1. INTRODUCTION

The Japanese Archipelago and Taiwan are located along the east margin of the Asian Continent, with Japan in the north and Taiwan in the south, ranging from 45° to about 24° northern latitude. Between the Japanese island of Kyushu in the north and Taiwan are situated the Ryukyu Islands, a series of small islands belonging to Japan.

For convenience Hokkaido, Honshu, Shikoku and Kyushu, the main Japanese islands, are herein referred to as the ‘Japanese Islands’.

The faunas of all these islands were strongly influenced by local tectonic movements and climate changes, resulting in changes in the sea level in the Plio-Pleistocene. During periods of low sea level, the Strait of Korea immediately northwest of the southernmost Japanese islands, the Strait of Taiwan and the East China Sea, opposite the Ryukyu islands, were exposed as dry land, and these areas then played a central role in the migration of animals. When sea levels rose, islands were again formed, and endemic species sometimes evolved on those islands.

There are two main factors influencing the faunas in these islands. Firstly, the depth of the strait between the islands and the Asian mainland. The maximum depth of the Strait of Korea between the continent and the Japanese islands is about 130 m. Most of the depth of the Strait of Taiwan between the continent and Taiwan is less than 100 m depth. These differences suggest that Taiwan has been connected longer or more frequently to the continent than the Japanese Islands, and such a difference has greatly affected the faunal composition of these two island groups.

A second factor is latitude. The Japanese Islands are located further north than Taiwan. Nowadays, the Japanese Islands are situated in the temperate zone, while Taiwan is situated in the subtropical zone. These difference in latitude must have resulted also in a difference in climate during the Plio-Pleistocene, which resulted in different faunas. It would have turned up as the movement of the boundary line between the Palaeartic and the Oriental that is presently located on the Ryukyu Islands.

The colonisation, evolutionary processes and the relationship between the faunas of these islands are summarized, and a comparison is
made of the fossil proboscidean taxa of these islands with those of the Chinese mainland (Takahashi and Namatsu 2000).

2. JAPANESE PROBOSCIDEAN FOSSILS

In recent years Japanese Plio-Pleistocene strata have been well studied by tephrochronology, palaeomagnetic stratigraphy and other dating methods, and recent studies of widespread volcanic ash deposits have allowed for the correlation of event horizons at geographically distant areas (Oda 1977; Machida et al. 1980; Yoshikawa et al. 1996; Satoguchi et al. 1999, etc.). Therefore, the geological horizon and the age of proboscidean fossils are known accurately.

The earliest proboscidean fossils from the Japanese Islands are found in Miocene deposits of Gifu prefecture, Honshu (Matsumoto 1926; Kamei et al. 1977). After the Pliocene the number of specimens increases and proboscidean fossil taxa appear in the following chronological sequence: Shinomastodon sendaicus, Stegodon shinshuensis, S. aurorae, Mammutthus protomammonticus, S. orientalis, Palaeoloxodon naumanni and M. primigenius. These fossil sites number are over 350 (Kamei 1991).

However, only two proboscidean molars have been found from the Ryukyu Islands (Tokunaga 1940; Nohara and Hasegawa 1973). Otsuka (1997) identified one of these specimens as being similar to Mammuthus paramammonticus shigensis, and estimated the age as the Late Pleistocene. There are too few proboscidean fossils recovered from the Ryukyu Islands to include this area in the present discussion.

3. TAIWANSE PROBOSCIDEAN FOSSILS

The horizon and the age of proboscidean fossils of Taiwan are not yet known accurately. Recently, the layers of the area in which Stegodon and Mammuthus occurred were studied. The nanofossil biostratigraphy (Shieh and Shieh, personal communication) suggests that the area involved must be placed in NN19. The boundary of NN19/NN20 is approximately 0.9 to 0.4 Ma.

We began our study in 1999 with a reexamination of 232 proboscidean molar fossils from the sea bottom around the Penghu Island and Tsiliaq area near Tainan, including much new material. Our comprehensive study confirmed the presence of two species of Stegodon, two species of Mammutthus from the Early to Middle Pleistocene, and one Palaeoloxodon from the Late Pleistocene. There are no fossils before the Pleistocene.

4. COMPARISON OF JAPANESE AND TAIWANESE PROBOSCIDEAN FOSSILS

A comparison of Japanese and Taiwanese proboscideans by Shikama et al. (1975) shows two mammalian faunas in Taiwan. One was named the Cho-chen fauna, being represented by Mammutthus armeniacus taiwanicus, S. aurorae and S. sinensis. The other was the Penghu-Tainan fauna represented by Palaeoloxodon naumanni. Shikama et al. (1975) placed the first fauna in the Middle Villafranchian and the last in the Late Pleistocene.

In the Japanese Islands, Stegodon and Mammuthus occur in the Early to Middle Pleistocene, the same age as on Taiwan. S. aurorae is known from the Late Pliocene to the Early Pleistocene (2.5 Ma – 1.0 Ma), M. protomammonticus from the Early to the Middle Pleistocene (1.0 Ma – 0.7 Ma), and S. orientalis from the Middle Pleistocene (0.5 Ma – 0.4 Ma). Using data from tephrostratigraphy and oxygen isotope stratigraphy, Konishi and Yoshikawa (1999) estimated the immigration date of M. protomammonticus into the Japanese Islands as 1.15 Ma, and that of S. orientalis as 0.62 Ma. S. sinensis, S. (Parastegodon) akashiensis, S. (Parastegodon) aurorae, Elephas hysudricus and M. armeniacus taiwanicus were recorded among the Cho-chen fauna described by Shikama et al. (1975). S. (Parastegodon) akashiensis has subsequently been synonymised with S. aurorae (Taruno 1991), and our studies indicate that the specimens identified as Elephas hysudricus by Shikama et al. (1975) are identi-
The fossils from the Cho-chen fauna of Taiwan are considered as reworked fossils, and as such the chronological sequence of the proboscidean fossils cannot be decided accurately. However, based upon direct comparison with the Japanese sequence, we posit a sequence of *S. aurorae*, *M. a. taiwanicus* and *S. orientalis*, with the latter the most recent taxon.

Shikama *et al.* (1975) described *Palaeoloxodon* from Taiwan as *Palaeoloxodon naumannii*. However, our detailed investigations indicate that *Palaeoloxodon* of Taiwan differs markedly from *P. naumannii* of the Japanese Islands in the size and wearing pattern on the occlusal surface of the molar.

We think that three species of *Palaeoloxodon* (*P. namadicus*, *P. naumannii* and *P. huaihoensis*) are represented in China, and that *Palaeoloxodon* of Taiwan is the same as *P. huaihoensis*, as Qi (1999) described. *P. naumannii* has been recorded from Japan, but *P. huaihoensis* has not.
The migration of *P. naumanni* into the Japanese Islands has been estimated as at 0.43 Ma by Konishi and Yoshikawa (1999). After this age, there exists no evidence that the Japanese Islands were connected with the Asian Continent. Because *Palaeoloxodon* of Taiwan is considered to be of the Late Pleistocene (Hu and Tao 1993), it is understandable that *P. huaihoensis* has not been found in Japan.

Comparison of the research results in the Japanese Islands and Taiwan with data from mainland China indicates that *M. protomammuteus* and *S. aurorae* evolved in the Japanese Islands and Taiwan, and that *S. orientalis, P. naumanni* and *P. huaihoensis* migrated there from the mainland.

5. REFERENCES


