in the studied area.

2. Stratigraphic position of the vertebrate fossils in the Ch'iting Formation

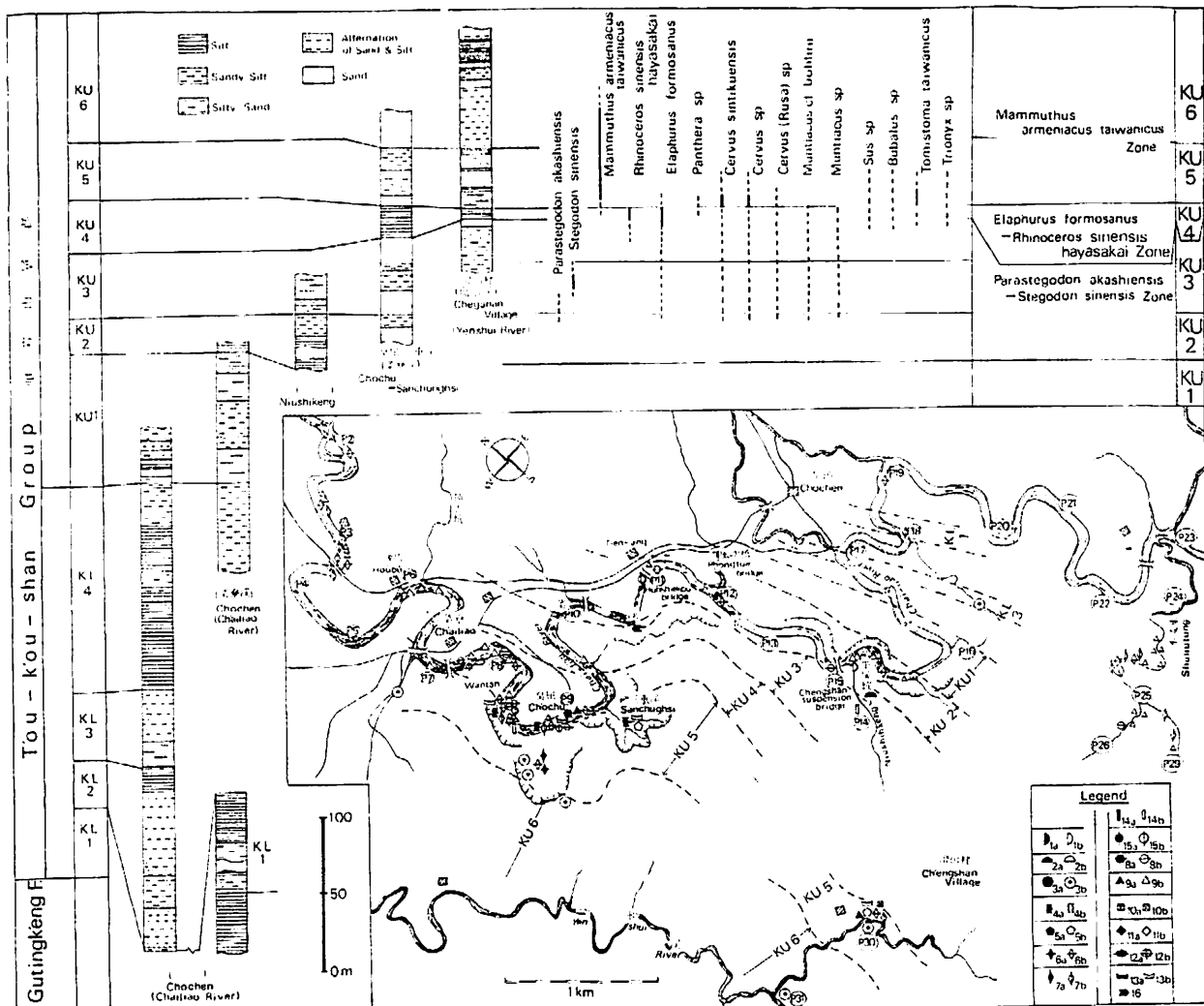
Three main localities of the vertebrate fossils in Chochen district area; (1) river floor or river sides of the Ch'ailiao River and its tributary between Ch'ailiao and Chochen villages, (2) valley of Suiilutung, a tributary of

Table 1. Stratigraphy of the Ch'iting Formation exposed in the area along the Ch'ai-liao River, Chochen District.

Lithofacies and fossil	
Ch'iting Formation	Upper Member (LU)
	KU6: Yellowish brown coarse-grained sand (+15m). KU5 and KU6 are largely exposed in the area of the upper Sanchunghsi, Chengshanchun and the southern river side of Ch'ai-liao. To date, many specimens of <i>Mammuthus armeniacus taiwanicus</i> , <i>Rhinoceros sinensis hayasaki</i> and <i>Tomistoma taiwanicus</i> etc. were found by Messrs. Chen, Kuo and P'an from Sanchunghsi (Loc. P9).
	KU5: light brown coarse-grained sand (6m), silt with abundant shells of <i>Placuna placenta</i> (1m), brown coarse-grained sand with thin silt layers (22m), massive sandy silt (15m).
	KU4: grey massive silt with thin sand (20m) and yields abundant marine molluscan fossils such as <i>Placuna</i> , <i>Umbonium</i> , <i>Batillaria</i> , <i>Ostrea</i> and <i>Anadara</i> etc.
	KU3: coarse-grained sand with thin silt layers (25m), alternation of sand and silt (17m) and yellowish brown coarse-grained sand (20m) in ascending order. Mr. Kuo collected a fish fossil from the basal part of this unit. Mrs. Wu collected a molar of <i>Stegodon sinensis</i> from coarse-grained sand bed exposed in the neighbourhood of Niushihkeng. Locs. P13, P14 and P15 are located in the distribution area of this unit.
	KU2: bluish green fine-grained silt and alternation of silt and sand (20m) with some marine molluscan fossils as <i>Monileta</i> and <i>Paphia</i> . This unit is exposed in the neighbourhood of Chengshan suspension bridge between Loc. P15 and P16. Mr. P'an collected a molar of <i>Stegodon (Parastegodon) akashiensis</i> .
KU1: sand with thin silt layers (67m), medium- to fine-grained sand with thin silt layers (15m), silty sand (19m), medium- to coarse grained sand with silt layers (20m), alternation of sand and silt (5m), massive medium-grained sand with thin silt layers (8m), in ascending order. This unit is exposed in the neighbourhood of Loc. P16 making a hogback landscape and yields abundant marine molluscan fossils such as <i>Pecten</i> , <i>Cucullaea</i> , <i>Natica</i> and <i>Dentalium</i> etc.	
Lower Member (KL)	KL4: massive bluish grey silt (65m), sandy silt (7m), silty sand (5m), bluish grey massive silt (30m), massive grey sandy silt (25m), alternation of silt and sand (4m), in ascending order. Marine molluscan fossils are found abundantly in this unit.
	KL3: coarse-grained sand with thin layers of silt (17m) and alternation of fine sand and silt (32m), carrying marine molluscan fossils such as <i>Ostrea</i> etc. Mr. Kan picked up a right lower jaw of <i>Mammuthus armeniacus taiwanicus</i> from the rivulet of the Ch'ai-liao River about 900 meters east of P17.
	KL2: alternation of thin layers of sand and silt (25m), massive grey sandy silt (20m), alternation of sandy silt and sand (60m) and clay with thin layers of sand (15m) in ascending order. Marine molluscan fossils such as <i>Venericardia</i> and <i>Dentalium</i> etc. are occurred from Loc. P17.
	KL1: lower grey sandy silt (20m) and upper massive bluish grey silt (40m) with thin layers of sand. These beds are exposed in the area near Loc. P17 and yields marine molluscan fossils such as <i>Paphia</i> , <i>Crassatellites</i> etc.



Text-fig. 2. Route map of the Fouk'oushan Group along the Ch'ai-liao and the Yen-shui Rivers of the Chochen district, Tainan Prefecture. KL1-KL4: Lower Ch'iting Formation, KU1-KU6: Upper Ch'iting Formation.



Text-fig. 3. Figures showing the geological columns and range chart of vertebrate fossils of the Tou-kou-shan Group along the Ch'ai-liao and the Yen-shui rivers of Cho-chun district. Distribution of the vertebrate fossils are also shown in the map. Legend: a: the specimens picked up from the degraded sediments or excavated from the bosts; b: the specimens collected from the river floor. 1. *Stegodon* (*Parastegodon*) *akashiensis*, 2. *Stegodon sinensis*, 3. *Mammuthus armeniacus taiwanicus*, 4. *Tomistoma taiwanicus*, 5. *Rhinoceros sinensis hayasakai*, 6. *Cervus* (*Sika*) sp., 7. *Cervus* (*Sika*) *taiwanicus*, 8. *Muntiacus cf. bohtini*, 9. *Elaphurus formosanus*, 10. *Panthera* sp., 11. *Cervus* (*Rusa*) sp., 12. *Sus* sp., 13. *Trionyx* sp., 14. *Bubalus* sp., 15. *Muntiacus* sp., 16. pisces, 17. *Stegodon* cf. *orientalis*.

Ch'aiiao River and (3) river floor of the Yenshui River. Each fossil localities are shown in Fig. 3. In this map, the mode of fossil occurrence is shown in two different ways; one of which deals with the specimens collected from the river floor and another those picked up from the degraded sediments or excavated directly from the bed of the Ch'iting Formation.

It is quite easy to suppose that the fossil specimens scattered among the gravels on the river floor might be washed out from the beds exposed in the area along the Ch'aiiao River or its rivulets during the season of heavy rain falls and these were transported to the spots of the fossil accumulation in the Ch'aiiao River by the river flows. Therefore, it seems to be difficult to confirm the source beds of their derivation, however, it seems to be possible to some extent to presume the sources of them judging from the density of their distribution on the river floor (Fig. 3). On the otherhand, it is rather easy to decide the bed of their source when the specimen is picked up from the debris near the outcrop at the heavy rain falls or excavated directly from the beds of the Ch'iting Formation.

As shown in Fig. 3, the most of the vertebrate fossils from the river floor of the Ch'aiiao River were picked up from the area between the neighbourhood of the Ch'engshan suspension bridge and Shizigi, while in the area of the Yenshui River, these were mostly collected from the neighbourhood of the Ch'engshan village. These accumulated data indicate that the most of the vertebrate fossils in Chochen district appears to be yielded from the Upper Ch'iting Formation.

(1) Ch'aiiao River area

A. From the entrance of Niushik'eng and the river side near the Ch'engshan suspension bridge, several specimens of *Elaphurus formosanus*, *Muntiacus cf. bohlini*, *Muntiacus* sp. were collected and these were judged to be washed out from the silt or sand beds of KU2 (Otsuka and Shikama, 1978). An well-preserved molar specimen of *Stegodon sinensis* was also collected by Mrs. S. P. Wu from the compact, massive sand bed with grey silt belonging to the lower part of KU3 (Shikama et

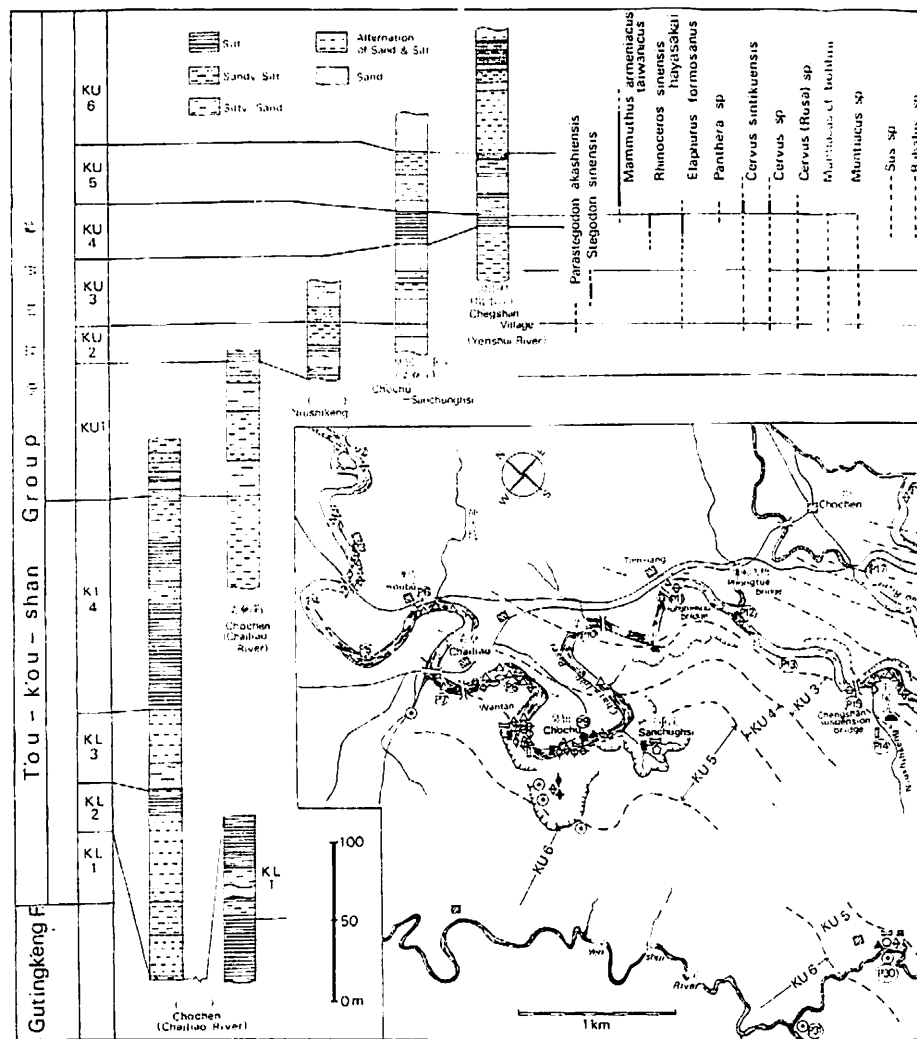
al., 1975).

B. At the river floor between the Fanliokeng and the Huhsiekou bridge, several specimens of *Elaphurus formosanus*, *Muntiacus cf. bohlini*, *Muntiacus* sp. were collected and these were regarded as derived fossils probably washed out from KU2 or lower part of KU3 (Otsuka and Shikama, 1978). From the grey massive sand bed of KU3 exposed on the left bank about 500 meters lower reaches of the Huhsiekou bridge, Mr. Kuo collected fish fossils of family Leithrinidae.

C. On the right bank of the Ch'aiiao River near Ch'ochü of Ch'aiiao, there is an outcrop of bluish grey silt bed corresponding to the upper part of KU4. In 1972, the project team of the Taiwan Provincial Museum with the late Professor T. Shikama and the writer excavated an individual skeletons of *Rhinoceros sinensis hayasakai* subsp. nov. and an antler of *Elaphurus formosanus*.

D. The bank of Sanch'unghsi, which is a small tributary of the Ch'aiiao River exposed on opposite side of Ch'ochü, has been formed by erosion of the beds consisting of sand and sandy silt of KU5. At present, prominent collapse of the beds sometimes happened after heavy rain falls. The vertebrate fossils such as *Mammuthus armeniacus taiwanicus*, *Rhinoceros sinensis hayasakai*, *Tomistoma taiwanicus* and *Trionyx* sp. have been found by Chen and Kuo from this rivulet and these were recently studied by Shikama (1972), Shikama et al. (1975) and Otsuka and Shikama (1978). The sand beds of KU5 and KU6 with silt layers are also exposed in the western parts of Sanch'unghsi forming a steep, high cliff. To date, deer fossils such as *Cervus (Sika) sintikuensis* and *Cervus (Sika)* sp. have been collected from the yellowish brown sand bed belonging to the lower part of KU5 and *Mammuthus armeniacus taiwanicus* from KU5 and lower part of KU6.

E. To date, abundant vertebrate fossils has been collected from the river floor between Ch'ochü and Ch'aiiao by Chen, Kuo and P'an. They are as follows: *Elaphurus formosanus*, *Muntiacus cf. bohlini*, *Muntiacus* sp., *Cervus (Rusa)* sp., *Macaca* sp., *Bubalus* sp. and *Panthera* sp. Sand and silt beds belonging to KU4



TEXT-fig. 3. Figures showing the geological columns and range chart of vertebrate fossils of the Tou'koushan Group along the Ch'aiiao and the Yenshui rivers of Chochen district. Distribution of the vertebrate fossils are also shown in the map. Legend: a: the specimens picked up from the degraded sediments or excavated from the beds, b: the specimens collected from the river floor. 1. *Stegodon (Parastegodon) akashensis*, 2. *Stegodon sinensis*, 3. *Mammuthus armeniacus taiwanicus*, 4. *Tomistoma taiwanicus*, 5. *Rhinoceros sinensis hayasakai*, 6. *Cervus (Sika)* sp., 7. *Cervus (Sika) taiwanicus*, 8. *Muntiacus cf. bohlini*, 9. *Elaphurus formosanus*, 10. *Panthera* sp., 11. *Cervus (Rusa)* sp., 12. *Sus* sp., 13. *Trionyx* sp., 14. *Bubalus* sp., 15. *Muntiacus* sp., 16. pisces, 17. *Stegodon cf. orientalis*.

and KU5 are exposed in this area forming a river wall and these beds are conspicuously eroded out by heavy rain falls as in the case of the rhinoceri-bed in Ch'ochü. Large amount of debris including vertebrate fossils from Santchunghsi flows into the Ch'ai-liao River as turbid flows in rainy seasons. Judging from these fact, it may be said that the vertebrate fossils scattered among the gravels on the river floor in this area might be washed out from KU5 and KU6 of the Upper Ch'iting Formation.

(2) Yenshui River (= Yenshuishi) area in Ch'engshan Village

As mentioned in the preceding chapter, there is an important localities of the vertebrate fossils in the neighbourhood of Ch'engshan village. The vertebrate fossils such as molar of *Mammuthus armeniacus taiwanicus* and *Stegodon (Parastegodon) cf. akashiensis*, antlers and teeth of *Elaphurus formosanus*, *Cervus (Sika) sinitikuensis*, *Cervus (Sika) sp.*, molars of *Rhinoceros sinensis hayasakai*, phalanges of *Panthera cf. tigris* and fragmental shells of terrapine (*Trionyx sp.*) were collected from the river floor near Loc. P30. Another fossil locality is Loc. P31, located about 800 meters west of Ch'engshan village where the beds of the upper part of KU6 and the lower part of KU7 are exposed. Judging from the lithofacies, it may be said that the vertebrate fossils from the Yenshui river area might be washed out from the beds ranging from KU4 up to KU6.

(3) Valley of Shuiliutung area
Shuiliutung, one of a tributary of the Ch'ai-liao River is situated about 3 km east of Chochen. It is rised from Kanling eastward and flows into the Ch'ai-liao River. In the neighbourhood of upstream of the Shuiliutung, there are distribution of the upper part of the Lower Ch'iting Formation (KU3 and KU4) and the lower part of the Upper Ch'iting Formation (KU1 and KU2). Many deer fossils were collected from this area. As to the vertebrate fossil bed in this area, the writer presume that the deer fossil might be washed out from the lower part of the Upper Ch'iting Formation

(KU1 and KU2) exposed in the area of upstream near Kanling and these were transported to the lower reaches of the stream. However, it need further investigation before we come to our final decision about the source of these mammalian fossils in this valley.

To sum up, the ranges of the vertebrate fossils in the Ch'iting Formation distributed in the environs of the Ch'ai-liao and the Yenshui Rivers are given as follows:

1. *Stegodon (Parastegodon) akashiensis* ranges from the upper part of KU2 up to the lower part of KU3, but it may ranges up to KU5.
2. *Stegodon sinensis* occurs from the lower to the middle parts of KU3.
3. *Mammuthus armeniacus taiwanicus* ranges from KU5 up to KU6.
4. *Rhinoceros sinensis hayasakai* ranges from the upper part of KU4 up to the lower part of KU5.
5. *Elaphurus formosanus*, *Muntiacus cf. bohlini*, *Muntiacus sp.* ranges from KU2, to KU4.
6. *Cervus (Rusa) sinitikuensis*, *Cervus (Sika) sp.* and *Cervus (Rusa) sp.* ranges from KU3 up to the lower part of KU5.
7. *Stegodon cf. orientalis* occurs from KU5.
8. *Sus*, *Bubalus*, *Macaca*, *Panthera*, *Tomistoma* and *Trionyx* ranges from KU4 up to the lower part of KU5.

Based upon the range of each vertebrate fossils mentioned above, the following three mammalian zones¹ are tentatively discriminated in the Ch'iting Formation.

- Stegodon sinensis* Zone² KU3
- Elaphurus formosanus-Rhinoceros sinensis hayasakai*³ Zone KU4
- Mammuthus armeniacus taiwanicus* Zone KU5-KU6

III. Brief Remarks on the T'ouk'oushan Group in the Southwest Taiwan

In the southwest Taiwan, especially in the eastern foothills of Tainan and Kaosiung

Prefectures, the Tertiary Systems were recognized to be composed of three formations such as Mokusaku (= Muzha), the Koteiko (= Gutingk'eng) and Kicho (= Ch'iting) in ascending order (Torii, 1933). Among these formations, the Ch'iting (= Kicho) has been regarded to be contemporaneous with the T'unghsiao Formation of the T'ouk'oushan Group in the Taichung district (Lin, 1963; Shikama *et al.*, 1975; Otsuka and Shikama, 1978). The Gutingk'eng Formation is composed mainly of sandstone and alternation of sandstone and shale and yields abundant marine, brackish and fresh water molluscs. This formation is estimated to be 2500 meters thick. The Ch'iting Formation conformably overlies the Gutingk'eng Formation and is classified into two members, the lower and the upper. Abundant molluscs indicating the brackish to littoral habitats and vertebrate fossils including *Stegodon akashiensis*, *Stegodon sinensis*, *Mammuthus armeniacus taiwanicus*, *Rhinoceros sinensis hayasakai*, *Elaphurus formosanus*, *Muntiacus cf. bohlini*, *Muntiacus sp.*, *Cervus (Sika) sinitikuensis*, *Cervus (Rusa) sp.*, *Bubalus sp.*, *Sus sp.*, *Panthera sp.*, *Tomistoma taiwanicus*, *Trionyx sp.*, and pisces were recorded from the upper member of this formation (Shikama, 1937, 1967, 1972; Shikama *et al.*,

1975; Otsuka and Shikama, 1978; Kaneko, 1941; Hayasaka, 1929, 1930, 1934, 1942; Lin, 1933; Ueno, 1978).

The Neogene stratigraphy in the southwest Taiwan was refined by Stach (1955), who recognized the two discordant breaks within the Ch'iting Formation in the Ch'isan section of Tainan Prefecture and proposed three new formations, the Liushuang, the Erchungchi, the Upper Gutingk'eng and the Lower Gutingk'eng in descending order (Table 2). However, his proposal has been made merely in an unpublished report of the Chinese Petroleum Corporation. Afterwards, these formation names were formally proposed by Chang (1962). According to him and also to Chen *et al.* (1977), the Upper Gutingk'eng Formation is distinguished from the Lower Gutingk'eng Formation by its more sandy lithofacies with well-bedded structure and corresponds to the muddy sandstone member of the Ch'iting Formation by Torii (1932), while the Erchungchi and the Liushuang Formations correspond to the sand member of the Ch'iting Formation by Torii. After the Second World War, the Neogene sediments in the southern Taiwan were studied in detail by the Taiwanese geologists and the paleontologists from the biostratigraphical and the megneostratigraphical point of view

Table 2. Stratigraphic divisions of the upper Neogene and the Pleistocene formations in Chochen district by previous authors.

Torii (1932)		Shikama <i>et al.</i> (1975)		Stach (1955)	
Alluvium					
Terrace deposits				Liushuang Formation (510m)	
Kicho (Ch'iting) Formation	sandstone bed (2000m)	T'ouk'oushan Group	Upper Ch'iting Formation	Erchungchi Formation (380m)	
	silty sandstone bed (1450m)		Lower Ch'iting Formation	Upper Gutingk'eng Formation (500m)	
Koteiko (= Gutingk'eng) Formation	bluish grey sandy shale bed (2150m)	Gutingk'eng Formation		Lower Gutingk'eng Formation (1590m)	
	sandstone bed (1350m)				
Mokusaku (= Muzha) Formation	slack to grey shale (1700m)				
	sandstone and shale in alternation (1300m)				

¹ Kamei and Otsuka (1979) called these zone as "level".
² This zone as previously called "*Stegodon akashiensis-Stegodon sinensis* Zone" by Otsuka and Shikama (1978).
³ *Rhinoceros sinensis hayasakai* was previously called *R. hayasakai* by Otsuka and Shikama (1978).

(Huang, 1967, 1975; Chen *et al.*, 1977, etc.). In 1975, Huang studied the planktonic foraminifers from the late Neogene formations exposed along 14 geological sections in the southern Taiwan and recognized six biozones and biostratigraphic events in the sequence. He placed the Plio-Pleistocene boundary at the base of the *Globorotalia truncatrinoides* Zone in the Erchungchi Formation, while Chen *et al.* (1977) placed it in the Lower Gutingk'eng Formation on the basis of the paleomagnetic and the biostratigraphical data. The vertebrate fauna of the T'ouk'oushan Group in Chochen district was called the Chochen fauna by Shikama (1937) and was considered to be of the Pliocene age by the predominant appearance of Akashi (Japan) - Nihowan (N. China) elements. Recently, however, results of the studies on the proboscidean and cervid fossils of this fauna led the age of the Chochen vertebrate fauna to the Early Pleistocene (middle Villafranchian) (Shikama *et al.*, 1975; Otsuka Shikama, 1978).

IV. Correlation of the Chochen Vertebrate Fauna to Those of the Other District in Taiwan

1. Tainan Prefecture

In addition to the vertebrate fossil beds in the Chochen district, mentioned in the preceding chapter, here the writer tries to discuss about the vertebrate faunas in the other localities.

In 1941, Kaneko described the following three mammalian fossil localities with special reference to the local geology and mammalian assemblage.

Wuchanfu of Takunwei, Hsinzhu
Wujia of Kuanmiaoehuang
Ch'iting of Longchichuang

An outline of his paper is as follows: "At Wuchanfu, there is an outcrop consisting of bluish grey shale, thin layer of conglomerate and light green sandstone. From the conglomerate of the succession, molluscan fossils showing fresh water habitat and cervid teeth were collected. A lower jaw of *Stegodon cf.*

sinensis reported by Hayasaka (1942) also occurred from this area. At Wujia, there is a fossil bed consisting of bluish grey to yellow shale and sandstone and yielding *Stegodon*, *Elephas*, *Bison* and *Cervus* etc. and this mammalian bed can be correlated to the upper part of the Ch'iting Formation of Torii (1932)".

As to a lower jaw of *Stegodon cf. sinensis* from Wuchanfu, Shikama *et al.* (1975) regarded it as *Stegodon (Parastegodon) aurorae*. At my present knowledge, furthermore, the mammalian beds described by Kaneko (1941) corresponds to the horizon upper than KU6 of the Ch'iting Formation and to the Liushuang Formation by Stach (1955). Among the mammalian fossils from Wuchanfu, "Elephas" is referable to *Mammuthus armeniacus taiwanicus*. Therefore, there is a possibility that the *Mammuthus armeniacus taiwanicus* Zone in Chochen district discriminated in the zone between KU5 and KU6 extends to the uppermost part of the Ch'iting Formation.

2. Nantou Prefecture

The T'ouk'oushan Group distributed in Nantou Prefecture, about 210 km north of Tainan City, is divided into two formations based on their lithofacies; the lower T'unghsiao and the upper Houyenshan (Lin, 1964). The T'unghsiao Formation is made up largely of fine- to coarse-grained sand and alternation of sand and silt which might be deposited under the littoral environment. This formation is estimated to be 350 meters thick and is correlated to the Tak'eng Facies in the Taichung district. To date, a molar of *Mammuthus armeniacus taiwanicus* was collected from this formation exposed in the environs of Jialiao in Tungshuke of Chunliaoehsiang and a molar of "Stegodon orientalis" also recorded from the two localities: 1 km NE of Tungshuke and about 7 km ESE of Shibali. The bed of *Mammuthus armeniacus taiwanicus* corresponds to the middle horizon of the T'unghsiao Formation, while those of "Stegodon orientalis" is the upper part of the formation. Judging from the proboscidean fossils, the horizon of *M. armeniacus taiwanicus* in Nanto Prefecture can be correlated to the upper part of the Ch'iting

Formation (*M. armeniacus taiwanicus* Zone) and those of "S. orientalis" has a possibility to be correlative with the horizon upper than KU6 in Chochen district.

3. Taichung Prefecture

According to Lin (1932) and Hayasaka (1930, 1942), some of mammalian fossils were known from the following three localities in Fengyuan district of the Taichung Prefecture.

- (1) Tak'enghsi of Petunchuang, Taichung
Rhinoceros sp. (= *Rhinoceros sinensis hayasakai* Otsuka, 1983)
Stegodon sinensis, Hayasaka 1942, pl. VII, fig. 10 (= *Stegodon akashiensis*, Shikama *et al.*, 1975)
Stegodon orientalis, Hayasaka 1942, pl. VII, figs. 14a, 14b.
Stegodon insignis, Hayasaka 1942, pl. V, figs. 3a, 3b.
Cervus (Sika) taiwanus, Hayasaka 1942, p. 103.
- (2) Shuichentsu of Shinduchuang, Tungshih
Stegodon insignis, Hayasaka 1942, p. 103.
- (3) Hsiaunank'eng of Fengyuan, Taichung
Stegodon cf. orientalis, Hayasaka 1942, p. 103.
Stegodon insignis, Hayasaka 1930a, p. 113-118; 1930b, p. 10.

Of the above listed species those with parenthesis are the names recently revised by Shikama *et al.* (1975) and Otsuka (1984).

As to the mammalian bed recognized in the localities mentioned above, Lin (1933, 1935) and Hayasaka (1942) regarded them as the "Lower Tökazan Beds" of the Tökazan Series by Lin (1933). At present, the "Lower Tökazan Beds" is regarded to be equivalent to the T'unghsiao Formation which is typically distributed in the environs of Miaoli Prefecture, Northwest Taiwan (Lin, 1963).

In 1934, Shikama and Otsuka had an opportunity to examine the proboscidean fossils recorded by Hayasaka (1942) and now stored in the Department of Geology, National Taiwan University. By the re-examination of the molar of "Stegodon sinensis" from Takeng (Hayasaka 1942, pl. VI, figs. 10a, 10b), Shikama *et al.* (1975) regarded it as those of *Stegodon (Pa-*

rastegodon) akashiensis which is typical Early Pleistocene *Stegodon* in the Japanese Islands. However, they could not check the other specimens listed by Hayasaka (1942) under the name of *Stegodon orientalis* and *Stegodon insignis*, because of missing of the specimens. Certainly, a molar of "S. sinensis" from Tak'eng rather resembles *Stegodon (Parastegodon) akashiensis* or *Stegodon (Parastegodon) aurorae* recorded from the Japanese Pleistocene deposits than *Stegodon orientalis* in having narrow crown. As to "Stegodon orientalis" (Hayasaka 1942, pl. VII, figs. 14a, 14b) from Tak'eng, Shikama *et al.* (1975) regarded it as *Stegodon sinensis*, judging from the dental characters seen in the picture and dimensions of a molar in the another Hayasaka's paper (Hayasaka 1930, 1942). At present, the writer think that the molar specimen in question has similar dental characters to those of *Parastegodon* group such as *Stegodon (Parastegodon) akashiensis* or *aurorae* from the Japanese Islands and *Stegodon orientalis* Owen recorded by Colbert and Hooijer (1953) from Yenchingkou of Szechuan, China in width of the crown, hypsodonty, number of mammillae and degree of development of dental cement. Among these related species, a molar of "Stegodon orientalis" from Tak'eng seems close to *Stegodon orientalis*.

The lower second or the third molar of *Stegodon* was recorded from the "Lower Tökazan Beds" exposed in the valley of Hsianank'eng, about 800 meters west of Shuichengtsu (Hayasaka 1930a, 1930b, 1942) under the name of *Stegodon insignis*. Judging from the locality, the horizon of this specimen probably corresponds to the lowest part of the T'unghsiao Formation.

At present, there is no record of *Mammuthus armeniacus taiwanicus* from the Fengyuan district and the mammalian fauna from the T'ouk'oushan Group in this district seems to be characterized by "insignis-like" *Stegodon* and *Rhinoceros sinensis hayasakai*. Judging from the mammalian assemblage, the T'unghsiao Formation in this district, as a whole, is probably correlated to the lower part of the Upper Ch'iting Formation ranges from the

Stegodon sinensis – *Stegodon akashiensis* Zone up to the *Elaphurus formosanus* – *Rhinoceros sinensis hayasakai* Zone in Chochen district.

V. Conclusive Remarks on the Geological Age of the Chochen Vertebrate Fauna

1. Previous opinions on the geological age of the Chochen vertebrate fauna

As to the geological age of the Chochen vertebrate fauna, the following opinions were stated by the Chinese and the Japanese paleontologists. Shikama (1937) regarded it as the Upper Pliocene by the predominant appearance of archetypal cervids of Akashi (Japan)-Nihowan (N. China) elements which were then regarded as useful indicators of Villafranchian, while Takai (1938) considered it as the Early Pleistocene because he thought such two species of the subgenus "*Deperetia*" as *Cervus* (*Deperetia*?) *kokubuni* and *Cervus* (*Deperetia*?) *syatinensis* by Shikama (1937) as *Cervus* (*Deperetia*) *kazusensis* recorded from the Early- to Middle Pleistocene deer in Japan. Hayasaka (1942) agree with the Takai's opinion. Judging from the present day opinion about the relative age of the Villafranchian, Shikama's "Pliocene" and Takai's "Early Pleistocene" correspond to the Early Pleistocene and the Middle Pleistocene, respectively.

Lin (1966) has mentioned the following opinion about the mammalian fauna of the T'ouk'oushan Group: "among the mammalian fauna of the Tunghsiao Age of the T'ouk'oushan Epoch, the mammalian fauna of the lower member of the Tunghsiao Formation is represented by *Rhinoceros cf. sinensis* while those of the uppermost part of the formation is represented by *Stegodon orientalis* and *Bison geron*; the former is correlated to the Nihowan Fauna and the latter is to the Wanhsien Fauna (Günz glacial to Günz-Mindel Interglacial) in the Chinese Continent".

Recently Shikama *et al.* (1975) correlated the Chochen vertebrate fauna with those of the Akashi-Kuchinotsu vertebrate fauna in West

Japan, based upon the results of the study on the proboscidean fossils. Especially, they considered the Taiwanese archetypal *Mammuthus* – *Mammuthus armeniacus taiwanicus* – to be closely related to *M. "proximus"* or "*shigenis*" known from the Middle- to the Upper Villafranchian deposits in Japan such as Kuchinotsu, Osaka and Kazusa Groups. Furthermore, they regarded *Stegodon* (*Parastegodon*) *akashiensis* as a characteristic species common in the Japanese and the Taiwanese Villafranchian deposits.

Based upon the results of the study on the deer fauna in the Chochen vertebrate fauna, Otsuka and Shikama (1978) regarded the Chochen vertebrate fauna to be the Early Pleistocene in age by the predominant appearance of primitive form of *Elaphurus*, *Muntiacus* and *Cervus* (*Sika*). This conclusion is in accordance with the opinion expressed by Shikama *et al.* (1975).

2. A proposal on the geological age of the Chochen vertebrate Fauna

As mentioned before, the Upper Ch'iting Formation yields several characteristic proboscidean fossils such as *Stegodon* (*Parastegodon*) *akashiensis*, *Stegodon* (*Parastegodon*) *aurorae*, *Stegodon sinensis*, *Stegodon cf. orientalis* and *Mammuthus armeniacus taiwanicus* (Shikama *et al.*, 1975). Among these, *Stegodon sinensis* occurs from the basal part of KU3, *Stegodon akashiensis* ranges from the upper part of KU2 to the middle part of KU5 up to KU6, accompanying with *Stegodon cf. orientalis*. These proboscidean fauna valuable clues to the geological age of the Chochen vertebrate fauna. On the other hand, the Chochen vertebrate fauna includes the fossils of the forest- and glassland-living mammals showing the close relationships with those in the Pleistocene deposits of the Chinese Continent such *Rhinoceros sinensis hayasakai*, *Tapirus* (*Megatapirus*) *cf. augustus*, *Sus* sp., *Macaca* sp., *Muntiacus cf. bohlini*, *Histrix cf. suberistata* and *Panthera tigris*. These mammalian fossils appear to be found from the horizons ranging from KU2 up to KU5 without showing defined horizon. Therefore, the "Chochen vertebrate fauna"

can be tentatively regarded as a "single fauna".

According to Huang (1979), the Pleistocene Cave-Fauna in South China is grouped into three faunas such as the Early Pleistocene Liucheng *Gigantopithecus* Cave-fauna, the Middle Pleistocene Bijasan Cave-fauna and the Upper Pleistocene Liujang Man-fauna. Among these faunas, the Bijasan Cave-fauna includes the Wanhsien Fauna in Szechuan (Colbert & Hooijer, 1953) and the *Stegodon-Ailuropoda* Fauna in several provinces in South China (Pei, 1957, 1965; Chow, 1957; Kahlke, 1961). In comparison with these Cave-fauna in South China, the Chochen vertebrate fauna shows affinity to both faunas of the Early- and the Middle Pleistocene, however, it is more closely related to the Middle Pleistocene Wanhsien fauna in Yenchingkou (*Stegodon-Ailuropoda* Fauna) in having common species or subspecies such as *Panthera cf. tigris*, *Stegodon cf. orientalis*, *Tapirus cf. augustus* and *Rhinoceros sinensis*.

The Chochen vertebrate fauna is also allied to the Early Pleistocene vertebrate fauna in Southwest China. In the Yuanmou basin located in the northeastern part of Yunnan Province, South China, the Pliocene and the Pleistocene sediments attains to 600 m in thickness (You *et al.*, 1978). In this basin, the Early Pleistocene Yuanmou Formation (in narrow sense) overlies the Late Pliocene Shagou Formation and the fossil-bearing beds in the upper part of the Yuanmou Formation was named Shangnabang Formation. The magnetostratigraphical study by Li *et al.* (1976) revealed that the base of the Yuanmou Formation corresponds to the boundary of Gauss/Matsuyama Epoch. The fossil assemblages in the Shangnabang Formation said to be characterized by the occurrence of the Middle Pleistocene fauna known in South China such as *Stegodon orientalis*. The Chochen vertebrate fauna shows close alliance with those of the Yuanmou Formation in occurrence of *Panthera cf. tigris*, *Rhinoceros cf. sinensis*, *Muntiacus cf. bohlini* and *Sus* sp. but differs noticeably in the absence of the characteristic mammals in the

Yuanmou Formation such as *Equus yuanmouensis*, *Stegodon yuanmouensis* and *Stegodon zhantongensis*.

In comparison with the typical Early Pleistocene fauna of North China such as those of Nihowan, Loc. 12 and Loc. 18 of Choukoutien, the Chochen vertebrate fauna differs in absence of *Hipparion sinensis*, *Equus sanmeniensis*, *Elasmotherium*, *Eucladoceros boulei*, and *Bison palaeosinensis*. Certainly, *Elaphurus formosanus* (the Taiwan Su-pu-hsian) has more primitive characters than the living species (*Elaphurus davidianus*), but it is discriminated from the Early Pleistocene primitive *Elaphurus* from Northeast Asia such as *Elaphurus* (*Elaphroides*) *bifurcatus* from Nihowan and *Elaphurus* (*Elaphroides*) *shikamae* from the Osaka Group in West Japan (Otsuka and Shikama, 1978) by having more progressive antler.

In comparison with the Middle Pleistocene fauna of Choukoutien (Locs. 1 and 13) (Pei, 1934; Young, 1932, 1934), the Chochen vertebrate fauna differs from these faunas in lacking of megacerid deer (*M. flabellatus*, *pachyosteus*), *Hyaena*, *Equus cf. sanmeniensis* and *Felis youngii* etc. However, the Chochen vertebrate fauna shows little affinity to those of Loc. 1 (*Sinanthropus* Site) in having such common animals as *Panthera cf. tigris*, *Mustera* sp., *Rhinoceros cf. sinensis*, *Bubalus* sp. and *Cervus* (*Sika*)*.

The Konwanling fauna associated with the hominid skull of the Lantian-man was recorded from the Lantian of Shensi, North China (Chow, 1965; Hu and Oi, 1978). This fauna said to be characterized by the presence of the southern forms showing the warm or subtropical climate such as *Ailuropoda melanolueca*, *Stegodon cf. orientalis*, *Nestoritherium cf. sinense*, *Tapirus sinensis*, *Elaphodus cephalopus*, *Carpicornis sumatraensis*, *Rusa* sp. and *Rhinoceros sinensis* etc. (Chow *et al.*, 1965). The chronological age of the Konwanling Fauna was previously regarded as transitional between the Nihowanian and the Choukoutienian but closer to the latter (Chow *et al.*, 1965). The Chochen vertebrate fauna,

* In Loc. 1 of Choukoutien, the *Sika*-type deer was described under the name of *Pseudaxis greyi*.

especially those from the upper part of the Upper Ch'iting Formation shows close relationship with the Konwanling fauna in the presence of *Stegodon cf. orientalis*, *Tapirus (Megatapirus) augustus*, *Rusa sp.*, and *Rhinoceros sinensis*. The absence of *Ailuropoda*, *Equus*, *Sinomegaceros*, *Nestoritherium* and some small mammals in the Chochen vertebrate fauna may imply the ecological control for the mammalian distribution. Although the Chochen vertebrate fauna is characterized by the presence of the Middle Pleistocene elements commonly known in the Chinese Continent, its fauna includes the proboscidea of the Early Pleistocene elements such as *Stegodon (Parastegodon)*. These facts support the idea that the geological age of the Chochen vertebrate fauna may be contemporaneous with those of the Konwanling in Shensi.

The conclusion about the geological age of the Chochen vertebrate fauna mentioned above is general agreement with the results of the magnetostratigraphical and the biostratigraphical studies of the Neogene and the Pleistocene formations in Chishan area, southwest Taiwan by Chen *et al.* (1977). The Chishan area, is situated in the hilly land area about 15 km south of the Chochen area. In this area, the Plio-Pleistocene sediments are lithologically divided into four formations which in ascending order are the Lower Guting-k'eng, the Upper Guting-k'eng, the Erchungchi and the Liushung. According to Chen *et al.* (1977), the Plio/Pleistocene boundary is placed at the lower part of the Guting-k'eng Formation, much lower horizon than previously reported by Huang (1967) and the boundary of the Matsuyama/Brunhes Epoch is recognized in the upper part of the Lower Guting-k'eng Formation. The younger three formations such as the Upper Guting-k'eng, the Erchungchi and the Liushung correspond to the Brunhes Normal Epoch. In general, the Plio-Pleistocene sediments distributed in the southwest Taiwan extend northward with little change in lithofacies. Judging from the lithofacies, the Ch'iting Formation in the Chochen area is tentatively correlated with the Upper Guting-k'eng Formation and the Upper Chiting Formation

probably corresponds to the Erchungchi and the Liushung Formations in the Chishan area. Consequently, the Upper Ch'iting Formation carrying "Chochen vertebrate fauna" corresponds to the lower half of the Brunhes Normal Epoch.

For the consideration of the Chochen vertebrate fauna, the Early- to Middle Pleistocene vertebrate fauna in the Japanese Islands are also important. In the Plio-Pleistocene formations in Kinki district, West Japan, Kamei and Setoguchi (1970) recognized the following five zones of the mammalian fossils in ascending order: 1. *Stegodon cf. elephantoides* Zone (3.4 m.y.B.P., Late Pliocene), 2. *Stegodon insignis sugiyamai* Zone (about 2.5 m.y.B.P., Middle Villafranchian), 3. *Stegodon shodoensis akashiensis* (about 2.0-1.5 m.y.B.P., Upper Villafranchian), 4. *Elephas shigensis* Zone (about 1.5-0.6 m.y.B.P., Upper Villafranchian) and 5. *Stegodon orientalis* Zone (about 0.6-0.3 m.y.B.P., post Villafranchian). The regarded each zone as: Zone 1 - the temperate forest elements of the Indo-Malayan Faunal Complex widely distributed in Southeast Asia and its environs in the late Pliocene; Zone 2 and 3 - the remnants on the Indo-Malayan faunal Complex and the temperate-forest to grassland elements of the Nihowan fauna of the early Pleistocene in North China; and Zone 4 - elements of the Nihowan fauna or the temperate-forest to grassland elements of the early Pleistocene Choukoutien fauna and Zone 5 - the temperate elements of the middle Pleistocene Wanhshien fauna vigorously developed in South China. At present, "*Elephas shigensis* (Matsumoto & Ozaki)" (Kamei, 1966) from the Osaka and the Kobiwako Groups and *Parelephas protomammonteus proximus* Matsumoto (Matsumoto, 1926) from the Kazusa Group in the Boso Peninsula are regarded as a primitive form of the genus *Mammuthus* and these two species were named as *Mammuthus paramammonteus shigensis* and *Mammuthus armeniacus proximus*, respectively (Kamei and Otsuka, 1981). Among five mammalian zones in Kinki district, the Zone 3 corresponds to the lower half of the Matsuyama Reversed Epoch and Zone 4 ranges from the latter half of the Matsuyama

Reversed Epoch (Ishida *et al.*, 1969; Itihara *et al.*, 1973, 1977).

In the Kazusa Group distributed in the Boso Peninsula, East Japan, *Mammuthus armeniacus proximus* is known to occur from the Umegae Formation and *Stegodon (Parastegodon) aurorae* occurs from the Kokumoto Formation (Shikama and Otsuka, 1971; Mitsunashi, 1970). Furthermore, the magnetostratigraphical study of the Kazusa Group by Nitsuma (1976) revealed that the Umegae Formation corresponds to the upper half of the Matsuyama Reversed Epoch and the Kokumoto Formation ranges from the upper most part of the Matsuyama Reversed Epoch to the early part of the Brunhes Normal Epoch.

As was mentioned by Shikama *et al.* (1978) and Kamei and Otsuka (1981), *Mammuthus armeniacus taiwanicus* is representative element in the Chochen vertebrate Fauna showing close relationship with *Mammuthus armeniacus proximus* or *Mammuthus paramammonteus shigensis* and *Stegodon (Parastegodon) akashiensis* is species common to the Taiwanese and the Japanese Islands as an element of the Indo-Malayan Faunal Complex. Therefore, it seems to be possible to consider that the mammalian zones discriminated in the Upper Ch'iting Formation are correlative with those in the Japanese Islands ranging from the *Stegodon shodoensis akashiensis* Zone to the *Stegodon orientalis* Zone in the Osaka and the Kobiwako Groups in Japan. However, there is a large possibility that the Upper Ch'iting Formation carrying the element of the *Stegodon-Ailuropoda* Fauna in South China probably corresponds to the Brunhes Normal Epoch. These fact support the idea that *Stegodon (Parastegodon) akashiensis* and *Stegodon (Parastegodon) aurorae* may range up to the early Middle Pleistocene (lower part of the Brunhes Normal Epoch) and the archetypal *Mammuthus-Mammuthus armeniacus taiwanicus* undoubtedly existed together with *Stegodon orientalis* in Taiwan at that time.

Taking all these factors in consideration, it is concluded that the age of the Chochen vertebrate fauna appear to be transitional between the *Gigantopithecus* Cave-fauna and the Wan-

hsien fauna (*Stegodon-Ailuropoda* fauna) in South China but closer to the latter. In comparison with the Pleistocene fauna in North China, the Chochen vertebrate fauna may be contemporaneous with those of Konwanling. Consequently, the geological age of the Chochen vertebrate fauna ranges from the late Early Pleistocene to the early Middle Pleistocene (Upper Villafranchian - post Villafranchian).

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Locality Names

Bijasan	筆架山
Ch'itiao	箭 寮
Chishan	池 山
Chengshan	登 山
Ch'ochu	臭 窟
Chochen	左 鎮
Choukoutien	周口店
Fanliaokéng	坊在坑
Fengyuan	豐 原
Guoling	溝 梁
Hengchun	恒 春
Hlinzhú	林 竹
Hsiaounankéng	下南坑
Huhshiekou	虎脚口
Hotibú	後 廬
Hsilochu	西螺溪
Jialiao	甲 寮
Kongwangling	公王廟
Kuanmiao	關 廟
Kuchinotsu	口之津
Kuansi	關 西
Kaoshiung	高 墩
Kanglin	岡 林
Lantian	藍 田
Liucheng	柳 城
Liujan	柳 江
Longchi Huang	龍崎庄
Müzhá	木 柵
Nantou	南 投
Niushihkeng	牛羣坑
Nihowan	尼河灣
Puli	埔 里
Petunzhuang	北屯庄
Sanchunshi	三重溪
Sanpao	山 豹
Shensi	陝 西
Shinduchuang	新莊庄
Shinfeng	新 豐
Shuichengtsu	水井子
Shuiliutung	水流東
Shibali	十八里
Shitsuchi	石手崎
Szechuan	四 川
Szefuzhuang	西湖庄
Tachiachi	大甲溪
Tahsi	大 溪

Takengwei	大坑尾
Takenghsi	大坑溪
Taichung	台 中
Tainan	台 南
Tátún	大 屯
Ti'eningang	田 筆
Tienzuche	田子街
Tungshih	東 勢
Tungshuke	東勢閣
Tsengwenhsi	曾文溪
Wantan	灣 潭
Wuchanfu	烏古湖
Wuja	五 甲
Yuanmou	元 謀
Yunnan	雲 南

Formation Names

(Chinese)	(Japanese)
Chiting	崎 頂 Kicho
Cholan	卓 崙 Takuran
Choukoushan	獅山 Shokkosan
Chungli	中 壠 Chureki
Erchungchi	二崙崎 Nijukei
Gutíngkeng	古亭坑 Koteiko
Houyenshan	大崙山 Kaenzan
Hsiangshan	香 山 Kozan
Liushuang	六 雙 Rokusō
Miaoli	苗 栗 Byoritsu
Muzha	木 柵 Mokusaku
Neizha	內 柵 Naisaku
Takéng	大 坑 Taiko
Tóukóushan	頭崙山 Tokazan
Túngshiao	通 霄 Tsusho
Yüchih	魚 池
Yushe	榆 社
Yuanmou	元 謀

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