

## *On the Cenozoic Vertebrates in Korea*

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Fossils of Cenozoic vertebrates of Korea are in poorer condition than those of China and are also inferior to those of Japan, which have been considered rather poor. To summarize the present knowledge of these fossils may be significant for future studies on Cenozoic formations, so their specific names, the fossil-bearing formations, and their localities are given below in the order of their geological succession. Their palaeontological descriptions are omitted, but references to periodicals which include descriptions are given at the end of this article.

### **Eocene**

The following seven mammalian species occur in the coal seams of the Pongsan and Sariwŏn coal mines of the Pongsan coal field in Pongsan-gun, Hwanghae-do, and the geological age of the seven is presumed to be latest Eocene from their relationships with the Shara Murun and Irdin Manha formations of Mongolia.

Carnivora	<i>Harpagolestes koreanicus</i> SHIKAMA
Perissodactyla	<i>Cristidentinus</i> sp.
	<i>Desmatotherium grangeri</i> TOKUNAGA
	<i>Lophialetes tokunagai</i> TAKAI
	<i>Colodon hodosimai</i> TAKAI
	<i>Caenolophus makii</i> TAKAI
	<i>Protitanotherium koreanicum</i> TAKAI

Occurrences of mammalian remains in the Pongsan coal field were first reported by TOKUNAGA (1926), and although lacking sufficient data, he considered their geological age to be Miocene. Later, MORI (1929) and TOKUNAGA (1929 B) stated that their age was Miocene, but TOKUNAGA (1932, 1933A-C) concluded that they were late Eocene from the occurrences of late Eocene species which had close relationships with the Mongolian Eocene species collected by the Asiatic Expedition of the American Museum of Natural History. The results of the research on freshwater mollusc and plant remains by MATSUSHITA, ONOYAMA and MAEJIMA (1935) also confirmed their age as late Eocene. Further study by the writer (1938, 1939A, 1945) and SHIKAMA (1943) revealed that the Pongsan formation consisted of the above-mentioned seven species.

Through a comparison of mammalian assemblages, the writer (1950) concluded that the Pongsan formation may be correlated with the Ube coal-bearing formation and the Sōshu sandstone in the upper part of the Tachibetsu formation in Japan.<sup>1)</sup> Other equivalent beds which are assigned to latest Eocene are the Kuan-chuang series of Shansi Province, the lower Yuanch'u series of Shansi and Honan Provinces, the Lushih series and the Fanchuang series of Honan Province, the Lunan series of Yunnan Province, all of China; the Irдин Manha formation and the Shara Murun formation, Inner Mongolia; the Pondaung formation, Burma; and the Melawi group, Borneo.

### Miocene

The Miocene series occurs in several limited areas, but among them the Myōngch'ōn and Kilchu districts of North Hamgyōng-do in North Korea and the Yongil, Changgi, and Yōnil districts of North Kyōngsang-do in South Korea are comparatively wide.

The Myōngch'ōn series in North Korea is divided into two parts, the lower P'yōngnyuk stage and the upper Hamjin stage. The latter contains some mollusc remains which are characteristic of the Miocene, and the following four vertebrates. From these remains its geological age is presumed to be middle Miocene.

Pisces	Teleostei	<i>Clupea</i> sp.
Mammalia	Cetacea	<i>Cetacea</i> gen. and sp. indet.
	Proboscidea	<i>Bunolophodon annectens</i> (MATSUMOTO)
	Perissodactyla	" <i>Rhinoceros</i> " sp.

From the Yōnil series in South Korea a shark of *Carcharodon megalodon* AGASSIZ and several bones and scales of unidentifiable bony fishes were collected, together with molluscs and other fossils, plants and animals. Their age is considered to be somewhat later than the Hamjin stage and from the middle to late Miocene.

Among the fossil fishes the occurrences of *Clupea* sp. and other bones and scales were reported for the first time by TATEIWA (1924, 1925), and KANEHARA later (1936) added the occurrence of *Carcharodon megalodon* AGASSIZ. But precise palaeontological studies of these have never been undertaken.

The first fragments of mammalian remains, unidentifiable cetacean bones, were reported by MORI (1926, 1929A) but were never studied palaeontologically. The second, mastodon, was first reported by MAKIYAMA (1935, 1936A) under the name *Trilophodon* cfr. *angustidens* (CUVIER), but later (1936B, 1938) he described it under the new specific name *Bunolophodon yokotii* Makiyama. The writer, however, (1938, 1939B, c) considered that it might be synonymous with the Japanese mastodon,

<sup>1)</sup> As the Gonosawa sandstone member, the lower part of the Tachibetsu formation, was erroneously mentioned in the previous report, here the writer corrects it to the Soshu sandstone member, the upper part of the Tachibetsu formation.

I correct my 1950 report in which I correlated the Pongsan formation with Gonosawa sandstone, the lower part of the Tachibetsu formation.

*Bunolophodon annectens* (MATSUMOTO). The third, rhinoceros, was also reported by MORI (1929A), but the writer (1938, 1939B) supposed it to be related to the Japanese Miocene rhinoceros, *Chilotherium pugnator* (MATSUMOTO), judging from its site of occurrence.

### Pleistocene

The mammal-bearing Pleistocene series is also not well developed. Remains were found at several localities, such as Kaesŏng-bu, Kyŏnggi-do; Changyŏn-gun, Hwangju-gun, and Kŭmch'ŏn-gun, Hwanghae-do; Sŏngch'ŏn-gun, South P'yŏnggan-do; and Kilchu-gun and Chongsŏng-gun, North Hamgyŏng-do. Some of the remains were derived from fissure-filling or terrace deposits, little is known of the other localities. From the above-mentioned localities the following nineteen mammalian species were recorded by several geologists. Judging from the species of the terrace deposits at Chongsŏng-gun, North Hamgyong-do (marked by an asterisk), the geological age of the deposit is evidently very late Pleistocene and all other remains are perhaps late Pleistocene.

Rodentia	* <i>Citellus tomanensis</i> TOKUNAGA and MORI * <i>Myospalax</i> cfr. <i>epsilanus</i> THOMAS * <i>Microtus maekawai</i> TOKUNAGA and MORI * <i>Ochotona</i> sp.
Carnivora	* <i>Hyaena ultima dokantinsensis</i> TOKUNAGA and MORI <i>Megantereon nihowanensis</i> (TEILHARD and PIVETEAU)
Proboscidea	<i>Palaeoloxodon naumanni</i> MAKIYAMA * <i>Mammonteuus primigenius</i> BLUMENBACH
Perissodactyla	* <i>Equus przewalskii</i> POLIAKOFF <i>E. caballus fossilis</i> LINN. * <i>Rhinoceros antiquitatis</i> BLUMENBACH <i>R. shindoi</i> TOKUNAGA
Artiodactyla	* <i>Capreolus</i> cfr. <i>pygargus ochracea</i> BARCLAY * <i>Cervus elaphus elaphus</i> LINN. * <i>C. elaphus canadensis</i> ERXLEBEN * <i>Megaceros</i> sp. * <i>Ovis</i> cfr. <i>ammon</i> LINN. * <i>Bos primigenius</i> BOJANUS * <i>Bison exguus</i> MATSUMOTO

Of these nineteen species, the fifteen marked by an asterisk were excavated on two occasions by MORI (1935), and TOKUNAGA and MORI (1939) from the terrace deposit at Tonggwang-jin, Chonggwang-myŏn, Chongsŏnggun, North Hamgyong-do, and they closely resemble the materials being excavated at Ho-chia-kou, Kuchiang-tung in the vicinity of Harbin, but seem to be younger than the Manchurian ones. The writer considers them to be very late Pleistocene.

A saber-toothed tiger, collected from the residual clay at the Hwan-san lime-

stone quarry at Kyomip'o-up, Hwangju-gun, Hwanghae-do, was identified by SHIKAMA (1934) as *Machairodus* cfr. *cultridens* (CUVIER) and he concluded its geological age to be Pliocene, but the writer (1938) had some doubt about SHIKAMA's conclusion and supposed its age to be late Pleistocene. TEILHARD DE CHARDIN and LEROY (1945) later identified it with the Villafranchian species *Megantereon nihowanensis* (TEILHARD and PIVETEAU), originally described from the Nihowan formation, Hopeh Province in North China, and presumed it to be early Pleistocene. Therefore, the Early Pleistocene mammalian faunule is expected to be confirmed in Korea some day.

MORI (1929A) reported the occurrence of an elephantine tooth, related to the Indian species of *Palaeoloxodon namadicus* (FALCONER and CAUTLEY) from near Kilchu-up, Kilchu-gun, North Hamgyong-do; but he gave no data about its precise location or formation. The writer has indentified it with a Japanese Pleistocene species of *Palaeoloxodon naumanni* MAKIYAMA because of its resemblance to the Indian *Palaeoloxodon*. The occurrence may be the most northern in the distribution of *Palaeoloxodon* in Japan, Korea and China. Another occurrence of this species was reported by TAKAI (1937, 1938) from the sea floor near the island of Paengnyŏng, Changyŏn-gun, Hwanghae-do; this is the only reliable example of this species from Korea. As *Palaeoloxodon naumanni* MAKIYAMA flourished in the Pleistocene of Japan, it may also belong to the late Pleistocene of Korea.

JIMBO (1915) reported the first occurrences of mammalian remains from a limestone cave near Kyejŏng, Kodong-myŏn, Kŭmch'ŏn-gun, Hwanghae-do. Afterwards TOKUNAGA (1929A, B, 1930) clarified that they were horse and rhinoceros remains, and he (1933C) altered the previously mentioned locality to Kyŏnggi-do. On the other hand, MORI (1929A) gave an account of some fossil horse and rhinoceros from a limestone cave near Che-sok-san, Kaesŏng-gun, Kyŏnggi-do. These two localities are very near each other, and, therefore, these fossils reported by TOKUNAGA and MORI probably occurred in the same locality and possibly belonged to the same specimens. The horses were named *Equus caballus fossilis* LINN. TOKUNAGA (1929B, 1930) gave a new specific name, *Rhinoceros koreanicus* TOKUNAGA to the rhinoceros but included no description or illustrations. TAKAI (1938) suggested that it might be identified with the Japanese Pleistocene species *Rhinoceros shindoi* TOKUNAGA. The geological age of these two fossils may be Pleistocene; a more exact age determination is impossible.

TOKUNAGA (1929A) and MORI (1929A) each reported a red deer from a limestone cave at Majŏn-ni, Sŏngch'ŏn-myŏn, Sŏngch'ŏn-gun, South P'yŏngan-do, but gave no description of it. Its geological age may also be Pleistocene.

### Holocene

MORI (1929B, 1930) reported a Korean bear, *Ursus ussuricus* HEUDE, and a Korean boar, *Sus coreanus* HEUDE, from a well-known limestone cave, Tŭngryong-gul, at Unhakch'am, Yongsan-myŏn, Yŏnghyŏn-gun, North P'yŏngan-do. As their occur-

rence in the Pleistocene has not been established, it cannot be determined whether the bones are Pleistocene or of a recent species which entered the cave to hibernate. Therefore, they may not be called fossils in a strict sense.

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