Population Prehistory of East Asia and the Pacific in the Late Pleistocene and Holocene: A Dental and Craniofacial Perspective

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Key Words. Negritos, Dajaks, Sundaland, Southeast Asia, Pacific.

Abstract

Distance analyses were applied to dental and craniofacial data recorded on samples from East and Southeast Asia, Australia, Melanesia, Polynesia, and Micronesia for the purpose of assessing biological affinities and possible origins of these populations. A clear separation between Australomelanesians and other populations from Southeast Asia and the Pacific is evident. The analysis of dental and craniofacial variations suggests that the generalized Asiatic populations, e.g. Negritos, Dajaks, Lesser Sunda Islanders, etc. represent at least part of the morphological background of not only the majority of present Southeast Asians, but also the Neolithic Jomon people and their lineage in Japan, western Micronesians, and Polynesians. The results obtained in this study suggest that the physical characteristics of the late Pleistocene Sundaland populations may have been similar to those of the Negritos and Dajaks of today. They could have colonized the continental shelf of East Asia, extending to Hokkaido and Sakhalin in the north and western Micronesia and Polynesia in the east.

Introduction

The vast majority of the inhabitants of Southeast Asia share considerable physical, cultural, and linguistic homogeneity (Garn, 1961; Coon, 1962; Bowles, 1977; Brues, 1977; Bellwood, 1985). The orthodox view based mainly on archaeological interpretations suggests that the East Asian invaders from the north gradually absorbed and replaced the aboriginal Southeast Asian populations within the past 2,000 - 4,000 years, producing today's Southeast Asian physical features (Coon, 1962; Brues, 1977; Bellwood, 1985).

However, there are other populations who are regarded as people with lesser admixture with the East Asian migrants from the north (Omoto, 1980, 1984; Bellwood, 1985; Hanihara, 1989c, 1990a, b, c, 1991, in press, submitted a, b). They have been called the "Proto-Malay" populations, including Semang of Malaya, Negritos of Luzon, Palawan, Negros, Mindanao, and Andaman islands, Dajaks of Borneo, etc. (Coon, 1962; Bellwood, 1985). Early attempts at explaining the physical characteristics of Negritos relied on the somatological investigations (Bean, 1910; Newton, 1920; Vanoverbergh, 1925, 1937, 1938; Sebesta and Lebzelter, 1928; Wastl, 1957). Although several studies of Negritos and Dajaks based on cranial measurements were published, few authors analyzed data in relation to the population prehistory in East Asia and the Pacific (Verneau, 1909; Sullivan, 1919; Bonin, 1931, 1936; Yokoh, 1931; Genet-Varcin, 1951; Brothwell, 1960; Yamaguchi, 1967, 1982; Tagaya and Ikeda, 1976). The simplest conclusion regarding these populations is that they are the short statured representatives of a once widespread "Australoid" population, which comprises the very varied peoples of Australia and Melanesia today (Birdsell, 1949, 1977; Garn, 1961; Coon, 1962; Howells, 1976; Jacob, 1967; Brues, 1977; Kennedy, 1977; Glinka, 1981; Bellwood, 1985).

On the basis of human genetic studies, Omoto (1980, 1984) and Omoto et al. (1981) first pointed out the closer relationships between Negritos and adjacent Southeast Asians as well as Chamorros of Guam than that between the former and Australian Aborigines. Omoto (1984) regarded the Southeast Asian Negrito populations as having phenotypic specialization in reduced size and gracilization. These are people who have undergone in situ evolution in mountainous tropical rain-forest environments through the time as long as 20,000 - 30,000 years.

Turner (1976, 1979, 1987, 1989, 1990) and Turner and Swindler (1978) has greatly advanced understanding of the possible origins, microevolution, relationships, biocultural adaptation, and dispersal of human populations in East Asia and the Pacific. Turner's excellent studies provide the concept that East Asia has two related but dentally distinguishable major human population systems. His works identified the Sundadont and Sinodont divisions for the Mongoloid dental complex (Hanihara, K., 1969). Turner (1979, 1987, 1989) described that Sundadonty evolved from the inhabitants in mainland Southeast Asia or in the landmass of the continental shelf called Sundaland in the late Pleistocene period when sea level was much lower than it is today, and out of it evolved the more specialized Sinodont pattern of the present Northeast Asians. He went on to say that the members of the late Pleistocene Sundaland population could have been the ancestors of all the present peoples of East and Southeast Asia, and Pacific Basin.

More recently, Turner (1987, 1990) has proposed a unifying local evolution model for Australasia based on the mutual possession of key Sundadont dental features among early and modern Southeast Asians, present Ainu, Neolithic Jomon people, Paleolithic Minatogawa man and modern Australian Aborigines. Based on such findings, Turner and his colleagues indicated that, in the period of climatic change, or from the late Pleistocene to the early Holocene, Sundaland populations seem to have colonized the continental shelf of East Asia, extending as far north as Hokkaido and Sakhalin (Turner, 1976, 1979, 1987, 1989, 1990; Turner and Swindler, 1978). Pietrusewsky (1988) has also suggested a local evolution hypothesis for modern Southeast Asians on the basis of similarities in the craniofacial morphology between the Neolithic and more recent Southeast Asians.

These views indicate the necessity to re-consider the basic replacement theories for the origins and affinities of modern Southeast Asians. From dental and craniofacial morphological viewpoints, the consistent associations of Negritos and Dajaks with modern Southeast Asians were demonstrated by the present author (Hanihara, 1989c, 1990a, b, c, 1991, in press, submitted, a, b). However, finer details of the evolutionary trends for these dispersed populations in East and Southeast Asia may always escape us.

The origins and migration of peoples within the great Polynesian triangle have long been matters for speculation. Physical anthropologists and related scientists have tried and are still trying to get at the facts, but even now a number of matters remain unexplained (Marshall, 1956; Bellwood, 1975, 1978;

Pietrusewsky, 1971, 1984; Heyerdahl, 1978; Kirch et al, 1989). Archaeological findings, together with linguistic studies, suggest that the origins of Polynesians are in the western Pacific. The Lapita Cultural Complex is regarded on archaeological grounds to include the common ancestral cultures of eastern Melanesia, somewhere in the Bismark Archipelago region or the New Britain - New Ireland area, and Tonga and Samoa in western Polynesia (Bellwood, 1975, 1978; Green, 1979; Kirch, 1982, 1986; Pietrusewsky, 1985, Kirch et al., 1989). This raises the fundamental problem of why the eastern Melanesians and Polynesians, who form a linguistic and to a lesser extent a cultural continuum, should be physically so different (Howells, 1973, 1979; Turner and Scott, 1977; Serjeantson, 1984; Pietrusewsky, 1985; Kirch et al., 1989). Physical anthropological findings based on dental and cranial morphology as well as human genetics have made it possible to say with some certainty that the first settlements were established by migrants from Southeast Asia, probably Indonesia (Riesenfeld, 1956; Coon, 1962; Simmons, 1962; Brues, 1977; Turner and Scott, 1977; Howells, 1979; Pietrusewsky, 1984, 1985, 1990; Kirch, 1986; Turner, 1987; Kirch et al., 1989). On the other hand, Brace and Hunt (1990) and Katayama (1990) developed the idea that Polynesians were not evolved from Southeast Asians but from the Neolithic Jomon people in Japan.

Meanwhile, western Micronesians had been settled about 3,000 years B.P. by Chamorros who had linguistic and cultural affinities with the Philippines or northeastern Indonesia (Bellwood, 1975, 1978; Serjeantson, 1984). Moreover, many investigators argue for the affinities of Micronesians with

Polynesians (Pietrusewsky, 1977; Turner and Swindler, 1978; Howells, 1979; Serjeantson, 1984). The settlement of migrants from the western Pacific in western Micronesia and Polynesia is much more evident than it has ever been, but the larger question of the general origins of the Polynesians and Micronesians is still incompletely answered.

In my previous studies, it was pointed out that the aboriginal populations in Southeast Asia, as represented by Negritos of Luzon and Dajaks of Borneo, share common dental and craniofacial morphology with not only modern Southeast Asians but also the Neolithic Jomon people and the successors in Japan, and the Pacific populations represented by western Micronesians and Polynesians (Hanihara, 1990a, b, 1991, in press, in submitted a).

In the present study, the major purposes are focused on analyzing the origins and evolutionary trends of the Southeast Asian and Pacific populations on the basis of dental and craniofacial data.

Materials and Methods

The approximate source locations of the samples are shown in Figures 1 and 2.

Dental data

The materials consist of prehistoric and near contemporary samples from East Asia and the Pacific. Tables 1 and 2 give the numbers of individuals investigated, the locations where the materials are curated, and the provenance of each sample.

Complete or nearly complete adult specimens were selected for recording metric and non-metric data. The metric data were recorded on male specimens. Mesio-distal crown diameters were measured on all the teeth except for the maxillary and mandibular third molars. Bucco-lingual crown diameters were omitted since they have more post-natal environmental influences than mesio-distal ones (Sofaer et al., 1971; Townsend and Brown, 1978; Kolakowski and Bailit, 1981; Matsumura, 1989). The non-metric observations were carried out on both male and female specimens to combine the data because sexual dimorphism in frequencies was insignificant in most of the samples observed. As regards the classification of non-metric traits, the teeth which carry the corresponding traits were distinguished from non-carriers in the following manner: (1) Shovel shape - Based on the data provided by a digimatic caliper with a pair of movable arms to measure the extent of shovelling, the maxillary central incisors with the lingual fossa less than 0.5mm depth were classified as "no-shovel" (-), those between 0.5mm and 1.0mm were classed as "moderate" (+), and those deeper than 1.0mm as "strong-shovel" (++). The types classified in this manner correspond respectively to "no- and trace shovel", "semi- and moderate-shovel", and "strong-shovel" types proposed by Hrdlicka in 1920 (Hanihara, K., et al., 1970). (2) Hypocone (UM2) - Distinction of carriers and non-carriers was based on A. A. Dahlberg's Plaque P9 (Dahlberg, 1949). The teeth classified into "3" were referred to as non-carriers of this trait. (3) Carabelli's cusp (UM1), 6th cusp, 7th cusp, deflecting wrinkle and protostylid (LM1) - These traits were classified as described by Hanihara, K. (1976). (4) Distal trigonid crest - The distal trigonid crest was first described by Weidenreich (1937) in his study on the <u>Sinanthropus</u> dentition and confirmed its appearance in modern man by Hanihara, K. (1956). In the present study the mandibular first molars with the crest connecting the metaconid central ridge with the protoconid distal accessory ridge were counted as carriers. (5) +4 pattern - The mandibular second molars showing the stage IV described by Hellman (1928) were referred to as carriers. Both metric and non-metric data were obtained from the right side teeth. When a right side tooth was missing or badly damaged, the corresponding left side tooth was investigated.

With computer programs coded by K. Hanihara and myself, distance analysis based on Q-mode correlation coefficients between every pair of populations which represent exclusively shape component, cluster analysis, and multidimensional scaling method were applied to 2 sets of dental measurements of different combinations of samples. For non-metric traits, Balakrishnan and Sanghvi's B-square distance was computed (Balakrishnan and Sanghvi, 1968; Constandse-Westermann, 1972).

Craniofacial data

The data from 44 adult male samples, totaling 2,123 individuals, are statistically analyzed in the present study. The names, sample sizes, initial investigators, and provenance of the populations are listed in Table 3.

Among 31 Martin's craniofacial measurements (Martin and Saller, 1957) already obtained, the following measurements are used because they were in common with those reported by Bonin (1931) and Pietrusewsky (1984); maximum cranial length (M1), cranial base length (M5), maximum cranial breadth (M8), minimum frontal breadth (M9), basion-bregma height (M17), bimaxillary breadth (M46), upper facial height (M48), orbital breadth, left (M51a), orbital height, left (M52), nasal breadth (M54), and nasal height (M55).

The same statistical methods used for the metric dental analyses were applied to 3 sets of craniofacial measurements of different combinations of craniofacial samples.

<u>Population history of Japanese and population labels</u>

As regards the affinities of modern Japanese, the points to be considered in combination are: 1) The first occupants of the Japanese Archipelago in the late Pleistocene came from somewhere in Southeast Asia. They gave rise to the people in the Neolithic Jomon age (ca. 10,000 - 2,300 years B.P.), or Jomonese. 2) A large scale migration from Northeast Asia at about 2,300 years B.P., and continuing throughout the subsequent 1,000 years, caused rapid changes in the physical characteristics of some indigenous people, or the descendants of Jomonese. 3) A part of the Aeneolithic Yayoi people as represented by the samples from the Doigahama site in the western end of Honshu, Kanenokuma site in north Kyushu, etc. were likely immigrants from Northeast Asia via Korean Peninsula, showing close similarity with the modern main-island Japanese and Northeast Asians. 4) The physical characteristics of the Jomonese are still retained to some degree in part of Japan's local areas, especially in geographically-isolated Nansei Islands, Hokkaido, and so forth (Turner, 1976, 1979, 1987, 1989, 1990; Hanihara, K., 1985, 1987, 1991; Hanihara, 1989a, b, c, 1990b, c, 1991, in press, submitted a, b). In fact, Ainu and the people of isolated islands are distinguished from the main-island Japanese and are referred to as indigenous Japanese or the people of the Jomon lineage.

The population terms such as the Neolithic Jomon population, Micronesians from Guam, the resident of Lesser Sundas, etc. will be simply referred to as Jomonese, Guam, Lesser Sundas, etc.

respectively in the following descriptions.

Results

Dental Analyses

The basic statistics for dental measurements are given in Table 4.

At first, using the single linkage method of clustering, a dendrogram (Figure 3) was constructed from the intergroup distances given in Table 5. In this study, samples from the islands of Hawaii and Maui as well as those from the islands of Molokai and Lanai were combined respectively to obtain a sufficient sample size.

The close relationships are found between the samples from Hawaiian Islands and Eastern Polynesia. This cluster links to the samples from Tonga and Marquesas. Guam are grouped into the same cluster of the Negritos and Filipinos of Southeast Asia. The last and most remote branch is Fiji from eastern Melanesia.

Another comparison was carried out by applying distance analysis to mesio-distal crown measurements for the 16 groups from the Pacific and East Asia. Table 6 is a distance matrix obtained and Figure 4 is a two-dimensional graph produced by the multidimensional scaling method, expressing 83.0% of the total variance. The most peripherally positioned group is Fiji. The samples of Polynesia are closely related to each other and form one group. Jomonese and their lineage, Ainu, Okinawa etc. form another group as already shown by the previous studies (Hanihara, 1989a, b, c, 1990a, b, c). Negritos, Filipinos, and Guam occupy an intermediate position between Polynesians and the Jomon lineage. Guam shows closer affinities to Polynesians than

Negritos and Filipinos show. Among the Polynesians, the Tonga samples are situated relatively close to those from Southeast Asia and Guam.

Another part of the present study concerns with the discrete tooth crown characters. Tables 7 and 8 give the frequencies of 9 non-metric crown traits for each group, and B-square distance coefficients computed from the frequencies, respectively. The two-dimensional expression resulted from multidimensional scaling on the B-square values is shown in Figure 5, in which the first two axes account for 84.7% of the total variance.

In this Figure, 3 major constellations are evident. The Polynesian samples, along with those from Guam, form a relatively tight cluster, bordering upon the indigenous Japanese groups and Negritos. Chinese, main-island Japanese, and 2 Yayoi immigrant samples occupy another position, forming the 3rd constellation. The latter populations are now recognized as those adapted to cold climate and have the Sinodont dental pattern (Hanihara, K., 1985; Turner, 1987, 1990; Hanihara, 1990b, c). It is noteworthy that Negritos are closely associated with Jomonese, occupying an intermediate position between the indigenous Japanese and the Pacific groups.

Craniofacial Analyses

The basic statistics of 11 craniofacial measurements were given in Table 9.

First of all, the 6 major geographical groups from East Asia and the Oceania, namely Australian Aborigines, Melanesians, Polynesians, Micronesians, Southeast Asians, Jomonese, and the indigenous Japanese, were analyzed to find general trends of affinities.

A distance matrix based on 11 craniofacial measurements in male samples (Table 10) was used to construct a dendrogram with the group average method of clustering (Figure 6).

All the groups in Melanesia and Australia form a unique cluster. The construction of another large cluster suggests a division between the samples of Southeast Asia and Japan, and those of the Pacific (Polynesia and western Micronesia). In the Southeast Asian groups, Dajaks and Negritos show closer affinities to the Jomon lineage than to the rest of the mainland and island Southeast Asians.

Figure 6 suggests that further comparisons should be focused on the Asian and the Pacific populations. Figure 7 is a two-dimensional expression obtained by multidimensional scaling method based on a distance matrix in Table 11. The first two dimensions account for 65.2% of the total variance.

This figure shows, with the possible exception of Formosa, a gradual change in craniofacial morphology from the Dajaks and Negritos to mainland and island Southeast Asians, and to East Asians represented by main-island Japanese, Chinese, and Koreans. A clear separation of samples of the modern Jomon lineage Japanese is evident. The samples from Polynesia and western Micronesia form another cluster. Jomonese are most closely aligned with Dajaks and then with Negritos. It is of much interest to note that Dajaks and Negritos are plotted inside a circle containing the groups of the Pacific, Nansei Islands, and mainland as well as island Southeast Asia.

Distance analysis was also carried out for the samples excluding those from East Asia, China, Korea, main-island Japan, and Formosa. Figure 8 is the result of group average method of clustering based on the distance matrix shown in Table 12. A major distinction is indicated between the indigenous Japanese and the Southeast Asian - Pacific groups. The structure of the indigenous Japanese cluster containing the Dajak and Negrito groups is identical to the dendrogram in Figure 6. The only difference is recognized in closer relationship between the groups of Southeast Asia and those of Polynesia and western Micronesia.

Figure 9 shows a scattergram provided by multidimensional scaling method, in which 73.2% of the total variance is expressed. The clustering is similar to Figure 8, namely, a major cluster comprising the Southeast Asian groups is located close to that of Negritos, Dajaks and Jomonese. A clear separation between Southeast Asians and the indigenous Japanese, and that between the Pacific populations and the latter are evident. On the other hand, Jomonese show close affinities to Dajaks and are included in the Negrito-Dajak sphere, which is plotted at an intermediate position among the groupings of Southeast Asians, the Jomon lineage, and the Pacific groups.

Discussion

Broad comparisons including both Australian Aborigines and Melanesians re-affirm the distinctiveness of the two macro-populations as demonstrated by Pietrusewsky (1979, 1984, 1990). According to recent investigations, early Australians and Melanesians might have diverged from the ancestral populations of Sundaland and moved into Wallacea and Sahulland by the time of the late Pleistocene period, or some 40,000 - 50,000 years ago (Bowler, 1976; Howells, 1976, 1977; Thorne, 1976; Birdsell, 1977;

Brace and Hinton, 1981; Omoto, 1984; Pietrusewsky, 1984, 1990; and others). In subsequent biological histories, selective forces that have produced the configuration in modern Australian Aborigines and Melanesians have worked in different fashion in other populations under the influence of different environmental and cultural effects. It may be one of the reasons for the fairly loose association of the Australomelanesian complex with other populations.

Negritos and Dajaks, who may have evolved in the tropical rain-forest or open inlands of Sundaland in the late Pleistocene time and survived with minimal admixture with surrounding populations through the subsequent period, share a large amount of characteristics with a majority of modern Southeast Asians and Jomonese.

I stressed that Negritos have Sundadont dental pattern. On the other hand, the dental pattern of Australian Aborigines is characterized by the higher frequencies of crown traits which appear frequently in the individuals of the Upper Pleistocene or earlier ages. This pattern, tentatively termed "Proto-Sundadont" dental pattern, may represent a microevolutionary step prior to the emergence of the Sundadont (and Sinodont) patterns (Hanihara, 1990a, 1991, in press, in submitted a).

The craniofacial evidence obtained in the present study shows that the modern East Asian phenotype predominates in the west and north and gradually fades southwards and eastwards. The samples from Lesser Sundas including the islands of Timor, Flores, Sumba, etc. (Pietrusewsky, 1984) and Borneo-Celebes show closer affinities to the Negrito-Dajak group than other Southeast Asians show. Bijlmer (1929), Keers (1948), Bellwood (1978, 1985), Glinka (1981), and Omoto (1984) traced the "Proto-Malays" eastwards to western Flores and western Sumba, and proposed that there were traces of the earlier Negrito population in some Lesser Sundas of today. Moreover, Jomonese and the Negrito-Dajak group have sufficient dental and craniofacial similarities to suggest that the latter has retained some archaic characters even to the present day. It is also probable that the post-glacial climatic amelioration perhaps had little effect in the core regions of the Sundaland equatorial rain-forest, although it might have had more impact on the fringing areas with a seasonal climate pattern.

Taking all of these together, it is likely that the indigenous inhabitants of Southeast Asia are not the people with physical affinities to "Australoid" groups. All the dental and craniofacial evidence suggest that the prototype of present Southeast Asians might have evolved within Southeast Asia from the late Pleistocene onwards, as suggested by Turner (1987, 1990) and Pietrusewsky (1988). The populations as represented by Negritos, Dajaks, and some Lesser Sundas are, therefore, considered as "generalized Asiatic populations" in Southeast Asia.

Another problem to which I should turn my attention concerns with the racial affinities of Polynesians and western Micronesians.

A number of archaeologists and linguists are willing to accept the hypothesis that the modern Austronesian-speaking cultures of eastern Melanesia and Polynesia share the common origins in the Lapita Cultural Complex as described previously (Bellwood, 1975, 1978; Green, 1979; Kirch, 1986; Pawley and

Green, 1986; Kirch and Green, 1987). The biological evidence is, however, not in agreement with the evidence emerging from recent archaeological and linguistic investigations (Howells, 1979; Pietrusewsky, 1984, 1985, 1990; Serjeantson, 1984; Turner, 1987, 1989; Kirch et al., 1989). Pietrusewsky (1985) arrived at contradictory conclusions regarding the hypothesis of Melanesian derivation for Polynesians based mainly on a securely dated Lapita edentulous mandible. He stressed a close biological connection between the Neolithic inhabitants of mainland Southeast Asia and the more recent inhabitants of Polynesia (Pietrusewsky, 1988). Turner (1987, 1989) attributed the late Pleistocene Sundaland to the homeland from which subsequent expansion took place to not only the area of Jomonese but also that of Polynesians.

Recently, the ancestral roots of Polynesians are traced back to Jomonese by Brace and Hunt (1990) and Katayama (1990). The grounds for this argument are based mainly on the similarity between the cranial morphology of Jomonese and Polynesians. Brace and Hunt (1990) felt that the oldest human skeletal materials solidly aligned with the members of the "Jomon-Pacific cluster" were the early Jomon specimens from approximately 6,000 - 10,000 years ago. However, morphological associations in this case do not necessarily imply causal relationships.

In the present study, Polynesians and Jomonese share the common dental and craniofacial morphology which can be trace back to the Southeast Asian populations, most likely Negritos, Dajaks, and Island Southeast Asians. The former 2 populations represent, therefore, the common morphology through the intermediation of the "generalized Asiatic populations", not because of their direct lineage.

Meanwhile, the ethnic pattern in Micronesia reflects more varied origins. It has been pointed out that the Palau and Mariana islanders originated in Indonesia or the Philippines; and the Carolines, Marshalls, and Gilberts in eastern Melanesia, or most likely in New Hebrides (Bellwood, 1975, 1978; Serjeantson, 1984). A good number of physical anthropologists suggest that, however, neither Polynesians nor Micronesians could have emerged from Melanesians (Howells, 1970, 1976, 1979; Harris, et al., 1975; Turner and Scott, 1977; Pietrusewsky, 1974, 1984, 1985, 1990; Kirch, et al., 1989; Turner, 1989; Brace and Hunt, 1990).

Omoto et al. (1981) found the variant carbonic anhydrase-1 ($CA_1$3N) in the Mamanwas, one of the Negrito tribes of Mindanao, and Manobos, the indigenous inhabitants of the same district. The same red cell enzyme is also recorded in the Chamorros of Guam and Saipan, Mariana Islanders, Filipinos, Malaysians, and Indonesians (Omoto, 1980; Omoto et al., 1981). These workers suggested that this variant was once common in an aboriginal population of the western Pacific, from which it was scattered through gene flow. The results of the present study indicate that western Micronesians are more closely related to Negritos, Dajaks, and other Island Southeast Asians. It is quite likely, therefore, that the population of western Micronesia has derived from the "generalized Asiatic populations" as is the case of Polynesians.

Summary and Conclusion

The scattering patterns of the populations shown in Figures 4, 5, 7, and 9 are in substantial agreement with their geographic distribution. It is generally accepted that geographic distance and genetic divergence among populations tend to be strongly correlated regardless of how they are measured (Howells, 1966; Gould and Johanston, 1972; Felsenstein, 1976; Endler, 1977; Dillon, 1984; Hanihara and Natori, 1989; Sciulli, 1990; Hanihara, in press). It is probable, therefore, that the baseline Southeast Asians, or "generalized Asiatic populations", are possible representatives of ancestral forms from whom remaining Southeast Asians, the Jomonese and their lineage, and also the Oceanic populations (Polynesians and western Micronesians) have originated.

This idea may be expressed by the term "diffusion model" for the population history in the Asian-Pacific regions. According to the diffusion model, a hypothetical process of microevolution in East and Southeast Asia and the Pacific can be summarized as shown in Figure 10. This model is quite agreeable with Turner's extensive studies suggesting that the late Pleistocene Sundaland is a geogenetic center from which all the Pacific Basin and Rim populations may have radiated (Turner, 1976, 1979, 1987, 1989, 1990; Turner and Swindler, 1978).

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Table 1. Materials used in the metric dental analysis (male)

Population	N	Housed in	Provenance
Ainu	20	University of Tokyo	Hidaka, Hokkaido
Aogashima	62	University of Tokyo	
Okinawa	34	University of Tokyo	
Tokunoshima	72	Kagoshima University	
Jomon	106	University of Tokyo National Sci. Museum	
Philippines	14	University of Tokyo	Marcos Village, Philippines
Negrito	21	University of Tokyo	Aeta tribe, Bataan Peninsula, Luzon, Philippines
Guam	52	B. P. Bishop Museum	Chamorros
Tonga	17	B. P. Bishop Museum	
Marquesas	21	B. P. Bishop Museum	
Eastern Polynesia	20	B. P. Bishop Museum	Society, Gambier, and Tuamotu Islands
Hawaii	11	B. P. Bishop Museum	Southpoint of Hawaii Island
Maui	13	B. P. Bishop Museum	
Molokai	14	B. P. Bishop Museum	
Lanai	31	B. P. Bishop Museum	
Oahu	84	B. P. Bishop Museum	Mokapu series
Kauai	25	B. P. Bishop Museum	
Fiji	8	B. P. Bishop Museum	

Table 2. Materials used in the non-metric dental analysis

Population	Housed in	Provenance
Japanese	University of Tokyo Jichi Medical School	All area from main-island Japan
Tokunoshima	Kagoshima University	
Okinawa	University of Tokyo	
Ainu1	University of Tokyo Sapporo Medical College	Central and eastern Hokkaido
Ainu2	University of Tokyo Sapporo Medical College	Southwest Hokkaido
Yayoi		
Doigahama	Kyushu University	Doigahama site, Yamaguchi Prefecture
Kanenokuma	Kyushu Univeristy	Kanenokuma site, Fukuoka Prefecture
Jomon	University of Tokyo National Sci. Museum	Mainly from eastern part of Japan
Chinese	University of Tokyo Kyoto University	Manchuria Liaoning and Kirin Prefectures
Negrito	University of Tokyo	Aeta tribe, Bataan Peninsula, Luzon
Eastern Polynesia	B. P. Bishop Museum	Marquesas, Society, Gambier, and Tuamotu Islands
Marginal Polynesia	B. P. Bishop Museum	Hawaii, Molokai, Maui, Lanai, and Kauai Island
Oahu	B. P. Bishop Museum	Mokapu series, Mokapu Peninsula of Oahu Island
Guam	B. P. Bishop Museum	Chamorros

Number of samples observed for each trait are shown in Table 7.

Table 3. Materials used in the craniofacial analysis (male)

Population	N	Author	Provenance
Japanese	30	Present study	Main-island eastern Japan
Nansei Islands			
Nansei1	70	Present study	Tanegashima, Amami-Oshima, and Kikai Island
Nansei2	24	Present study	Tokunoshima, Yoro-, Yoron-, and Okinoerabu Island
Okinawa	24	Present study	Okinawa Island
Nansei3	24	Present study	Miyako-, Yonaguni-, Hateruma-, and Ishigaki Island
Jomon	93	Present study	West and east Japan, Late and the Latest Jomon period
Chinese1	71	Present study	Manchuria, Liaoning Prefecture
Chinese2	26	Present study	Manchuria, Kirin Prefecture
Korean	36	Present study	
Formosa	13	Present study	
Dajak1	11	Present study	Pontianak, Kapuas River, Borneo
Dajak2	41	Bonin (1931)	Borneo
Negrito	33	Bonin (1931)	Aeta tribe, Philippines
Micronesia			
Guam	115	Present study	Pre-contact Chamorros
Mariana	13	Present study	Saipan and Tinian
Ponape-Truk	16	Present study	
Polynesia			
Tonga	7	Present study	Tonga and Samoa
Mokapu	56	Present study	Mokapu Peninsula of Oahu Island
Hawaii1	23	Present study	Hawaii Island
Hawaii2	76	Present study	Molokai, Lanai, Maui and Kauai
East Polynesia	16	Present study	Tuamotu, Societies, Gambier and Marquesas Islands
Southeast Asia		Pietrusewsky	
SE-Asia	86	(1984)	Mainland Southeast Asia: Vietnam, Laos, Cambodia, Thailand and Burma
Java	73		
Sulu	38		Sulu Islands
Borneo-Celebes	76		Including Dajaks
Lesser Sundas	44		Bali, Flores, Sumba, Lomblen, Alor, Timor, Wetar, Leti and Babar
Melanesia		Pietrusewsky	
New Britain	85	(1984)	
New Ireland	53		
New Hebrides	84		
New Caledonia	85		
Solomon	50		
Fiji	32		
Santa Cruz	46		
Purari-Delta	71		New Guinea
Mysore-Rubi	48		New Guinea
Australia		Pietrusewsky	Australian Aborigines
N-Territory	62	(1984)	Northern Territory
N-Queensland	34		Northern part of Queensland
S-Queensland	74		Southern part of Queensland
Coastal-NSW	62		Coastal New South Wales
Murray-R	21		Murray River
Swanport	36		
S-Australia	52		South Australia
W-Australia	18		Western Australia
Broadbeach	17		

Table 4. Basic statistics of the mesiodistal crown diameters (male)

Sample name	U-I1			U-I2			U-C		
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.
Ainu	8.39	.4246	.05	7.19	.3660	.05	7.91	.3227	.04
Aogashima	8.49	.5629	.07	6.91	.5645	.08	7.83	.4582	.06
Okinawa	8.36	.5316	.06	6.98	.6598	.09	7.69	.4203	.05
Tokunoshima	8.54	.4940	.06	7.07	.5118	.07	7.88	.4276	.05
Jomon	8.61	.3515	.04	7.07	.4427	.06	7.41	.4684	.06
Philippine	8.71	.5323	.06	7.00	.5845	.08	7.86	.2679	.03
Negrito	8.36	.6781	.08	6.79	.6979	.09	7.50	.3772	.05
Guam	8.76	.5106	.06	7.11	.6434	.09	8.52	.3365	.04
Tonga	8.78	.4362	.05	7.14	.2175	.03	8.01	.7794	.09
Marquesas	8.42	.4954	.06	6.82	.5981	.08	7.72	.4207	.05
E-Polynesia	8.15	.4800	.05	7.20	.1155	.02	8.30	.2772	.03
Hawaii-Maui	8.53	.3707	.04	6.86	.4827	.07	8.04	.3928	.05
Molokai-Lanai	8.34	.5385	.06	6.97	.6276	.09	7.76	.4957	.06
Oahu (Mokapu)	8.46	.6012	.07	6.87	.5095	.07	7.87	.3549	.05
Kauai	8.48	.6611	.07	6.91	.6528	.09	7.76	.4630	.06
Fiji	9.21	.3927	.05	7.23	.2328	.03	8.86	.4621	.05

Sample name	U-P3			U-P4			U-M1		
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.
Ainu	6.99	.3837	.05	6.48	.3275	.05	10.41	.4536	.04
Okinawa	7.25	.4763	.07	6.69	.4522	.07	10.52	.5424	.05
Tokunoshima	7.13	.4194	.06	6.69	.4048	.06	10.37	.6209	.06
Aogashima	7.29	.3922	.05	6.84	.3878	.06	10.51	.5239	.05
Jomon	6.86	.3775	.06	6.40	.3742	.06	10.27	.4259	.04
Philippine	7.38	.6181	.08	7.04	.6064	.08	10.89	.8134	.07
Negrito	7.11	.3972	.06	6.77	.4775	.07	10.05	.4295	.04
Guam	7.71	.3774	.05	7.49	.4139	.06	11.19	.4060	.04
Tonga	7.69	.6791	.08	7.22	.4962	.07	11.33	.7189	.06
Marquesas	7.11	.3152	.04	6.73	.4669	.07	10.39	.4181	.04
E-Polynesia	7.72	.3451	.04	7.22	.4625	.06	10.91	.7211	.07
Hawaii-Maui	7.29	.3837	.05	6.66	.4352	.07	10.42	.4636	.04
Molokai-Lanai	7.07	.4701	.07	6.62	.5125	.08	10.50	.6572	.06
Oahu (Mokapu)	7.20	.3622	.05	6.63	.4282	.06	10.43	.4828	.05
Kauai	6.98	.5558	.08	6.45	.4783	.07	10.36	.5284	.05
Fiji	7.50	.2196	.03	7.17	.1626	.02	11.43	.3484	.03

Table 4 (cont'd)

Sample name	U-M2			L-I1			L-I2		
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.
Ainu	9.09	.5566	.06	5.38	.2608	.05	6.01	.3354	.06
Okinawa	9.44	.5153	.05	5.46	.3771	.07	6.10	.3862	.06
Tokunoshima	9.57	.4507	.05	5.39	.3895	.07	5.90	.3438	.06
Aogashima	9.73	.6870	.07	5.54	.3524	.06	6.09	.3473	.06
Jomon	9.31	.5332	.06	5.27	.3525	.07	5.76	.3199	.06
Philippine	10.20	.8540	.08	5.63	.3386	.06	6.16	.2907	.05
Negrito	9.46	.5870	.06	5.37	.3577	.07	6.02	.4524	.08
Guam	10.27	.6643	.06	5.64	.3786	.07	6.36	.3708	.06
Tonga	10.79	.5988	.06	5.69	.3156	.06	6.38	.0986	.04
Marquesas	9.88	.3889	.04	5.27	.3009	.06	5.87	.3435	.06
E-Polynesia	10.30	.4027	.04	5.59	.2780	.03	5.92	.1862	.03
Hawaii-Maui	10.09	.4357	.04	5.38	.0757	.03	5.96	.2772	.05
Molokai-Lanai	10.12	.5538	.05	5.29	.2419	.05	5.85	.3295	.06
Oahu (Mokapu)	10.01	.6770	.07	5.32	.2993	.06	6.07	.3672	.06
Kauai	10.25	.8545	.08	5.24	.2349	.04	5.93	.3232	.05
Fiji	10.19	.5188	.05	5.29	.5081	.09	5.67	.6200	.08

Sample name	L-C			L-P3			L-P4		
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.
Ainu	7.10	.3220	.05	6.96	.3069	.04	6.70	.3284	.05
Okinawa	6.89	.4533	.07	7.02	.3699	.05	6.99	.4631	.07
Tokunoshima	6.75	.4070	.06	7.03	.3920	.06	7.03	.4823	.07
Aogashima	6.98	.3850	.06	7.14	.4411	.06	7.14	.4762	.07
Jomon	6.60	.2900	.04	6.90	.3877	.06	6.96	.4159	.06
Philippine	7.11	.2222	.03	7.14	.6685	.09	7.19	.5941	.08
Negrito	6.72	.4522	.06	6.84	.4467	.07	7.14	.6239	.08
Guam	7.33	.3895	.05	7.72	.4143	.05	7.76	.3425	.04
Tonga	7.46	.1632	.03	7.88	.5435	.07	8.07	.4358	.05
Marquesas	6.85	.4307	.06	7.18	.4184	.06	7.28	.4540	.06
E-Polynesia	7.12	.5048	.07	7.12	.4385	.06	7.57	.4647	.06
Hawaii-Maui	7.07	.3233	.05	7.19	.4180	.06	7.24	.4458	.06
Molokai-Lanai	6.81	.4613	.07	6.87	.5009	.07	7.08	.5851	.08
Oahu (Mokapu)	6.95	.3903	.06	7.16	.4355	.06	7.13	.4728	.07
Kauai	6.79	.3338	.05	7.07	.5560	.08	6.98	.5568	.08
Fiji	7.03	.5116	.07	7.26	.4563	.06	7.67	.6681	.08

Table 4 (cont'd)

Sample name	L-M1			L-M2		
	Mean	S.D.	C.V.	Mean	S.D.	C.V.
Ainu	11.23	.5182	.05	10.45	.7015	.07
Okinawa	11.42	.6399	.06	10.38	.6749	.07
Tokunoshima	11.25	.5546	.05	10.21	.7090	.07
Aogashima	11.44	.4727	.04	10.56	.5718	.05
Jomon	11.50	.4580	.04	10.63	.6119	.06
Philippine	11.62	.6759	.05	11.11	.4902	.04
Negrito	11.14	.4088	.04	10.12	.5755	.06
Guam	12.56	.4669	.04	11.60	.6249	.05
Tonga	12.46	.4042	.03	12.11	.4956	.04
Marquesas	11.48	.4053	.04	11.10	.5682	.05
E-Polynesia	11.84	.6457	.05	11.58	.8960	.08
Hawaii-Maui	11.25	.4130	.04	10.83	.6802	.06
Molokai-Lanai	11.27	.5548	.05	10.99	.5427	.05
Oahu (Mokapu)	11.45	.4897	.04	10.91	.6759	.06
Kauai	11.22	.5196	.05	10.82	.7320	.07
Fiji	12.06	.5859	.05	11.03	.7324	.07

Table 5. Distances (Q_T) transformed from Q-mode correlation coefficients (Q_C) between every pair of samples $Q_T = 1 - Q_C / \max(Q_C)$

Sample name	1	2	3	4	5	
1 Tonga	—					
2 Marquesas	0.6129	—				
3 E-Polynesia	1.1328	1.2633	—			
4 Hawaii-Maui	0.8011	1.0021	1.0093	—		
5 Molokai-Lanai	1.0518	1.2885	0.7716	1.3423	—	
6 Oahu (Mokapu)	0.7892	0.8593	1.5754	0.6444	1.1787	—
7 Kauai	0.9016	1.0376	1.3650	0.9952	0.3947	0.5356
8 Fiji	1.6998	1.1116	0.8409	1.2949	0.8859	1.5289
9 Guam	0.9785	0.8032	1.0573	0.8217	1.7770	0.8654
10 Negrito	1.1355	1.0667	1.4202	1.2568	1.5283	0.8080
11 Philippine	0.9270	1.3596	1.4816	1.1247	0.9241	0.7998

Sample name	7	8	9	10	11
7 Kauai	—				
8 Fiji	1.0305	—			
9 Guam	1.6656	1.3411	—		
10 Negrito	1.4151	1.2472	0.4396	—	
11 Philippine	0.9823	1.4034	0.9535	0.5221	—

Table 6. Distance matrix transformed from Q-mode correlation coefficients based on mesiodistal crown diameters

Sample name	1	2	3	4	5	6
1 Tonga	—					
2 Marquesas	0.4640	—				
3 E-Polynesia	1.1021	0.9066	—			
4 Hawaii-Maui	0.6943	0.5062	0.7506	—		
5 Molokai-Lanai	1.0429	0.7665	0.5696	0.8633	—	
6 Oahu (Mokapu)	0.6068	0.4962	1.2223	0.3871	0.9066	—
7 Kauai	0.9177	0.6276	1.1666	0.7334	0.3714	0.3888
8 Fiji	1.6196	1.0132	0.8280	1.1829	0.8675	1.4419
9 Guam	0.7304	0.8021	1.0046	0.7751	1.6632	0.8781
10 Negrito	0.9016	1.0705	1.3631	1.1047	1.4473	0.8731
11 Jomon	1.1575	1.1309	1.2861	1.8303	0.9385	1.4370
12 Ainu	1.3517	1.7497	1.1272	1.4025	1.2820	1.3415
13 Okinawa	1.2606	1.6505	1.2372	1.4791	1.4268	1.5428
14 Aogashima	1.1238	1.5587	1.5364	1.2387	1.7013	0.9923
15 Tokunoshima	1.1861	1.7627	1.4362	1.4289	1.5119	1.3256
16 Philippine	0.8601	1.2762	1.4921	1.1112	1.0687	0.9732

Sample name	7	8	9	10	11	12	13
7 Kauai	—						
8 Fiji	0.9732	—					
9 Guam	1.5569	1.3161	—				
10 Negrito	1.3166	1.4478	0.6255	—			
11 Jomon	0.9163	0.6463	1.3893	1.2591	—		
12 Ainu	1.2886	1.0549	1.1343	1.2321	0.7308	—	
13 Okinawa	1.4102	1.0685	0.9490	0.5797	0.8450	0.7212	—
14 Aogashima	1.4791	1.3694	0.5943	0.4000	1.1491	0.6376	0.4990
15 Tokunoshima	1.4391	1.3876	0.9478	0.4912	0.9388	0.4299	0.2008
16 Philippine	1.1041	1.4650	1.0236	0.5416	1.1572	0.9768	0.7898

Sample name	14	15	16
14 Aogashima	—		
15 Tokunoshima	0.2459	—	
16 Philippine	0.4600	0.4724	—

Table 7. Frequency distributions of non-metric crown characters in each population (in %, parenthesis; number of teeth observed)

Sample name	Shovel (UI1)				Carabelli (UM1)			Hypocone (UM2)		
	++	+	-		+	-		+	-	
Japanese	49.5	41.3	9.2	(109)	6.5	93.5	(72)	95.9	4.1	(49)
Chinese	63.0	29.6	7.4	(27)	17.5	82.5	(80)	95.3	4.7	(85)
Doigahama	57.1	33.3	9.8	(42)	14.5	85.5	(62)	84.3	15.7	(51)
Kanenokuma	47.5	45.0	7.5	(40)	12.2	87.8	(41)	95.8	4.2	(23)
Jomon	17.3	43.2	39.5	(81)	5.0	95.0	(101)	73.9	26.1	(111)
Ainu1	24.8	41.9	33.3	(117)	8.0	92.0	(150)	65.0	35.0	(120)
Ainu2	13.5	67.6	45.9	(37)	2.2	97.8	(90)	76.7	23.3	(90)
Okinawa	40.6	50.0	9.4	(64)	9.1	90.9	(66)	79.7	20.3	(59)
Tokunoshima	36.9	46.9	16.2	(111)	14.9	85.1	(114)	82.6	17.4	(109)
Negrito	23.8	42.9	33.3	(21)	25.0	75.0	(20)	88.2	11.8	(17)
Guam	16.9	54.2	28.8	(59)	16.7	83.3	(90)	81.7	18.3	(82)
Oahu	16.5	68.5	15.0	(127)	18.4	81.6	(179)	90.8	9.2	(152)
M-Polynesia	5.5	50.9	43.6	(55)	13.2	86.8	(121)	85.3	14.7	(102)
E-Polynesia	16.7	58.3	25.0	(24)	13.3	86.7	(45)	95.1	4.9	(41)

Sample name	6th cusp (LM1)			7th cusp (LM1)			Defl. wrink.(LM1)		
	+	-		+	-		+	-	
Japanese	42.6	57.4	(342)	4.3	95.7	(342)	30.7	69.3	(342)
Chinese	32.7	67.3	(52)	4.7	95.3	(64)	45.2	54.8	(42)
Doigahama	41.5	58.5	(53)	4.2	95.8	(72)	41.3	58.7	(46)
Kanenokuma	47.6	52.4	(42)	4.3	95.7	(47)	48.6	51.4	(35)
Jomon	42.9	57.1	(119)	9.2	90.8	(131)	27.6	72.4	(87)
Ainu1	17.9	82.1	(140)	2.1	97.9	(146)	17.5	82.5	(137)
Ainu2	20.9	79.1	(86)	6.7	93.3	(90)	17.6	82.4	(68)
Okinawa	20.3	79.7	(64)	3.1	96.9	(64)	29.7	70.3	(64)
Tokunoshima	39.4	60.6	(71)	2.9	97.1	(70)	35.9	64.1	(53)
Negrito	17.7	82.3	(17)	11.8	88.2	(17)	17.7	82.3	(17)
Guam	34.9	65.1	(106)	6.3	93.7	(111)	46.7	53.3	(105)
Oahu	43.2	56.8	(132)	6.9	93.1	(144)	37.3	62.7	(118)
M-Polynesia	45.5	54.5	(101)	3.5	96.5	(113)	33.3	66.7	(90)
E-Polynesia	38.9	61.1	(36)	2.4	97.6	(41)	28.6	71.4	(35)

Table 7 (cont'd)

Sample name	Dist.tri.cr.(LM1)			Protostylid (LM1)			4 cusp pattern (LM2)		
	+	-		+	-		+	-	
Japanese	12.0	88.0	(342)	6.6	93.4	(425)	26.0	74.0	(96)
Chinese	23.3	76.7	(43)	7.5	92.5	(53)	15.6	84.4	(64)
Doigahama	14.0	86.0	(50)	9.4	90.6	(64)	12.5	85.7	(56)
Kanenokuma	21.6	78.4	(37)	8.7	91.3	(46)	18.5	81.5	(27)
Jomon	4.3	95.7	(93)	4.2	95.8	(96)	37.6	62.4	(133)
Ainu1	5.9	94.1	(136)	5.2	94.8	(135)	60.2	39.8	(113)
Ainu2	15.0	85.0	(80)	2.4	97.6	(82)	52.3	47.7	(86)
Okinawa	1.6	98.4	(63)	10.9	89.1	(64)	57.6	42.4	(59)
Tokunoshima	7.8	92.2	(51)	10.6	89.4	(66)	36.2	63.8	(94)
Negrito	5.9	94.1	(17)	5.9	94.1	(17)	58.8	41.2	(17)
Guam	6.4	93.6	(101)	12.9	87.1	(93)	24.7	75.3	(94)
Oahu	13.7	86.3	(131)	7.3	92.7	(138)	45.8	54.2	(142)
M-Polynesia	13.0	87.0	(100)	5.0	95.0	(101)	46.0	54.0	(113)
E-Polynesia	5.1	94.9	(39)	5.4	94.6	(37)	33.3	66.7	(36)

Table 8. B-square values between every pair of samples

Sample name	1	2	3	4	5	6	7
1 Japanese	—						
2 Chinese	0.7240	—					
3 Jomon	1.1184	2.7067	—				
4 Tokunoshima	0.4121	1.2383	0.5657	—			
5 Okinawa	1.1059	2.2961	0.9264	0.4838	—		
6 Ainu1	1.9881	3.4570	0.7727	1.0490	0.4748	—	
7 Ainu2	1.9451	3.7661	0.7797	1.2830	1.0025	0.6611	—
8 Negrito	1.7445	2.6116	1.1190	1.0307	0.7638	0.8799	1.1012
9 Guam	1.1527	2.0467	0.6468	0.4037	1.1516	1.6187	1.3956
10 Oahu (Mokapu)	1.2758	2.4809	0.8529	0.6222	1.1739	1.6260	0.8740
11 Marginal-P	1.4141	2.8711	0.4660	0.6942	1.2615	1.1833	0.7686
12 Eastern-P	0.8465	2.3092	0.6129	0.4749	1.0191	1.4362	0.9413
13 Doigahama	0.3736	0.3571	1.6462	0.6214	1.6764	2.5821	2.9867
14 Kanenokuma	0.1982	0.5841	1.3304	0.4388	1.4693	2.4717	2.1554

Sample name	8	9	10	11	12	13	14
8 Negrito	—						
9 Guam	1.3824	—					
10 Oahu (Mokapu)	1.0257	0.5340	—				
11 Marginal-P	1.0916	0.6009	0.2874	—			
12 Eastern-P	1.0373	0.4705	0.3282	0.3378	—		
13 Doigahama	2.4700	1.2654	1.9976	2.1612	1.6342	—	
14 Kanenokuma	2.0635	0.8097	1.0433	1.3329	0.8938	0.3168	—

Table 9. Basic statistics of the craniofacial measurements (male)

Sample name	Max. cranial l.(M1)				Min. cranial b.(M5)				Max. cranial l.(M8)			
	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.
Japan	30	178.4	5.65	.03	30	102.3	3.54	.03	30	141.0	4.65	.03
China1	69	181.8	6.01	.03	71	100.4	3.70	.04	68	140.1	6.01	.04
China2	23	180.0	8.23	.05	25	99.8	4.37	.04	24	140.5	5.87	.04
Korea	30	180.0	6.58	.04	35	100.5	4.13	.04	31	140.8	6.00	.04
Formosa	13	179.9	4.35	.02	13	97.8	3.98	.04	13	138.3	5.56	.04
Jomon	25	185.5	5.54	.03	19	103.6	5.20	.05	27	144.1	4.47	.03
Nansei1	47	181.2	5.21	.03	36	101.2	2.62	.03	46	140.9	4.73	.03
Nansei2	42	183.5	6.45	.04	36	101.8	4.07	.04	43	140.4	4.82	.03
Okinawa	23	179.7	6.62	.04	20	100.6	4.32	.04	22	139.9	6.34	.05
Nansei3	22	182.5	4.49	.02	11	102.4	3.88	.04	19	140.4	5.51	.04
Guam	66	181.6	9.59	.05	51	104.4	3.92	.04	69	140.4	4.05	.03
Mariana	13	184.1	5.78	.03	8	104.9	3.14	.03	13	139.7	4.44	.03
Ponape-Truk	13	185.7	5.85	.03	12	105.1	4.85	.05	13	134.6	6.63	.05
Mokapu	56	186.0	7.63	.04	55	107.1	3.81	.04	56	144.9	7.72	.05
Hawaii1	23	182.7	8.93	.05	20	107.9	4.19	.04	23	142.7	6.06	.04
Hawaii2	74	181.9	6.71	.04	69	105.9	3.84	.04	75	144.2	5.74	.04
E-Polynesia	12	187.5	8.64	.05	10	108.0	4.94	.05	12	142.8	4.54	.03
Tonga	4	177.3	8.14	.05	3	109.7	5.51	.05	4	151.0	6.48	.04
Dajak1	9	178.0	4.50	.03	11	100.3	4.90	.05	11	137.1	4.99	.04
Dajak2*	41	175.8	5.51	.03	36	99.4	4.18	.04	40	137.7	6.04	.04
Negrito*	33	171.0	5.48	.03	29	98.3	3.78	.04	33	143.6	3.77	.03

*, Bonin (1931).

Sample name	Min. frontal b.(M9)				Basion-bregma h.(M17)				Mid.facial b.(M46)			
	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.
Japan	30	93.1	5.24	.06	30	139.8	5.83	.04	30	100.0	4.03	.04
China1	71	93.0	4.34	.05	71	137.3	4.78	.03	70	100.3	4.17	.04
China2	26	92.4	4.40	.05	26	136.8	4.91	.04	24	100.3	4.92	.05
Korea	36	93.4	3.59	.04	35	138.1	4.87	.04	33	101.0	4.50	.05
Formosa	13	93.8	3.17	.03	13	137.4	4.81	.04	13	101.9	4.80	.05
Jomon	31	96.7	4.61	.05	21	136.3	4.61	.03	13	104.2	4.40	.04
Nansei1	46	94.2	4.48	.05	36	137.4	4.99	.04	40	103.3	5.50	.05
Nansei2	43	95.4	4.29	.05	37	137.2	6.07	.04	37	104.4	4.83	.05
Okinawa	23	93.3	4.09	.04	20	135.1	3.78	.03	18	102.9	4.50	.04
Nansei3	24	95.5	3.71	.04	11	139.3	6.17	.04	13	105.7	3.09	.03
Guam	77	96.6	4.50	.05	51	142.1	5.21	.04	53	104.4	4.78	.05
Mariana	11	97.8	4.21	.04	8	143.5	2.07	.01	10	104.9	6.06	.06
Ponape-Truk	13	94.3	3.57	.04	13	139.7	4.23	.03	12	100.7	5.73	.06
Mokapu	56	97.1	5.17	.05	55	144.6	4.88	.03	55	101.2	4.52	.04
Hawaii1	23	96.4	4.46	.05	20	141.3	4.61	.03	22	101.8	5.12	.05
Hawaii2	76	95.8	4.51	.05	69	142.0	4.86	.03	71	99.3	4.82	.05
E-Polynesia	16	95.1	4.54	.05	10	144.7	5.03	.03	10	101.1	2.92	.03
Tonga	4	99.5	4.43	.04	4	144.3	5.62	.04	4	105.0	1.15	.01
Dajak1	11	94.2	3.76	.04	11	136.6	4.03	.03	10	100.3	4.14	.04
dajak2	41	93.2	4.16	.04	36	134.6	4.59	.03	40	101.1	4.92	.05
Negrito	33	92.8	4.39	.05	29	136.2	5.97	.04	31	98.4	5.44	.06

Table 9 (cont'd)

Sample name	Upper facial h.(M48)				Orbital b.left(M51a)				Orbital h.left(M52)			
	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.
Japan	29	72.8	4.24	.06	30	40.0	1.68	.05	30	34.3	1.84	.05
China1	71	75.1	5.14	.07	71	40.0	1.80	.04	71	35.8	2.20	.06
China2	26	75.0	4.95	.07	26	40.0	1.85	.05	26	35.7	1.72	.05
Korea	34	71.3	3.75	.05	34	40.0	1.38	.03	34	34.4	1.92	.06
Formosa	13	70.0	4.71	.07	13	39.4	1.33	.03	13	33.9	2.91	.08
Jomon	19	68.8	2.85	.04	38	41.1	1.96	.05	16	32.9	1.77	.05
Nansei1	45	67.2	4.39	.07	44	39.8	1.52	.04	45	33.8	1.79	.05
Nansei2	42	67.5	4.34	.06	43	39.4	1.68	.04	43	33.1	1.50	.05
Okinawa	20	67.4	4.96	.07	21	39.6	1.40	.04	21	33.6	2.31	.07
Nansei3	17	69.9	3.68	.05	19	40.8	1.69	.04	18	33.8	2.31	.07
Guam	51	69.3	5.07	.07	52	41.2	1.47	.04	56	35.2	1.67	.05
Mariana	10	68.4	3.72	.05	8	41.1	1.36	.03	10	35.5	1.43	.04
Ponape-Truk	12	70.8	4.71	.07	15	40.5	0.74	.02	15	35.5	1.55	.04
Mokapu	49	68.3	3.84	.06	54	40.0	1.51	.04	56	34.9	1.66	.05
Hawaii1	23	68.6	3.91	.06	23	40.7	1.92	.05	23	34.7	1.77	.05
Hawaii2	70	68.6	4.21	.06	74	41.1	1.70	.04	75	35.1	1.78	.05
E-Polynesia	12	70.2	2.48	.04	11	42.0	2.00	.05	11	36.1	2.12	.06
Tonga	3	65.3	2.52	.04	3	42.3	1.52	.04	3	35.7	1.15	.03
Dajak1	11	66.1	3.73	.06	11	39.6	1.81	.05	11	34.1	2.34	.07
Dajak2	34	69.8	4.27	.06	36	39.4	1.65	.04	40	33.7	1.73	.05
Negrito	27	69.6	3.06	.04	26	39.5	1.80	.05	32	33.6	1.46	.04

Sample name	Nasal breadth (M54)				Nasal height (M55)			
	N	Mean	S.D.	C.V.	N	Mean	S.D.	C.V.
Japan	30	26.3	1.81	.07	30	52.5	2.89	.06
China1	71	25.0	1.79	.07	71	56.5	3.07	.05
China2	25	24.6	2.14	.08	26	55.0	3.44	.06
Korea	34	25.9	1.12	.04	34	54.0	3.00	.06
Formosa	13	26.2	2.51	.09	13	53.4	3.57	.07
Jomon	18	26.3	1.37	.05	20	49.0	2.87	.04
Nansei1	42	26.5	1.61	.06	45	51.4	3.16	.06
Nansei2	41	27.3	1.82	.07	42	51.9	3.22	.06
Okinawa	21	26.8	2.47	.09	21	51.5	3.12	.06
Nansei3	19	27.2	1.47	.05	18	54.5	2.60	.05
Guam	54	26.6	1.85	.07	56	54.3	2.71	.05
Mariana	10	26.9	1.94	.07	10	53.3	2.11	.04
Ponape-Truk	11	26.6	1.36	.05	12	54.3	2.81	.05
Mokapu	54	26.5	1.88	.07	56	52.9	2.93	.06
Hawaii1	23	26.2	1.87	.07	23	54.7	3.38	.06
Hawaii2	74	26.4	1.89	.07	74	54.3	3.17	.06
E-Polynesia	11	27.2	1.66	.06	11	57.5	3.17	.06
Tonga	3	26.3	1.79	.07	3	55.7	2.89	.05
Dajak1	11	27.6	1.69	.06	10	51.1	3.00	.06
Dajak2	41	27.3	2.03	.07	39	50.2	2.79	.06
Negrito	32	26.8	1.68	.06	31	49.5	2.23	.05

Table 10. Distance matrix transformed from Q-mode correlation coefficients

Sample name	1	2	3	4	5	6	7
1 Jomon	—						
2 Nansei1	0.4685	—					
3 Nansei2	0.4231	0.1712	—				
4 Okinawa	0.5816	0.0626	0.1638	—			
5 Nansei3	0.7605	0.2592	0.2276	0.1793	—		
6 Guam	1.0316	0.3943	0.7038	0.4987	0.4086	—	
7 Mariana	0.9122	0.4617	0.6802	0.6634	0.6753	0.1511	—
8 Ponape	1.2419	0.7283	0.9497	0.6896	0.6329	0.3940	0.5957
9 Mokapu	0.7411	0.5039	0.6892	0.7396	0.8410	0.3928	0.2937
10 Hawaii1	0.9418	0.5938	0.8192	0.7262	0.6894	0.2660	0.4169
11 Hawaii2	1.1597	0.6626	1.0065	0.7748	0.8352	0.3091	0.4900
12 E-Polynesia	1.5019	0.8051	1.0701	0.8023	0.7646	0.4065	0.6464
13 Tonga	1.0331	0.7568	0.9824	0.9253	0.9919	0.4419	0.4325
14 Dajak1	0.9590	0.3524	0.3443	0.2721	0.4987	0.6323	0.5847
15 Dajak2	0.6850	0.3443	0.3918	0.1999	0.3081	0.6253	0.8003
16 Negrito	0.7052	0.4078	0.5903	0.3374	0.4798	0.6081	0.8290
17 Java	1.0509	0.6562	0.9884	0.6173	0.4610	0.3867	0.8266
18 Sulu	1.1453	0.8912	1.0833	0.8055	0.6089	0.6478	1.0559
19 L-Sundas	0.9920	0.9247	1.0587	0.8427	0.5976	0.6900	1.0348
20 Borneo	1.0555	0.5094	0.7330	0.3721	0.3276	0.5250	0.9701
21 SE-Asia	1.0037	0.6646	0.8939	0.5944	0.4041	0.4921	0.9263
22 Solomon	1.5083	1.2970	1.6017	1.3905	1.3731	0.9619	1.0428
23 Santa-Cruz	1.0812	1.4630	1.0831	1.4116	1.3579	1.7534	1.5428
24 New-Britain	0.8707	1.4303	1.2071	1.4839	1.4615	1.7428	1.5700
25 New-Ireland	1.1731	1.4256	1.7062	1.5728	1.4932	1.1117	1.2138
26 New-Hebrides	1.2313	1.6346	1.3742	1.5144	1.4423	1.8474	1.8176
27 New-Caledonia	0.9329	1.5865	1.3806	1.6897	1.3688	1.3346	1.1968
28 Fiji	1.2746	1.6002	1.7095	1.7107	1.5259	1.1258	1.0653
29 Purari-Delta	1.4679	1.5185	1.6651	1.4692	1.3996	1.2208	1.3086
30 Mysore-Rubi	1.4854	1.4381	1.3854	1.2627	1.2696	1.4264	1.4632
31 N-Territory	1.2372	1.7333	1.3840	1.6028	1.5235	1.7751	1.5990
32 N-Queensland	1.4090	1.7911	1.4701	1.6988	1.6644	1.7390	1.4681
33 S-Queensland	1.1540	1.7333	1.3530	1.7041	1.6915	1.8223	1.5019
34 Coastal-NSW	1.3073	1.8670	1.6402	1.8285	1.8447	1.8086	1.5579
35 M-River	1.0911	1.6574	1.2753	1.5148	1.4681	1.9307	1.7921
36 Swanport	0.9243	1.6158	1.4483	1.5989	1.6985	1.7869	1.5681
37 S-Australia	1.0638	1.7710	1.4798	1.7356	1.7000	1.8168	1.6151
38 W-Australia	1.0461	1.6552	1.3188	1.6289	1.5626	1.7847	1.5112
39 Boradbeach	1.1555	1.4944	1.1150	1.4529	1.4913	1.6530	1.2588

Table 10 (cont'd)

Sample name	8	9	10	11	12	13	14
8 Ponape	—						
9 Mokapu	0.6003	—					
10 Hawaii1	0.4600	0.1866	—				
11 Hawaii2	0.4254	0.2109	0.1266	—			
12 E-Polynesia	0.1859	0.4942	0.3085	0.1869	—		
13 Tonga	1.0811	0.4449	0.3171	0.3854	0.7296	—	
14 Dajak1	0.8197	0.7677	0.9333	0.8160	0.8102	0.8712	—
15 Dajak2	0.6360	0.9312	0.9665	0.8834	0.9111	1.2058	0.2844
16 Negrito	0.7862	0.7923	0.8563	0.6456	0.8754	0.9687	0.4093
17 Java	0.6323	0.9319	0.6562	0.5427	0.6478	0.8143	0.9613
18 Sulu	0.9322	1.1499	0.9039	0.7383	0.8863	0.8740	1.0104
19 L-Sundas	0.9312	1.2246	1.0322	0.9262	1.0708	1.0524	1.0696
20 Borneo	0.8119	1.1097	0.8100	0.7046	0.7341	0.8240	0.6446
21 SE-Asia	0.8152	1.0563	0.7910	0.6957	0.8193	0.8569	0.9152
22 Solomon	0.7866	1.0037	0.8496	0.7659	0.5356	0.8756	1.4793
23 Santa-Cruz	1.5208	1.4340	1.5484	1.6257	1.3957	1.3787	1.1810
24 New-Britain	1.6647	1.3841	1.4610	1.5847	1.5126	1.2327	1.5305
25 New-Ireland	0.9810	0.9716	0.8917	0.8001	0.8501	0.9621	1.8251
26 New-Hebrides	1.2864	1.6463	1.6358	1.6276	1.2881	1.6785	1.5212
27 New-Caledonia	1.2034	1.1046	1.1043	1.3109	1.2788	1.1863	1.7176
28 Fiji	0.8139	1.0817	1.0341	1.0619	0.9371	1.1865	1.8108
29 Purari-Delta	0.5928	1.3165	1.1610	1.0934	0.6951	1.4480	1.5607
30 Mysore-Rubi	0.6590	1.4792	1.4858	1.3051	0.8332	1.7653	1.1533
31 N-Territory	1.4606	1.6395	1.6740	1.6768	1.4674	1.4464	1.2395
32 N-Queensland	1.4154	1.5595	1.6987	1.6196	1.4224	1.4114	1.2290
33 S-Queensland	1.6608	1.4309	1.6090	1.6128	1.5730	1.2479	1.2835
34 Coastal-NSW	1.5121	1.5249	1.6239	1.5595	1.4696	1.3034	1.4848
35 M-River	1.4880	1.6915	1.7636	1.7724	1.5345	1.6545	1.3257
36 Swanport	1.4934	1.5389	1.5637	1.6745	1.6004	1.3478	1.6065
37 S-Australia	1.4508	1.4720	1.4961	1.5934	1.5095	1.3695	1.6443
38 W-Australia	1.7183	1.6406	1.7087	1.8352	1.7296	1.3044	1.4388
39 Broadbeach	1.5649	1.4441	1.6621	1.7093	1.5607	1.2572	0.9805

Table 10 (cont'd)

Sample name	15	16	17	18	19	20	21
15 Dajak2	—						
16 Nebrito	0.1261	—					
17 Java	0.5415	0.3660	—				
18 Sulu	0.6427	0.4191	0.1001	—			
19 L-sundas	0.5643	0.4199	0.1467	0.0615	—		
20 Borneo	0.4040	0.3100	0.1418	0.1865	0.3032	—	
21 SE-Asia	0.5070	0.3412	0.0325	0.0496	0.0891	0.0991	—
22 Solomon	1.6191	1.5055	0.9616	1.1239	1.2637	1.1049	1.1183
23 Santa-Cruz	1.4309	1.5419	1.7281	1.5969	1.5662	1.5218	1.6279
24 New-Britain	1.6547	1.6301	1.5729	1.4673	1.4533	1.4856	1.4975
25 New-Ireland	1.6314	1.3547	0.7989	0.8391	0.8929	1.1502	0.9206
26 New-Hebrides	1.4873	1.5960	1.4787	1.3099	1.2926	1.4088	1.4280
27 New-Caledonia	1.5638	1.5660	1.3269	1.3277	1.1540	1.5953	1.3364
28 Fiji	1.6454	1.6261	1.0838	1.1132	1.0272	1.4885	1.2129
29 Purari-Delta	1.3918	1.4832	1.0575	1.1818	1.1514	1.2600	1.2090
30 Mysore-Rubi	1.0593	1.2611	1.2082	1.1769	1.1418	1.2189	1.2666
31 N-Territory	1.3281	1.4337	1.6082	1.4070	1.3017	1.4936	1.5184
32 N-Queensland	1.4620	1.5630	1.6798	1.3788	1.3183	1.6213	1.6039
33 S-Queensland	1.5524	1.5713	1.7851	1.4803	1.4291	1.6953	1.6760
34 Coastal-NSW	1.6475	1.6388	1.6470	1.3616	1.3210	1.6625	1.5999
35 M-River	1.3221	1.4459	1.6200	1.4002	1.3049	1.4819	1.5126
36 Swanport	1.5981	1.6817	1.6128	1.4519	1.3613	1.6162	1.5845
37 S-Australia	1.6535	1.7169	1.6442	1.4036	1.3286	1.6895	1.5960
38 W-Australia	1.3803	1.5590	1.6774	1.4252	1.3256	1.5855	1.5584
39 Broadbeach	1.5954	1.6962	1.8478	1.6109	1.5345	1.6522	1.7359

Table 10 (cont'd)

Sample name	22	23	24	25	26	27	28
22 Solomon	—						
23 Santa-Cruz	0.9015	—					
24 New-Britain	0.6957	0.1596	—				
25 New-Ireland	0.2637	1.0909	0.6836	—			
26 New-Hebrides	0.6979	0.2948	0.2844	0.6889	—		
27 New-Caledonia	0.7934	0.4813	0.4053	0.6023	0.6155	—	
28 Fiji	0.4144	1.0273	0.7901	0.2257	0.5988	0.4452	—
29 Purari-Delta	0.2643	0.8512	0.7914	0.3962	0.4192	0.6670	0.2441
30 Mysore-Rubi	0.6916	0.7628	0.9325	0.8367	0.3089	1.0033	0.5780
31 N-Territory	1.0284	0.1637	0.3926	1.1029	0.3490	0.4616	0.9022
32 N-Queensland	1.0113	0.3864	0.5738	1.0224	0.3291	0.6946	0.6881
33 S-Queensland	1.0921	0.2267	0.3477	1.0274	0.3771	0.5332	0.8354
34 Coastal-NSW	0.8545	0.4178	0.4309	0.7444	0.2880	0.5865	0.5377
35 M-River	1.0331	0.1363	0.2749	1.0116	0.1408	0.5217	0.8682
36 Swanport	0.8317	0.4927	0.3211	0.6878	0.2693	0.5838	0.5022
37 S-Australia	0.9216	0.4507	0.3696	0.7047	0.2216	0.4864	0.4691
38 W-Australia	0.9760	0.2481	0.2242	0.9365	0.3052	0.4815	0.7166
39 Broadbeach	1.1506	0.2540	0.4724	1.3152	0.5003	0.7280	0.9795

Sample name	29	30	31	32	33	34	35
29 Purari-Delta	—						
30 Mysore-Rubi	0.2295	—					
31 N-Territory	0.7472	0.6332	—				
32 N-Queensland	0.7226	0.4700	0.1963	—			
33 S-Queensland	0.9498	0.7841	0.1479	0.0970	—		
34 Coastal-NSW	0.6417	0.5598	0.2359	0.0672	0.0943	—	
35 M-River	0.6960	0.5019	0.0843	0.2203	0.1739	0.2326	—
36 Swanport	0.5896	0.6366	0.4126	0.3212	0.3000	0.1666	0.2982
37 S-Australia	0.6316	0.6025	0.3485	0.2057	0.1856	0.0949	0.2418
38 W-Australia	0.8368	0.7950	0.2101	0.1943	0.1216	0.1554	0.1871
39 Broadbeach	1.0111	0.7581	0.2203	0.1308	0.1097	0.2380	0.2772

Sample name	36	37	38	39
36 Swanport	—			
37 S-Australia	0.0782	—		
38 W-Australia	0.1565	0.1646	—	
39 Broadbeach	0.3932	0.3608	0.1516	—

Table 11. Distance matrix transformed from Q-mode correlation coefficients

Sample name	1	2	3	4	5	6	7
1 Japan	—						
2 China1	0.4740	—					
3 China2	0.4475	0.0191	—				
4 Korea	0.3256	0.0777	0.0913	—			
5 Formosa	0.7568	0.5500	0.6272	0.4063	—		
6 Jomon	1.3213	1.5213	1.4273	1.4418	1.1863	—	
7 Nansei1	1.3926	1.5521	1.5258	1.3754	0.8282	0.3676	—
8 Nansei2	1.3498	1.6097	1.6476	1.4249	0.7001	0.4193	0.1243
9 Okinawa	1.2466	1.4450	1.4608	1.2590	0.7146	0.5662	0.1304
10 Nansei3	1.3281	1.3985	1.4420	1.2242	0.4972	0.6646	0.3434
11 Guam	1.5387	1.2567	1.2512	1.4002	1.0223	1.0605	0.7778
12 Mariana	1.5702	1.4488	1.4483	1.5870	1.0834	0.8293	0.6149
13 Ponape	0.8256	0.6300	0.7325	0.7945	0.8174	1.4131	1.2513
14 Mokapu	1.0709	1.2605	1.2502	1.2430	1.2933	0.7932	0.7650
15 Hawaii1	1.2369	1.0911	1.0995	1.1953	1.4600	0.9619	1.0289
16 Hawaii2	0.9567	1.0080	1.0117	1.0989	1.6355	1.2543	1.4042
17 E-P	0.9404	0.8025	0.8932	0.8886	1.2376	1.5820	1.3691
18 Tonga	1.5323	1.4220	1.3497	1.4962	1.6236	0.8680	0.9091
19 Dajak1	1.2249	1.6181	1.7012	1.5852	1.0446	1.0234	0.6153
20 Dajak2	0.7152	1.2563	1.2750	1.1264	0.7394	0.9240	0.6906
21 Negrito	0.4824	1.1615	1.0984	0.9817	1.1532	1.0200	1.0630
22 Java	0.8589	0.6562	0.5833	0.6996	1.1158	1.2395	1.6005
23 Sulu	1.1083	0.9797	0.9550	1.0648	1.2970	1.0750	1.5902
24 L-Sundas	1.3462	1.2387	1.2816	1.4468	1.3555	0.8749	1.3736
25 Borneo	1.3250	1.2485	1.2616	1.3108	1.3240	1.0059	1.2803
26 SE-Asia	1.0201	0.9072	0.8623	0.9322	1.1175	1.0919	1.5107

Table 11 (cont'd)

Sample name	8	9	10	11	12	13	14
8 Nansei2	—						
9 Okinawa	0.1343	—					
10 Nansei3	0.2016	0.2518	—				
11 Guam	0.8917	1.0086	0.7108	—			
12 Mariana	0.6863	0.9027	0.7501	0.1089	—		
13 Ponape	1.1498	1.1472	1.1189	0.8395	0.7810	—	
14 Mokapu	0.8553	1.1367	1.3412	0.8763	0.6270	0.9971	—
15 Hawaii1	1.0942	1.2993	1.3362	0.7418	0.7343	0.9073	0.2725
16 Hawaii2	1.4899	1.5861	1.7917	1.1516	1.0714	0.9581	0.3441
17 E-P	1.4063	1.3690	1.4434	0.9921	1.0055	0.3942	0.7297
18 Tonga	1.1118	1.1677	1.2031	0.6102	0.7079	1.5856	0.6221
19 Dajak1	0.4433	0.4460	0.6580	0.9009	0.6730	0.8050	0.9545
20 Dajak2	0.5158	0.3680	0.5722	1.2411	1.1112	0.9511	1.3727
21 Negrito	1.0435	0.8966	1.2063	1.5737	1.5023	1.4982	1.0761
22 Java	1.6742	1.5322	1.2322	1.0969	1.4197	1.3880	1.5751
23 Sulu	1.4914	1.4909	1.2606	1.2769	1.3972	1.4282	1.4479
24 L-Sundas	1.1443	1.3202	1.0663	0.9653	0.8522	0.7282	1.2149
25 Borneo	1.1615	1.0451	0.8630	1.1434	1.2713	1.2072	1.6593
26 SE-Asia	1.4437	1.3867	1.0280	1.1401	1.3941	1.4749	1.6405

Sample name	15	16	17	18	19	20	21
15 Hawaii1	—						
16 Hawaii2	0.3306	—					
17 E-P	0.6146	0.3434	—				
18 Tonga	0.4344	0.5450	1.0544	—			
19 Dajak1	1.2309	1.1166	0.9104	1.1459	—		
20 Dajak2	1.6436	1.5604	1.3796	1.5035	0.3150	—	
21 Negrito	1.4049	0.9284	1.2956	1.0010	0.7638	0.4500	—
22 Java	1.2767	1.0388	1.1537	0.8046	1.6198	1.3153	0.8484
23 Sulu	1.2715	0.8785	1.1298	0.7852	1.2836	1.2195	0.7660
24 L-Sundas	1.0678	0.9254	0.8409	1.1124	0.8525	1.0931	1.2872
25 Borneo	1.3622	1.1230	1.0020	0.9216	0.9077	0.9450	0.9351
26 SE-Asia	1.3694	1.1500	1.2861	0.8286	1.4044	1.1560	0.8066

Sample name	22	23	24	25	26
22 Java	—				
23 Sulu	0.2053	—			
24 L-Sundas	0.8505	0.4624	—		
25 Borneo	0.4437	0.2276	0.3542	—	
26 SE-Asia	0.0761	0.0883	0.6434	0.2517	—

Table 12. distance matrix transformed from Q-mode correlation coefficients

Sample name	1	2	3	4	5	6	7
1 Jomon	—						
2 Nansei1	0.5068	—					
3 Nansei2	0.4737	0.1988	—				
4 Okinawa	0.7162	0.1472	0.2096	—			
5 Nansei3	0.7482	0.4421	0.2590	0.2872	—		
6 Guam	1.3423	1.0540	1.1850	1.2206	0.9107	—	
7 Mariana	1.0617	0.8900	0.9110	1.1675	1.0141	0.1825	—
8 Ponape	1.4633	1.2323	1.2214	1.0568	0.9865	0.6419	0.7865
9 Mokapu	0.8914	0.9334	1.0203	1.3184	1.5218	0.9965	0.7146
10 Hawaii1	1.0901	1.1982	1.2898	1.4431	1.4746	0.8113	0.8545
11 Hawaii2	1.4007	1.5245	1.6622	1.6473	1.8721	1.1706	1.1620
12 E-P	1.7332	1.3586	1.5054	1.2553	1.4253	0.9200	1.0665
13 Tonga	0.9895	1.0814	1.2412	1.3690	1.4935	0.8522	0.7835
14 Dajak1	1.2168	0.7264	0.5058	0.5234	0.7537	1.0851	0.7808
15 Dajak2	1.0030	0.7844	0.6012	0.4092	0.4674	1.2382	1.2502
16 Negrito	1.0291	1.0951	1.0736	0.8674	1.0506	1.5919	1.6472
17 Java	1.2083	1.5063	1.6274	1.3709	1.0456	0.9656	1.4463
18 Sulu	1.0795	1.6717	1.5194	1.5021	1.1627	1.2640	1.4778
19 L-Sundas	0.9554	1.5151	1.1876	1.3953	1.0307	0.9991	0.9086
20 Borneo	1.1271	1.3071	1.1936	0.9846	0.7931	1.2677	1.4892
21 SE-Asia	1.0741	1.4939	1.4280	1.3063	0.8745	1.0987	1.4893

Sample name	8	9	10	11	12	13	14
8 Ponape	—						
9 Mokapu	1.0651	—					
10 Hawaii1	0.8789	0.3114	—				
11 Hawaii2	0.8948	0.3737	0.3451	—			
12 E-P	0.3231	0.8195	0.6600	0.3432	—		
13 Tonga	1.6459	0.6253	0.5391	0.6362	1.1931	—	
14 Dajak1	0.8514	1.1227	1.4398	1.2686	0.8982	1.2403	—
15 Dajak2	0.7500	1.4940	1.6854	1.5492	1.1520	1.7221	0.4694
16 Negrito	1.2567	1.1592	1.4453	0.9510	1.1195	1.2225	0.9238
17 Java	1.0042	1.4951	1.1402	0.9484	0.9578	1.0891	1.6772
18 Sulu	1.2267	1.4662	1.2575	0.9092	1.1036	0.9871	1.4448
19 L-Sundas	0.6892	1.3187	1.1312	1.0574	0.8975	1.2781	0.9732
20 Borneo	1.0294	1.8104	1.4446	1.2136	0.9359	1.2033	1.0215
21 SE-Asian	1.1562	1.6257	1.2944	1.1276	1.1521	1.1119	1.5424

Sample name	15	16	17	18	19	20	21
15 Dajak2	—						
16 Negrito	0.4112	—					
17 Java	1.0546	0.7109	—				
18 Sulu	1.1131	0.7223	0.2168	—			
19 L-Sundas	1.0939	1.3626	0.8619	0.5207	—		
20 Borneo	0.8838	0.9230	0.4529	0.3118	0.4376	—	
21 SE-Asia	0.9891	0.7224	0.0723	0.1005	0.6757	0.2858	—

Figure legends:

Fig. 1. Map showing the approximate location of materials used.

Fig. 2 Map showing Nansei Island chain.

Fig. 3. Clustering by single linkage method. Distance matrix transformed from Q-mode correlation coefficients based on 14 mesio-distal crown diameters was applied.

Fig. 4. Two dimensional expression of multidimensional scaling applied to Q-mode correlation coefficients based on mesio-distal crown diameters. 83.0% of total variance is expressed.

Fig. 5. Two dimensional expression of multidimensional scaling applied to B-square distance based on nine-discrete crown traits. 84.7% of total variance is expressed.

Fig. 6. Inter-population relationships among the populations from Japan, Southeast Asia, Micronesia, Polynesia, Melanesia and Australia. Cluster analysis applied to the distance matrix from Q-mode correlation coefficients based on eleven craniofacial measurements.

Fig. 7. Two dimensional expression of multidimensional scaling applied to Q-mode correlation coefficients between every pair of populations. 65.2% of total variance is accounted for.

Fig. 8. Clustering by group average method. Distance matrix transformed from Q-mode correlation coefficients based on eleven craniofacial measurements.

Fig. 9. Two dimensional expression of multidimensional scaling method applied to the same matrix used in Fig. 3.

Fig. 10. A hypothetical schema showing racial diversification in East and Southeast Asia, Micronesia, and Polynesia during the late Pleistocene and Holocene times (modified from Omoto, 1984).

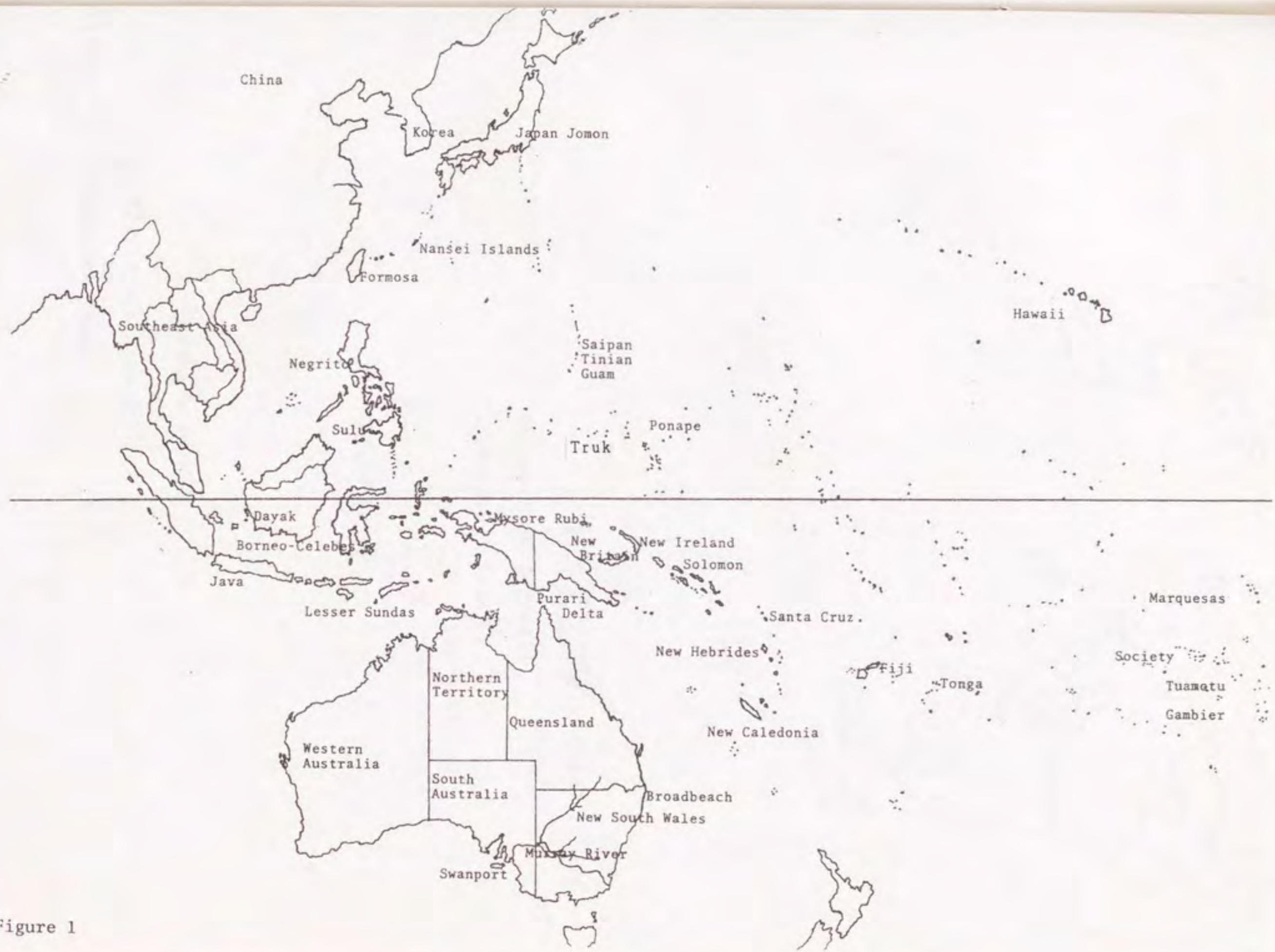

China
Korea
Japan Jomon
Nansei Islands
Formosa
Southeast Asia
Negrito
Sulu
Saipan
Tinian
Guam
Ponape
Truk
Hawaii
Dayak
Borneo-Celebes
Java
Mysore Rubi
New Britain
New Ireland
Solomon
Lesser Sundas
Purari Delta
Santa Cruz.
New Hebrides
Fiji
Tonga
Marquesas
Society
Tuamatu
Gambier
Northern Territory
Queensland
Western Australia
South Australia
New Caledonia
Broadbeach
New South Wales
Murray River
Swanport

Figure 1

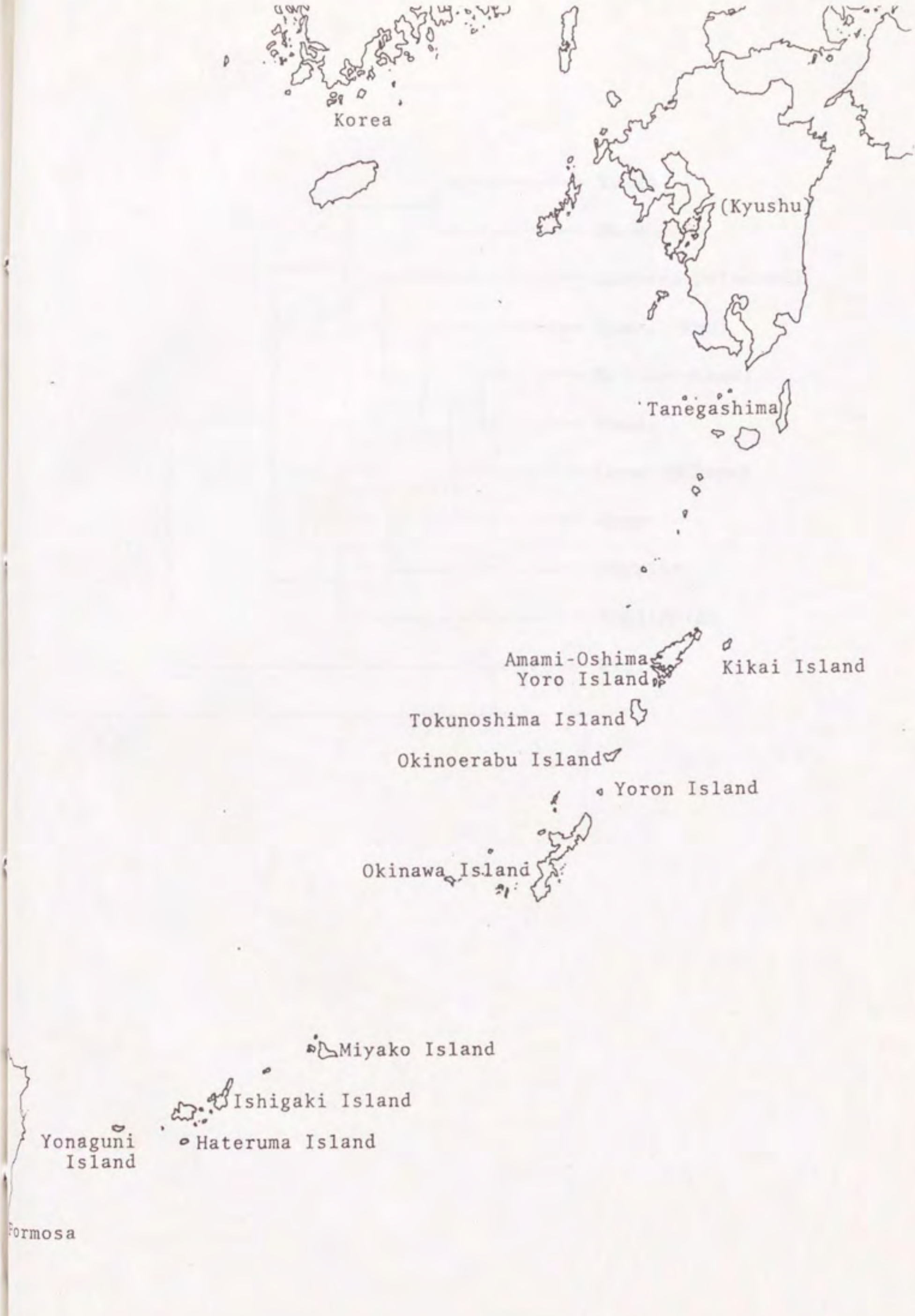

Korea
(Kyushu)
Tanegashima
Amami-Oshima
Yoro Island
Kikai Island
Tokunoshima Island
Okinoerabu Island
Yoron Island
Okinawa Island
Miyako Island
Ishigaki Island
Yonaguni Island
Hateruma Island
Formosa

Figure 2

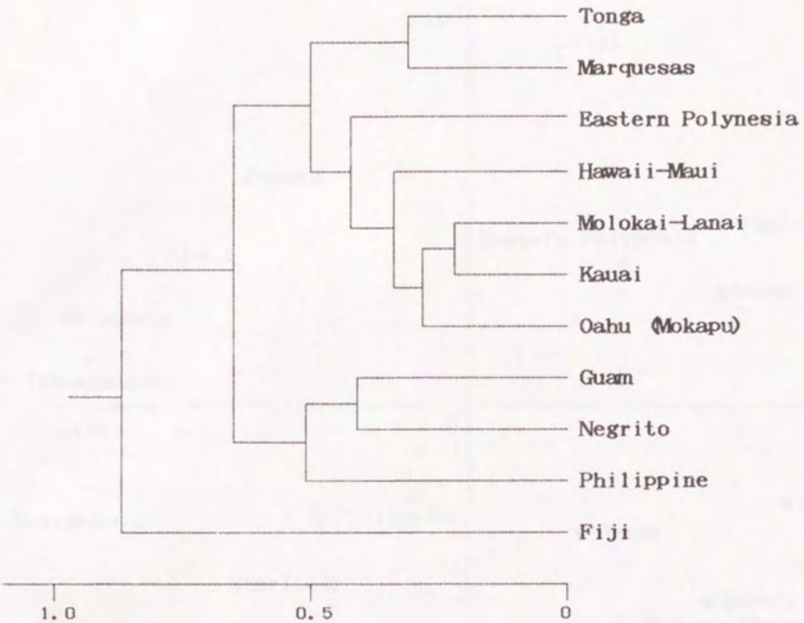

Tonga
Marquesas
Eastern Polynesia
Hawaii-Maui
Molokai-Lanai
Kauai
Oahu (Mokapu)
Guam
Negrito
Philippine
Fiji
1.0
0.5
0

Figure 3

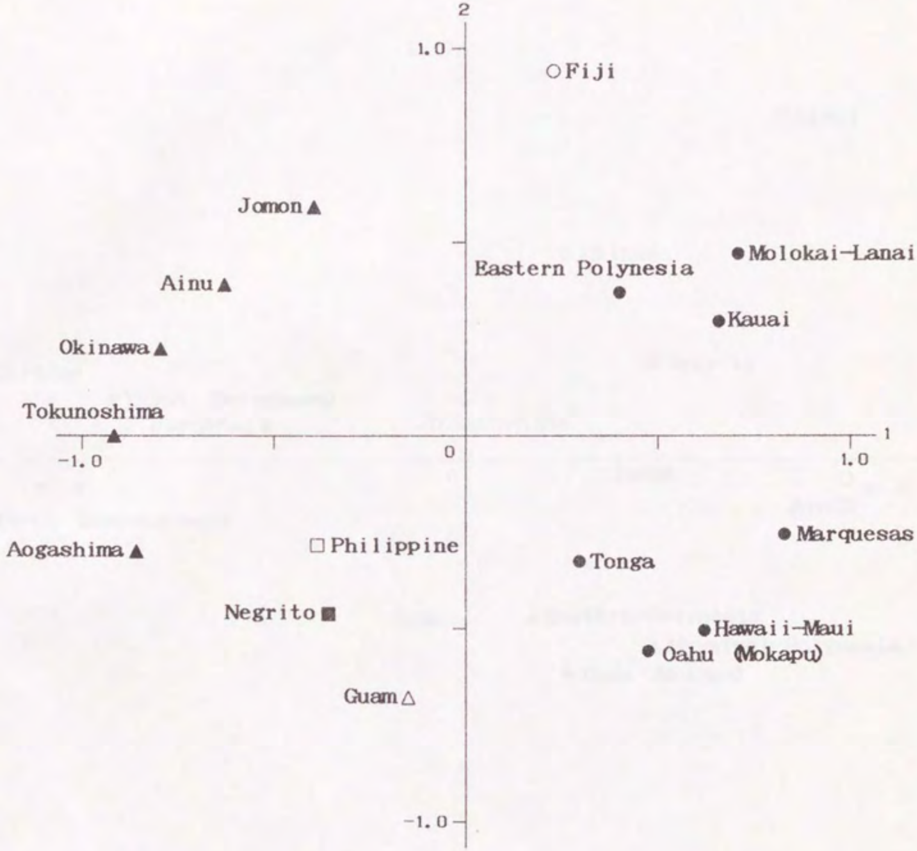

2
1.0
-1.0
0
1
1.0
-1.0
Fiji
Jomon
Eastern Polynesia
Molokai-Lanai
Ainu
Kauai
Okinawa
Tokunoshima
Aogashima
Philippine
Tonga
Marquesas
Negrito
Hawaii-Maui
Oahu (Mokapu)
Guam

Figure 4

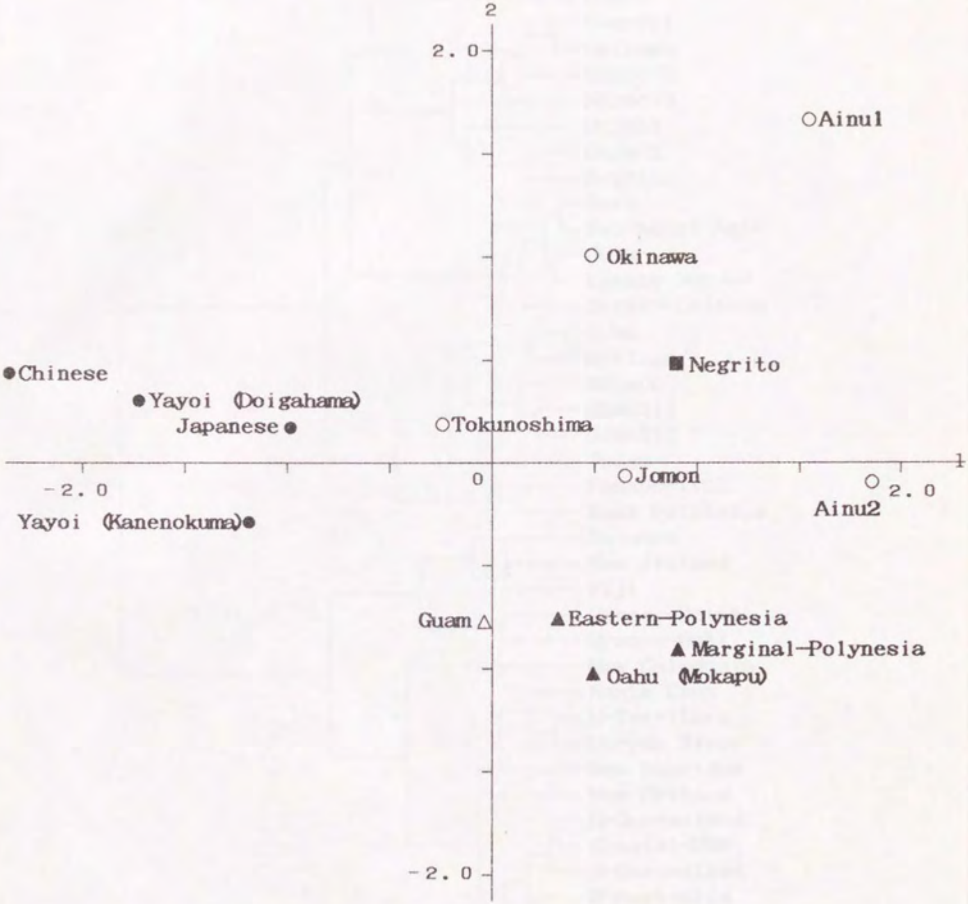

2
2.0
-2.0
0
2.0
-2.0
Ainu1
Okinawa
Negrito
Chinese
Yayoi (Doigahama)
Japanese
Tokunoshima
Jomon
Ainu2
Yayoi (Kanenokuma)
Guam
Eastern-Polynesia
Marginal-Polynesia
Oahu (Mokapu)

Figure 5

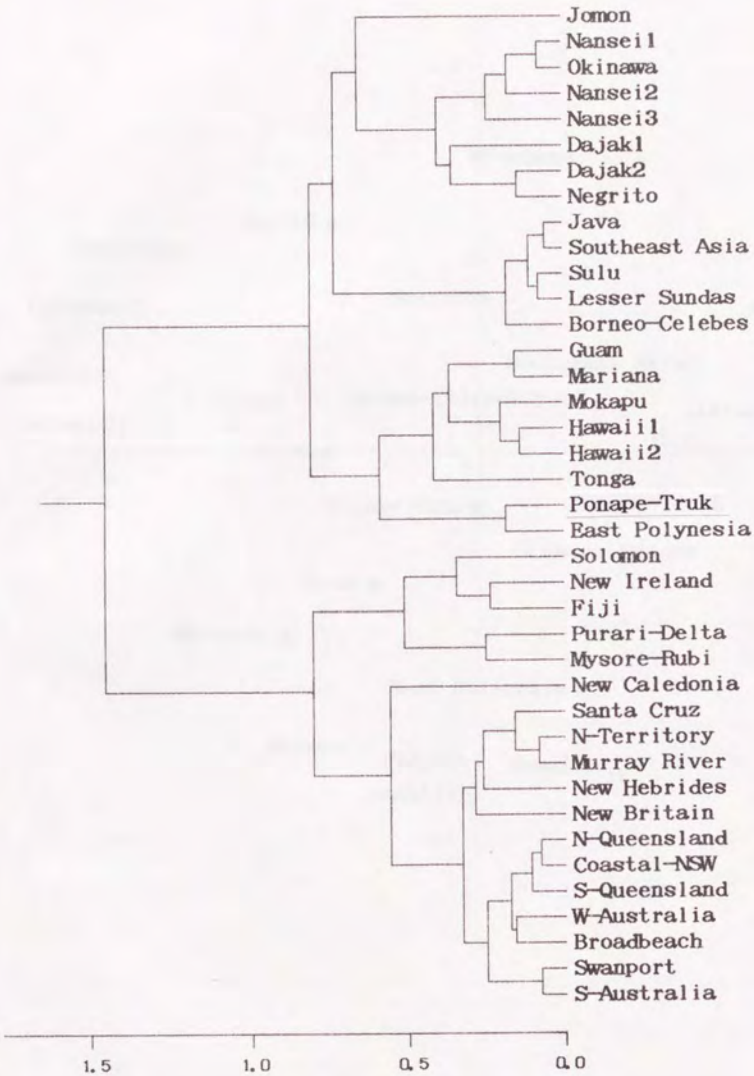
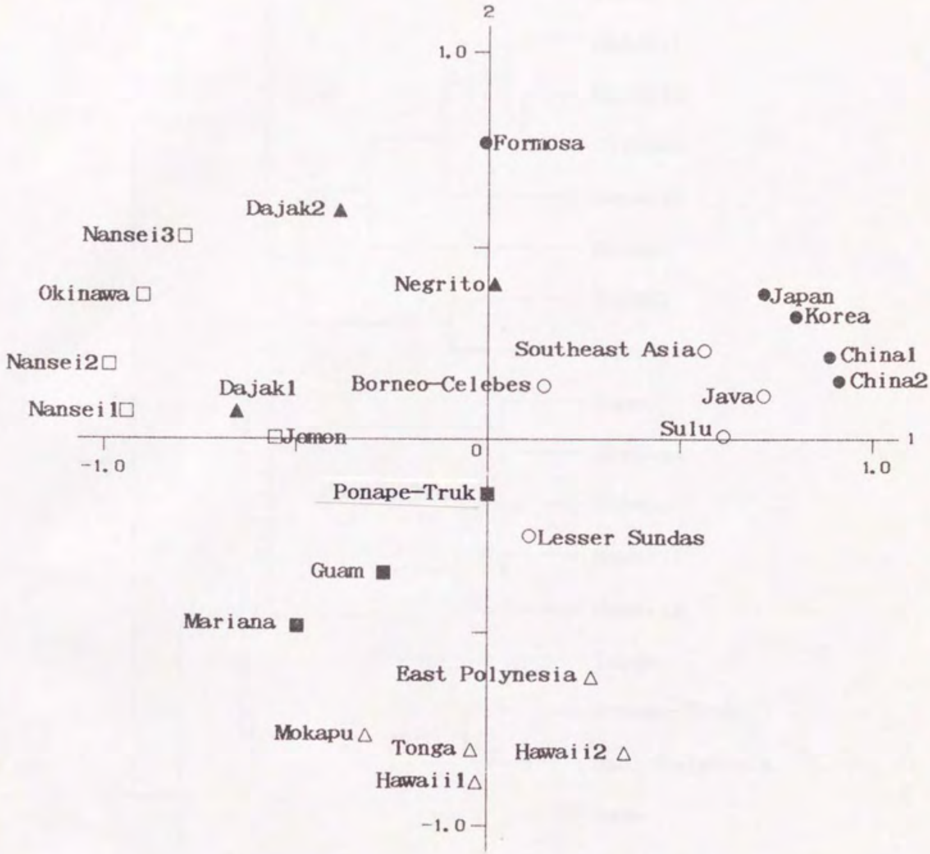

Jomon
Nansei1
Okinawa
Nansei2
Nansei3
Dajak1
Dajak2
Negrito
Java
Southeast Asia
Sulu
Lesser Sundas
Borneo-Celebes
Guam
Mariana
Mokapu
Hawaii1
Hawaii2
Tonga
Ponape-Truk
East Polynesia
Solomon
New Ireland
Fiji
Purari-Delta
Mysore-Rubi
New Caledonia
Santa Cruz
N-Territory
Murray River
New Hebrides
New Britain
N-Queensland
Coastal-NSW
S-Queensland
W-Australia
Broadbeach
Swanport
S-Australia
1.5
1.0
0.5
0.0

Figure 6



2
1.0
Formosa
Dajak2
Nansei3
Negrito
Okinawa
Japan
Korea
Southeast Asia
Nansei2
China1
China2
Dajak1
Borneo-Celebes
Java
Nansei1
Sulu
Jomon
1
0
-1.0
1.0
Ponape-Truk
Lesser Sundas
Guam
Mariana
East Polynesia
Mokapu
Tonga
Hawaii2
Hawaii1
-1.0

Figure 7

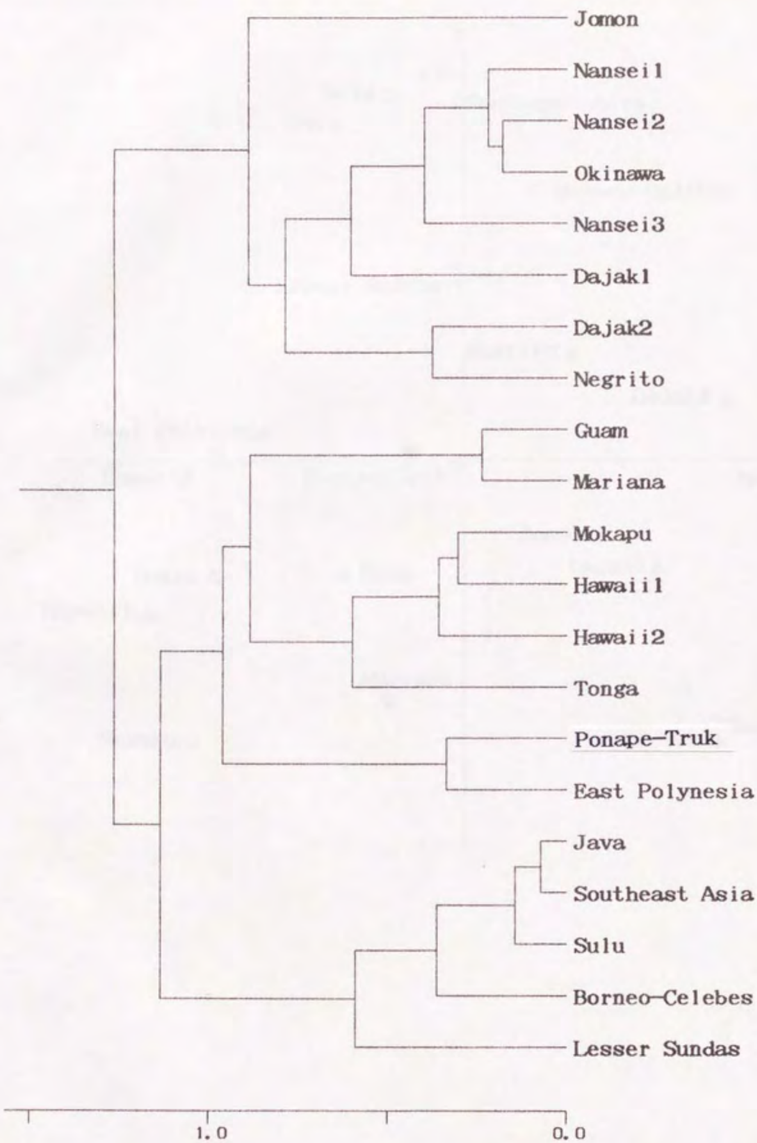

Jomon
Nansei1
Nansei2
Okinawa
Nansei3
Dajak1
Dajak2
Negrito
Guam
Mariana
Mokapu
Hawaii1
Hawaii2
Tonga
Ponape-Truk
East Polynesia
Java
Southeast Asia
Sulu
Borneo-Celebes
Lesser Sundas
1.0
0.0

Figure 8

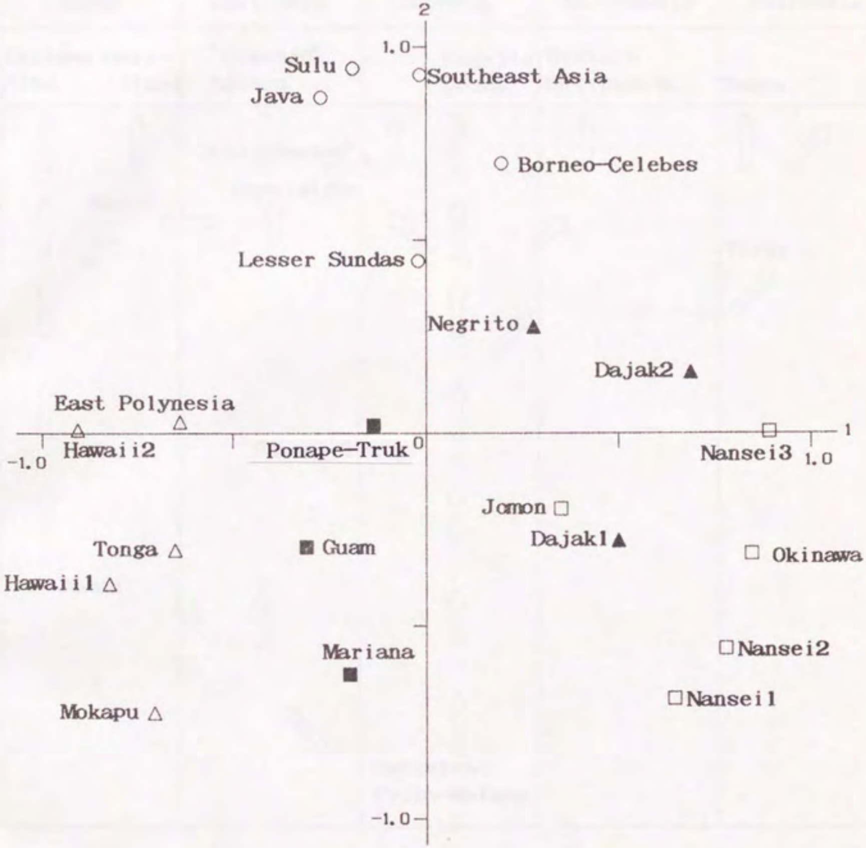

2
1.0
Sulu
Southeast Asia
Java
Borneo-Celebes
Lesser Sundas
Negrito
Dajak2
East Polynesia
Hawaii2
-1.0
Ponape-Truk
0
Nansei3
1.0
1
Jomon
Dajak1
Tonga
Guam
Okinawa
Hawaii1
Mariana
Nansei2
Nansei1
Mokapu
-1.0

Figure 9

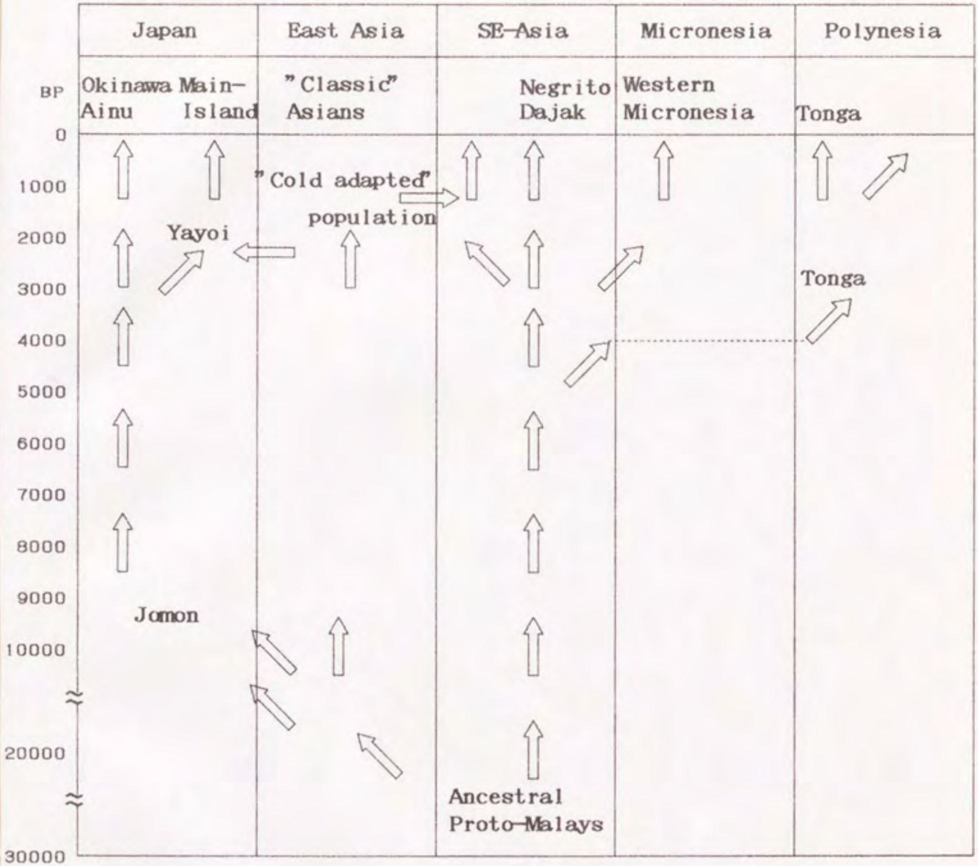
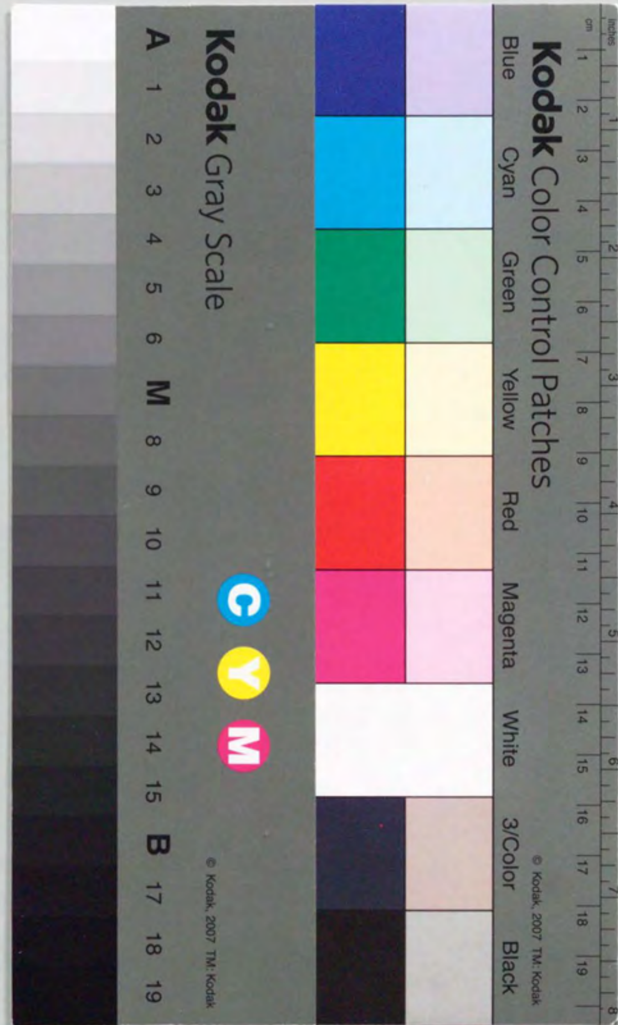

Japan
East Asia
SE-Asia
Micronesia
Polynesia
BP
Okinawa Main-
Ainu Island
"Classic"
Asians
Negrito
Dajak
Western
Micronesia
Tonga
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
20000
30000
"Cold adapted"
population
Yayoi
Tonga
Jomon
Ancestral
Proto-Malays

Figure 10


Kodak Color Control Patches
Blue
Cyan
Green
Yellow
Red
Magenta
White
3/Color
Black
© Kodak, 2007 TM: Kodak
Kodak Gray Scale
A 1 2 3 4 5 6 M 8 9 10 11 12 13 14 15 B 17 18 19
C Y M
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