Asian Paleoprimatology, vol. 1:149-160 (2000)
Kyoto University Primate Research Institute

Origins of Southeast Asian People as Viewed from Cranial and Dental Morphology

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Abstract

Human skeletons of the Hoabinian period from Malaysia, Indonesia and Vietnam demonstrates those affinities of the cranial and dental morphology to the Autralo-Melanseians. These specimens, as well as other fossils from Tabon, Niah and Vietnam, were members of population that originated in the late Pleistocene Sundaland, the ancestors of modern Australian Aboriginal peoples. On the other hand, particularly in the dental characteristics, similarities to the modern North/East Asians were observed in the subsequent Neolithic to modern populations in a part of Southeast Asian regions. This finding suggests that the migrants from the Asian Continent had expanded into its peninsula and the island regions of Southeast Asia since the Neolithic period, supporting the dual ancestry (hybrid) hypothesis for the population history of Southeast Asia.

Introduction

Population history of Southeast Asia seems complicated due to various migration processes and inter-blend of the population since the prehistoric time. The limitation of the prehistoric human remains and the uncertainty in their dating also adds a problem to the study of this region. In general perspective, the Southeast Asia was thought to be occupied by indigenous people, who are sometimes referred to as of Australo-Melanesian lineage, before the immigrants from North or East Asia widely spreading on this region (Callenfels, 1936; Mijesberg, 1940; Von Koenigswald, 1952; Coon, 1962; Jacob, 1967, 1975; Bellwood, 1987). Recent studies based on the human fossils such as the skull from Niah Cave in Borneo (Brothwell, 1960), Tabon specimens from Palawan Island in Philippine (Macintosh, 1978), early Hoabinhian skulls in Vietnam (Cuong, 1986), and Gua Gunung remain from Perak in Malaysia (Zuraina, 1994; Matsumura and Zuraina, 1999) support the existence of the Australo-Melanesian lineage in early Southeast Asia.

However, there are different interpretations about these people based on the studies of recent cranial and dental morphology. The studies made by Turner (Turner, 1989, 1990, 1992) based on nonmetric dental traits demonstrated that the both the early and the modern Southeast Asians display so-called "Sundadont" dental complex, which is commonly seen in the Australian Aborigines, too. On the other hand, craniometric studies by Hanihara

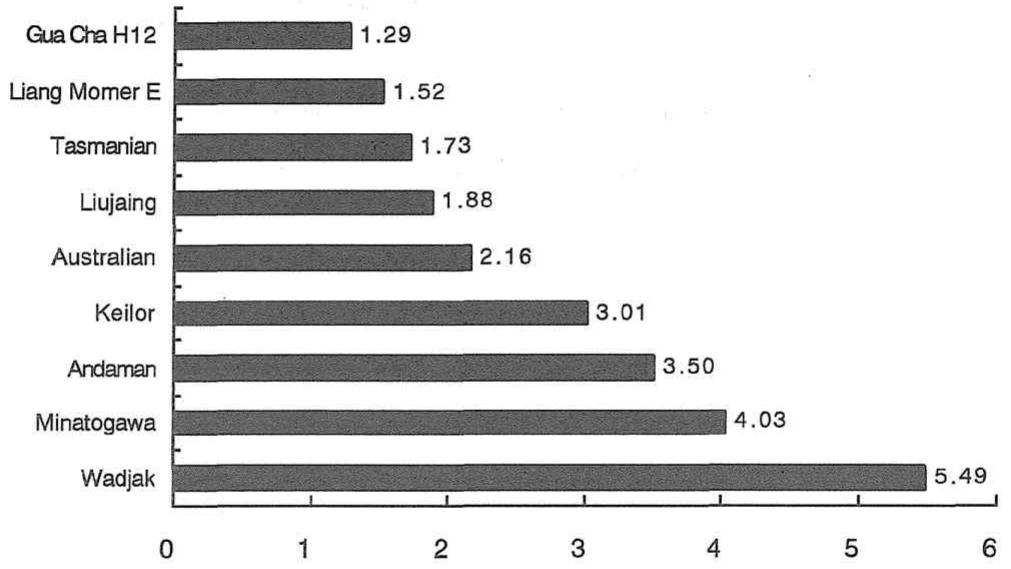

Figure 1. Euclidean distance from the Perak man based on seven cranial measurements.

(1993, 1994) gave a perspective that the Proto-Malay, who were morphologically similar to present-day Dayak, was the original source for present-day Southeast Asians.

Both Turner and Hanihara consider the evolvement of present-day Southeast Asians is by local adaptation and not by admixture with North/East Asians. However, the work of the present author based on the nonmetric dental traits of the various populations from East Asia indicates a different trend. This paper is to present an evidence which people belonging to the Australo-Melanesoid lineage occupied Southeast Asia during the early Holocene based on the analyses of skeletal measurements. In addition, this article shows an results which clearly supports the hybrid theory from the analyses of dental traits data.

The Perak Man: the Early Holocene Skeletal Remains in Malaysia

The discovery of Kota Tampan, an undisturbed Palaeolithic tool workshop site in 1987 led to a large-scale survey of the Lenggong valley resulting in the identification of many potential sites. Among these sites was a cave, Gua Gunung Runtuh, located at latitude 50 7' 3" North and longitude 100° 58' 3" East in the Kepala Gajah limestone massif, approximately 150 metres above sea level. It takes a 45 minute walk up this hill from Ulu Jepai village, to reach the cave. The site was excavated in May-June 1990, and again in July 1991. The team which were conducted by Dato Prof. Zuraina Majid and comprised staff and students from Universiti Sains Malaysia the Department of Museums and Antiquities and local villagers who had worked with us for many seasons.

The excavation of Gua Gunung Runtuh in 1990 revealed a 10,000-11,000 year old primary burial of an adult male buried in a foetal position and accompanied with stone

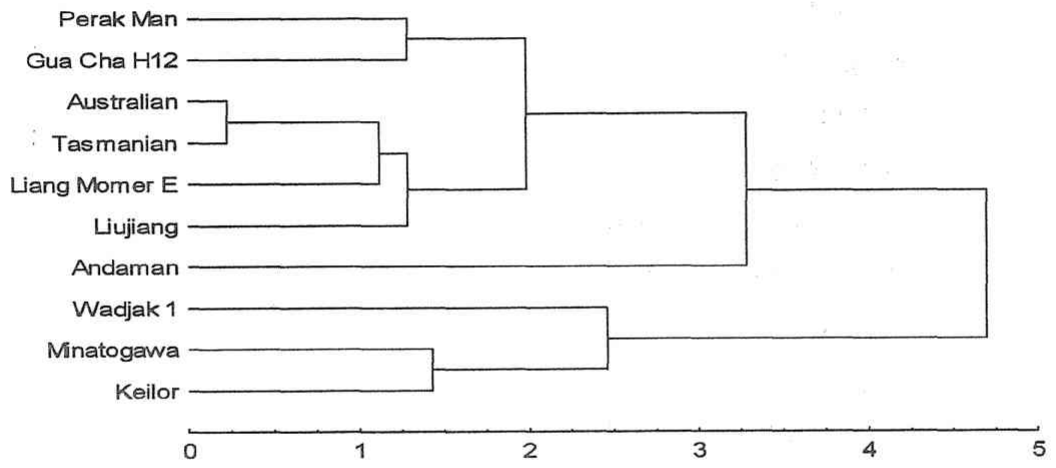

Figure 2. Dendrogram based on Eucridean distances by seven cranial measurements.

tools and food (Zuraina, 1994). This skeleton, the Perak man, was named after the Malaysian State of Perak, in which he was found. He was the only person buried in this cave, a cave that was used mainly for habitation from before 13,000 years ago.

Several sites in the north of Peninsular Malaysia have revealed evidence of human skeletons of a similar cultural stage as the Perak man as they were also found in preceramic levels and with similar lithic artifacts. Prior to the discovery of Perak man, skeletons from preceramic levels and associated with similar tools as the Perak man, have been found in other caves in Perak. However, these human remains were fragmentary and without chronometric dates (found before the advent of radiocarbon). In Gua kajang, Lenggong, a cave about 4 kilometres away from Gua Gunung Runtuh, where the Perak man was discovered, Evans (1918) found a fragment of human jaw and some teeth in it, and fragments of other parts of the human body. Duckworth (1934) interpreted this to have probably belonged to a female who died in her 20's, and her dental features resembled those of the Australian aborigines. In Gua Kerbau (Evans, 1928), located about 40 km away from Gua Gunung Runtuh, Gordon and later Evans and Callenfels collected fragmentary human bones "in inextricable confusion" and representing several individuals (5 or 6) ranging from a 10year old to a tall adult about 5'7", with one of them buried in a foetal position (Duckworth, 1934). In another site, Gol B'ait, a skeleton was found in s similar flexed position in the preceramic and lowest level (Callenfels, 1939). Further away, 100km from Gua Gunung Runtuh, in Guar Kepah, a shell midden site, Huxley in 1863 identified the remains of an Australomelanesoid (Winstedt, 1968), while a later excavation by Callenfels discovered more remains of a later period, i.e. the Neolithic (Callenfels, 1936).

Thus, the human skeletal remains that could have been of a similar cultural stage as

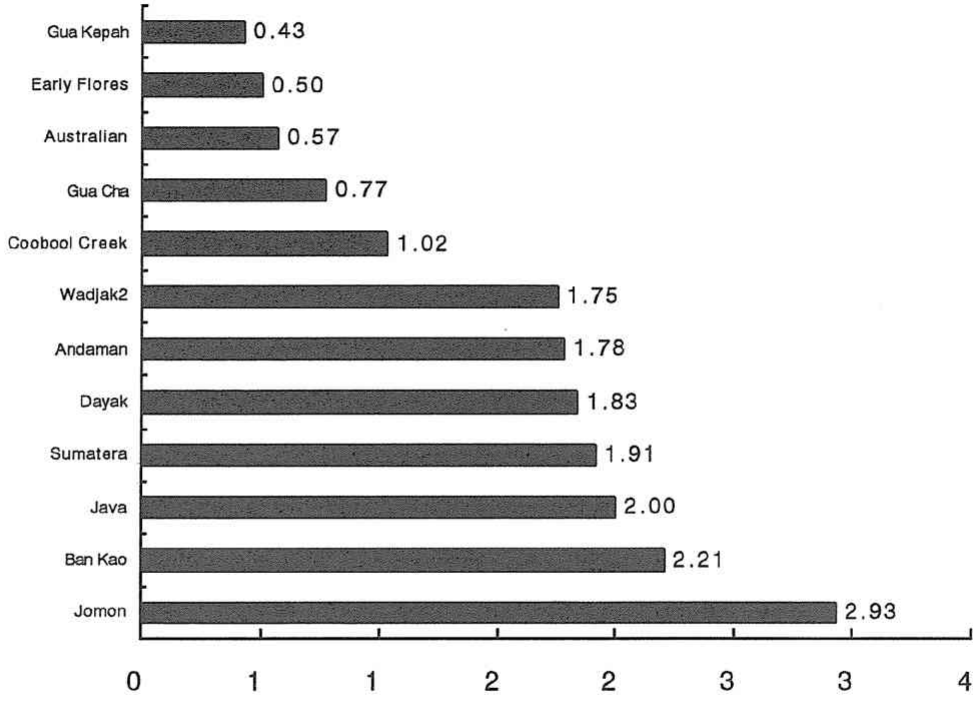

Figure 3. Euclidean distance from the Perak man based on nine tooth crown measurements.

the Perak man were those from Gua Kajang, Gua Kerbau, Gol B'ait and Guar Kepah. The skeletons in these caves have been interpreted as comparable to the Australian aborigines and Wadjak man as they "seem to fall within the confines fo a group of humanity spread over a large area of southeastern Asia and traceable even into Australia" (Duckworth, 1934). They were all associated with preceramic levels and the so-called "Sumatralith" pebble tool (oval unifacials), hammerstones and slab, and were all said to belong to the so-called "Hoabinhian" period. Almost all the mandibles recovered showed considerable attrition (Duckworth, 1934; Mijsberg, 1940), just as in the Perak man.

Biological Distances of the Perak Man to the Others

Following the findings made in the 1994 study, that the Perak man was Australomelanesoid (Jacob and Soepriyo, 1994), Matsumura and Zuraina (1995) attempted a statistical analysis of dental measurements to evaluate and confirm the Perak man's Australoid affinity. The tooth traits of the Perak man were statistically compared with those of early and modern samples from Australia, Southeast Asia and Japan. The results showed a close affinity with the Australian samples in both overrall tooth size and proportion, suggesting dentally Australoid occupation of this region during the Holocene.

The earlier study of the Perak man by Jacob and Soepriyo (1994) also demonstrated Australo-Melanesoid characteristics in the Perak man's cranial and limb bones, strengthening the possibility of Australoid occupation in this region during the early Holocene. In

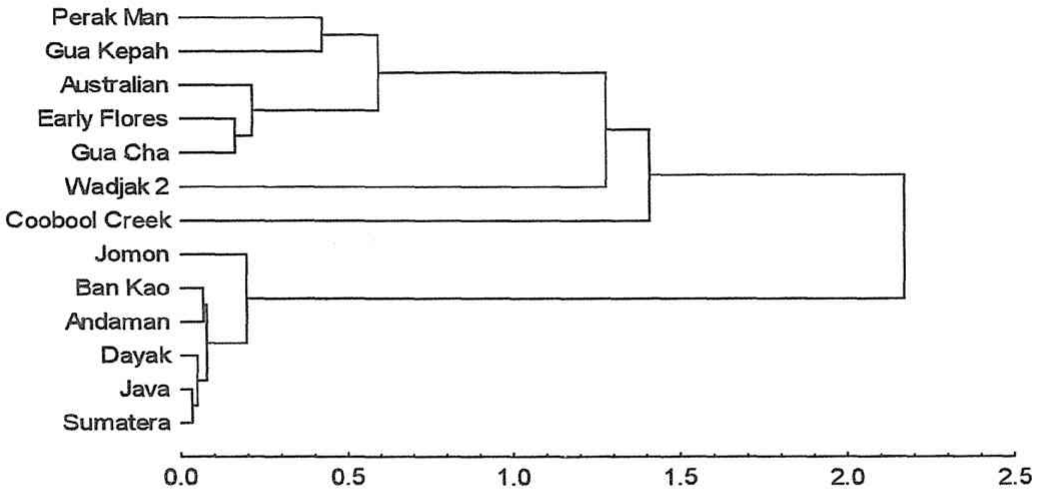

Figure 4. Dendrogram based on Eucridean distances by nine tooth crown measurements.

order to evaluate and confirm the Perak man's Australoid affinity, a statistical analysis comparing the skeletal and dental measurements of Perak man with those of the samples from other regions is expected. In the present study, therefore, morphological affinities of the Perak man with the prehistoric and modern Southeast Asians and Australians were assessed by applying the biological distances.

Cranial measurements of the Perak man are restricted to the distal half of cranium and some parts of facial skeleton. Only seven cranial measurements (cranial breadth, bi-auricular breadth, biasterionic breadth, occipital chord, nasal breadth, alveolar breadth, and cheek height) are used for the computation of Euclidean distances. Figure 1 displays the graphs of Euclidean distances from the Perak man to the 10 comparative samples. The Gua Cha H12 sample from Malay Peninsula shows the closest distance from the Perak man, and the next closest is the Liang Momer E from Flores Island. On the other hand, the Minatogawa man from Okinawa in Japan and Wadjak man from Java Island are quite far from the Perak man. Figure 2 depicts the dendrogram of cluster analysis applied to the distance matrix. The close similarity of the Perak man to the Gua Cha (H12) sample is again demonstrated in this figure. These two samples are secondly clustered with the Australian aborigines, Tasmanians, Liang Momer-E samples, and Liujiang sample from Southern China. The Keilor sample from Australia, Wadjak and Minatogawa men are distinctly separated from the Perak man by forming another major cluster.

Since the heavy attrition obviously reduced the mesiodistal dimensions of the tooth crowns, only the buccolingual crown diameters were used for the distance computations. The obtainable buccolingual crown diameters were from nine teeth of the upper second premolar, first and second molars, and all the lower teeth except the first and third molars.

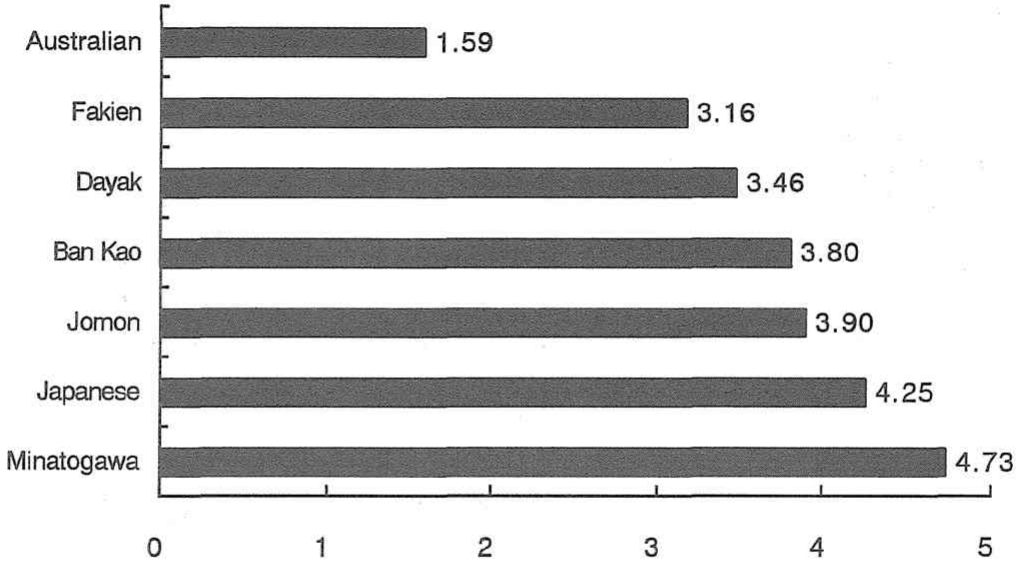

Figure 5. Euclidean distance from the Perak man based on 10 limb bones measurements.

Figure 3 exposes the Euclidean distances from the Perak man to the 13 comparative samples, and Fig. 4 represents the results of the cluster analysis applied to the distance matrix. The Perak man is close to the Gua Kepah, early Flores including the Liang Momer samples, Gua Cha sample and Australian aborigines including the prehistoric Coobool Creek sample. These samples are loosely connecting with each other in the upper cluster, while the Neolithic Jomon and Ban Kao samples and four modern Southeast Asians are distinguished from the Australians, early Flores and Malay samples including the Perak man as forming another separate cluster.

The limb bone measurements were taken from humerus, ulna, radius, femur, tibia, and fibula of the Perak man (maximum lengths of the humerus, radius, femur and tibia, sagital and transverse diameters of the femoral and tibial mid-shafts, subtrochanteric sagital and transverse diameters of the femoral shaft). Figure 5 shows the Euclidean distances from the Perak man to the seven comparative samples, computed using these 10 measurements from the limb bones. As a result, the Perak man is much closer to the Australian aborigines than to the other samples.

Reconstruction of Population History of Southeast Asia

Early Inhabitants of Southeast Asia: Ausralo-Melanesian Lineage?

Because the statistical comparison of the cranial metrics were restricted due to the lack of certain measurements in the incomplete Perak man's skull, other several representative cranial series excluding the Perak man,, dating early Holocene and Neolithic period, were reanalyzed on the cranial measurements. Nine (9) cranial measurements (Martin

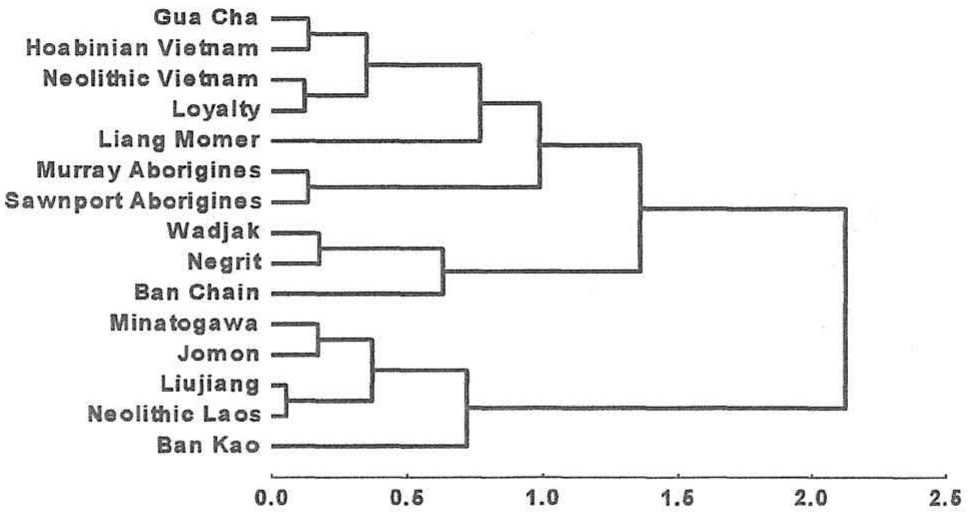

Figure 6. Dendrogram based on Q-mode correlation coefficients of nine cranial measurements.

Nos. 1, 8, 17, 45, 48, 51, 52, 54, 55) from the 15 male series were used for statistical comparisons. Q-mode correlation coefficients were calculated in order to evaluate similarities of proportion in these measurements. A cluster analysis was applied to this correlation matrix for visually display the relationships between the compared samples.

The result is shown in Fig. 6. Two major clusters were formed in this dendrogram. The upper cluster consists of the Gua Cha (No. H12) from Kelantan in Malaysia, Liang Momer specimen from Flores and early Hoabinian Vietnam. Two Australian Aborigines and Loyalty Islanders were also clustered with those early Malay and Flores samples. On the other hand, two Late Pleistocene samples from Liujiang in Southern China and the Minatogawa sample from Okinawa Island, Japan form another major cluster together with the Neolithic series from Laos, Thai and Jomon Japan. Thus, cranial affinities observed in former cluster obviously indicate that the early inhabitants of the Southeast Asia bear the characteristics similar to that of Australo-Melanesinan skulls. The other cluster indicates the close relationship between some Neolithic people from the Continental margin and the Late Pleistocene Southern Chinese.

Origins of Modern Southeast Asians from Dental Traits Perspective

Twenty-one nonmetric dental traits, which are regarded as relevant traits in studying population affinity, were observed according to the classification criteria already mentioned in else paper (Matsumura, 1995). All of the traits were scored on the bases of whether the traits were present or absent in order to facilitate the characterization of the population and of the statistical comparisons. Smith's MMDs were calculated between

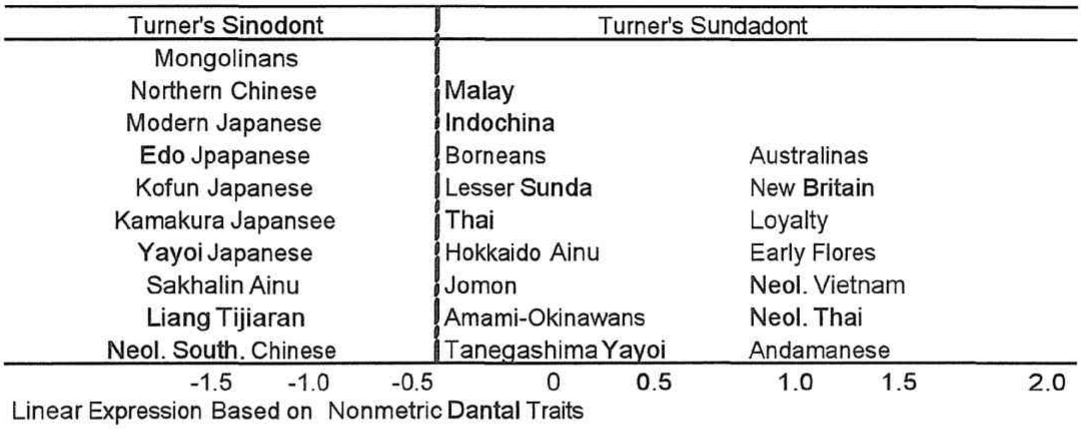

Figure 7. Summarize of the linear expression of the multi-dimensional scaling method applied to the Smith's MMDs on the basis of the 21 nonmetric dental traits.

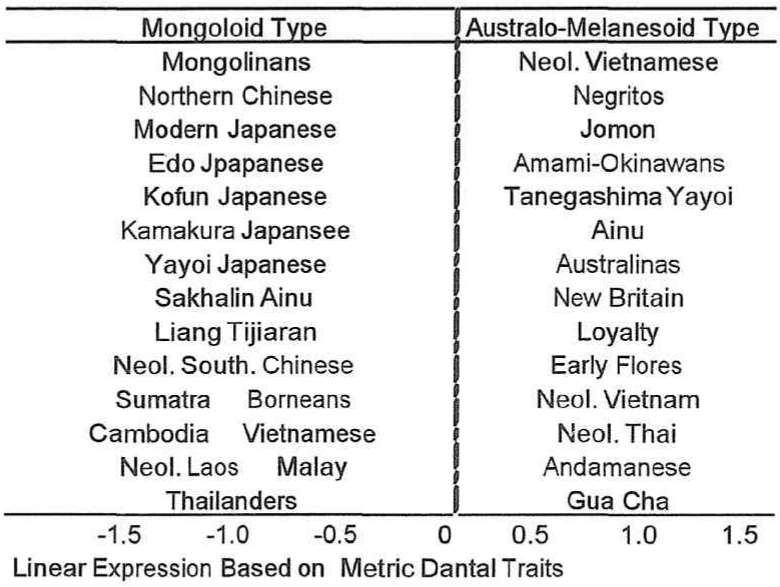

Figure 8. Summarize of the linear expression of the multi-dimensional scaling method applied to the Q-mode correlation coefficients of the dental crown diameters.

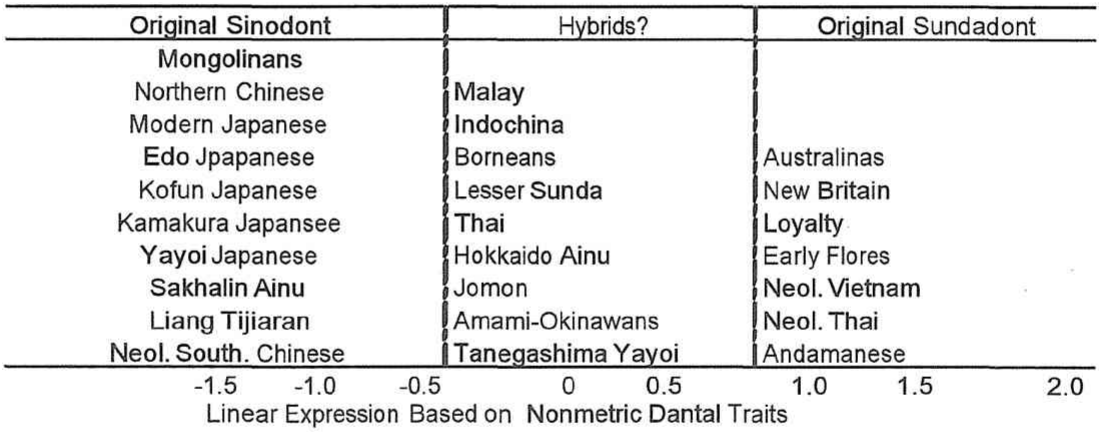

Figure 9. Another manner of the population classifications based on the nonmetric dental traits of Fig. 7.

the samples from the 25 populations based on 21 nonmetric traits. The multi-dimensional scaling (MDS) method by Torgerson (1958) was applied to the distance matrix to summarize their consanguinity.

The result is shown in Fig. 7. On the left side of the axis, the Northeast Asians such as modern Mongolians, Chinese and Japanese including historic samples are clustered together showing their close affinities. On the opposite side of the axis, all of the Southeast Asian specimens from prehistoric to modern times were grouped together with the Jomon, Hokkaido Ainu and Australian aborigines. Thus the population diversity observed in Fig. 7 shows a similar trend with Turner's "Sinodont" and "Sundadont" classifications.

To investigate the affinities of the populations based on the metric dental traits, Q-mode correlation coefficients between the 34 samples were calculated using the tooth crown diameters. The computed correlation coefficients indicate the differences in overall proportion in their tooth size. Figure 8 displays one-dimensional expression of MDS applied to the correlation matrix. So-called "Mongoloid" people including the modern Chinese, Mongolian, Buriat, and Japanese are situated on the left side of the horizontal axis. In addition to these typical Mongoloid samples, most of the modern Southeast Asian samples such as the Borneans, Thailanders, Indonesians, Cambodia and Vietnamese were also grouped together. On the right side of the horizontal axis, the Australian aborigines, Loyalty Islanders, Negritos, Jomon, Ainu, Hoabinian and Mesolithic Maly and Flores samples, Neolithic Thailanders and Vietnamese, and Andaman Islanders were grouped together indicating their close affinities.

Conclusion

The preceding studies had demonstrated the Australo-Melanesian affinities among the several late Pleistocene and early Holocene human remains from Southeast Asia. In Malaysia, Brothwell (1960) examined the late Pleistocene human skull excavated from Niah Cave in Borneo Island, and found that it bears closest similarity to the Tasmanians. The Tabon man unearthed from Palawan Island in Philippine is also well known as the late Pleistocene specimen from Southeast Asia. Macintosh (1978) considered this specimen akin to the Australoids. In Vietnam, Cuong (1986) studied two nearly complete skulls from the early Hoabinhian cultural sites, and found characteristics similar to the Australoids despite partially revealing some Mongoloid features. From these findings, it has been generally assumed that Southeast Asia was occupied by the Australo-Melanesoid stock before the invasion of the Mongoloid lineage from the north into this area (Callenfels, 1936; Mijesberg, 1940; Von Koenigswald, 1952; Coon, 1962; Jacob, 1967; Bellwood, 1987).

The biological distances based on the skeletal and dental measurements demonstrated

the Perak man morphologically links with the Australian lineage, suggesting that the ancestry of the Perak man can be traced back to the Australoid stock that occupied this region during late Pleistocene. The author have revealed a similar result in the else study of the Perak man (Matsumura and Zuraina, 1999) . The early Malay and Flores specimens, such as the Gua Cha and Liang Momer specimens, and early Hoabinian Vietnamese also displayed close affinities with the Australo-Melanesian samples in the cranial or dental characteristics. These specimens and other fossils from Tabon, Niah are regarded as people originated in the late Pleistocene Sundaland or the ancestors of modern Australian Aboriginal peoples. Therefore, it seems reasonable to say that the early inhabitants of Southeast Asia were the people of the Australo-Melanesian lineage at least before the Neolithic period. Those morphological characteristics shared with the Australoids had been retained as the relics of such regional inhabitants of Southeast Asia until the early Holocene.

At a glance, the result of nonmetric dental traits in Fig.7 seem to correspond with Turner's "Sinodont" and "Sundadont" classifications. However, if we examine it cautiously, we see that the most of the modern Southeast Asians were located in between "Sinodont", which consist of Northeast Asians on the left side, and "Sundadont", which consist of Australo-Melanesians and early Southeast Asians on the right side. Although there might have been a local evolution, by taking both the craniometric (Fig.6) and dental metric (Fig.8) results into consideration, the intermediately located specimens in Fig.7 can be interpreted as hybrids of these two groups. As revised Fig.7 into Fig.9, if the nonmetric dental traits observed in early Southeast Asians and Australo-Melanesians are regarded as the original "Proto-Sundadont" dental complex, the modern Southeast Asian specimens, which are situated in between "Proto-Sundadont" and "Sinodont" people, can be hybrids of Northeast Asian Mongolid and Australo-Melanesoid lineage.

Therefore, the present study based on the investigation of cranial and dental morphology supports the hypothesis stated by Bellwood (1987) that there was a diffusion of migrants from the Asian Continent, probably from Southern China, into Southeast Asia since the Neolithic period. These people inter-blended with indigenous Australo-Melanesoid stock as they diffused. It is noteworthy to find out that the Linag Tijiaran sample, Toalan Mesolithic (ca.4,000BP) from Sulawesi cave near Tijia, bears "Sinodont" characteristics (Fig. 7). The trace of the earliest infiltration invasion of the Mongoloid people into Southeast Asian archipelago was found in such an equatorial Island.

Acknowledgements

We are grateful to Dato' Prof. Zuraina Majid, Center for Archaeological Research Malaysia, Universiti Sains Malaysia, Dr. John de Vos, Nationaal Natuurhistorisch Museum, Netherlands, Prof. Robert Foley, Department of Biological Anthropology, Univer-

sity of Cambridge, Dr.Chris Stringer, Department of Palaeontology, Natural History Museum, London, and Prof. Andre Langaney, Laboratoire d Anthropologie Biologique, Musee de l'Home for permission to investigate the skeletal collections in their charge.

Thanks are due to Ms. Tomoko Anezaki for manuscript correction. This study was supported in part by Grants-in -Aid in 1995 from the Japan Society for the Promotion of Science, and by Grants-in-Aid for International Scientific Research in 1996 (No. 08041164) and 1998 (No. 09041161) and Priority Areas in 1999 (No. 11112225) from the Ministry of Education, Science and Culture, Japan.

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