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Metric Study of the Crania from Protohistoric Sites in Eastern Japan

By

Bin YAMAGUCHI

Department of Anthropology, National Science Museum, Tokyo

Abstract One hundred crania from Protohistoric burial sites in the Kantō district and the southern part of the Tōhoku district were measured. By comparing with six modern and seven earlier series from East and Northeast Asia, the eastern Japanese Protohistoric cranial series was found to be very close to the prehistoric Yayoi series from western Japan and considerably remote from the Jōmon series from eastern Japan. Among the pre- and proto-historic series from Asiatic mainland, the protohistoric Anyang series was disclosed as the closest to the cluster of the Yayoi and the Protohistoric series of Japan.

Comparative studies on the cranial measurements of the human remains from Protohistoric burial sites of mound type (*kofun*) or of cave type (*ōketsubo*) have already been carried out by Jō (1938) and SUZUKI (1969), after the traditional method of craniometry as defined by MARTIN (1928). The materials measured by Jō were derived from sites in western Japan, while those measured by SUZUKI were from the Kantō district in eastern Japan.

Both authors concluded that the Protohistoric crania were intermediate in metric characters between the prehistoric Jōmon and the modern Japanese crania. The present author also conducted a metric study on a series of Protohistoric crania from various sites in eastern Japan and arrived at a similar conclusion, i.e. craniometrically the Protohistoric series was situated just halfway between the Jōmon and the modern series, though there was a slight difference between the materials from western and eastern Japan, as pointed out previously by MORISAWA (1976), and those from eastern Japan were a little closer to the Jōmon, with broader facial skeleton (YAMAGUCHI, 1985 a).

On the other hand, a comparative analysis on the facial flatness measurements carried out recently by the present author has shown that the Protohistoric crania are far distant from the Jōmon crania, relatively closer to the modern Japanese crania, and closest to the Neolithic crania from North China (YAMAGUCHI, in press). The purposes of this article are first to publish a new craniometric table based on materials including some recent acquisitions, and secondly to carry out a comprehensive distance analysis on the craniometic data including the facial flatness measurements.

Materials and Methods

One hundred (58 male and 42 female) adult crania from Protohistoric burial sites, dating from the 4th to 8th centuries, in the Kantō district and the southern part of the Tōhoku district were measured according to the definitions given by MARTIN (1928) and YAMAGUCHI (1973). All the materials are kept either in the National Science Museum, Tokyo or in the University Museum, the University of Tokyo.

In measuring the facial length (no. 40) and the upper facial height (no. 48), two different prosthions were used in accordance to the following definitions given by MARTIN (1928). "Prosthion = derjenige Punkt am Alveolarrand des Oberkiefers, der in der Mediansagittal-Ebene zwischen den mittleren Schneidezähnen am meisten nach vorn vorragt. Das Prosthion liegt also nicht an dem unteren Ende des zwischen die Schneidezähne vorgeschobenen Knochenteiles, sondern an der am meisten nach vorn vorstehenden Stelle seiner Vorderwand. Nur für die Messung der Obergesichtshöhe (Maß Nr. 48) ist der Meßpunkt an die Spitze des genannten Fortsatses zu legen."

Definitions of the facial flatness measurements are as follows (WOO & MORANT, 1934; YAMAGUCHI, 1973). Frontal chord = the chord between the frontomalaria orbitalia (*fmo*), i.e. MARTIN's no. 43(1). Frontal subtense = the subtense from the nasion to the frontal chord. Simotic chord = the minimum horizontal breadth of the two nasal bones; i.e. MARTIN's no. 57. Simotic subtense = the minimum subtense from the median ridge of the nasal bones to the simotic chord. Zygomaxillary chord = the chord between the zygomaxillaria anteriora (*zma*), the points where the zygomaxillary sutures cross the upper margins of the attachment areas of the masseter muscles. Zygomaxillary subtense = the subtense from the subspinale (*ss*) to the zygomaxillary chord.

Results of Measurements

The means and the standard deviations of the measurements and indices are given in Table 1.

The vault is mesocranial, ortho-/hypsi-cranial, metriocranial, and metriometopic in average length-breadth, length-height, breadth-height, and transversal frontoparietal indices. The facial skeleton is mesenic, chamaeprosopic, mesokonchic, and platyrrhine in average KOLLMANN's upper facial, VIRCHOW's upper facial, orbital, and nasal indices, and extremely flat in transverse direction.

PENROSE's Shape Distances

Shape components of PENROSE's distances (CONSTANDSE-WESTERMANN, 1972) between 14 cranial series from East and Northeast Asia were calculated on the basis of 16 measurements of male samples (Table 2). Measurements were standardized by respective standard deviations of the modern Japanese series from the Kantō district (MITSUHASHI, 1958; YAMAGUCHI, 1973). Results are shown in Table 3.

The Protohistoric eastern Japanese series is extremely close to the prehistoric

Table 1. Measurements and indices of the crania from Protohistoric sites in eastern Japan.

	Males			Females		
	n	x	s	n	x	s
1. Glabello-occipital length (L)	41	182.6	5.76	27	174.9	4.87
5. Basion-nasion length (LB)	25	101.6	4.49	22	97.2	3.96
8. Maximum breadth (B)	28	143.1	5.32	21	138.3	5.09
8: 1	24	78.7	3.39	15	78.8	4.11
9. Minimum frontal breadth (B′)	35	94.5	4.10	22	91.5	4.19
9: 8	17	66.1	3.62	13	66.5	2.81
17. Basion-bregma height (H′)	30	136.6	5.15	26	131.3	3.50
17: 1	27	75.3	3.31	20	74.9	2.68
17: 8	20	96.1	4.15	15	95.6	5.06
40. Basion-prosthion length	13	100.1	3.09	11	94.9	4.25
40: 5	12	97.5	3.78	11	99.1	3.45
45. Bizygomatic breadth (J)	16	141.6	3.97	9	(131.8)*	5.61
46. Mid-facial breadth (GB)	16	102.4	4.91	8	97.3	4.80
48. Upper facial height (G′H)	22	71.0	3.14	16	66.7	3.68
48: 45	13	50.7	1.83	5	(52.3)*	3.36
48: 46	12	69.2	2.16	7	69.4	3.41
51. Orbital breadth (O_1)	32	42.9	1.91	24	41.2	1.29
52. Orbital height (O_2)	33	34.3	1.94	22	33.6	1.47
52: 51	32	80.3	4.62	22	81.7	3.87
54. Nasal breadth (NB)	30	27.1	1.55	18	26.6	1.04
55. Nasal height (NH′)	29	51.4	2.58	17	48.3	2.17
54: 55	27	53.2	4.46	16	55.1	3.34
Frontal chord (FC)	20	98.8	3.47	12	93.7	3.86
Frontal subtense (FS)	20	15.2	2.08	12	13.2	1.73
FS: FC	20	15.4	2.07	12	14.1	1.81
Simotic chord (SC)	37	7.4	1.75	27	8.1	1.25
Simotic subtense (SS)	37	2.3	0.89	27	1.8	0.80
SS: SC	37	31.2	9.07	27	22.0	9.18
Zygomaxillary chord (ZMC)	14	100.9	5.47	6	95.0	5.68
Zygomaxillary subtense (ZMS)	14	20.3	3.42	6	19.7	2.38
ZMS:ZMC	14	20.1	3.19	6	20.8	3.28

* Most of the bizygomatic breadth in the females were estimated by doubling half measurement from the midline.

Yayoi series from Doigahama site in Yamaguchi Prefecture. Next closest are the modern Japanese series and the protohistoric Chinese series from Anyang. The distance to the prehistoric Jōmon series is definitely greater than those to the modern Japanese series. The Jōmon series is the most divergent, and the Ainu series is situated between the isolated Jōmon and the cluster of the rest of the series.

Fig. 1 is a two-dimensional approximation of the distance relationship between the six cranial series from Japan. The cluster of the Yayoi and Protohistoric series is closer to the modern Japanese than to the Jōmon and the Ainu.

Table 2. Means of 16 measurements in 14 series of male skulls subjected to PENROSE's distance analyses.

	Jōmon, E. Japan[1)]	Yayoi, Doi-gahama[2)]	Protohist., E. Japan[3)]	Modern, Kantō[4)]	Modern, Kyūshū[5)]	Modern Ainu[6)]	Neolith., N. China[7)]	Shang, Anyang[8)]	Modern, N. China[9)]	Neolith., Baikal[10)]	Medieval, Trans-Baikal[11)]	Mokhe, Troitskoe[12)]	Modern Mongol[13)]	Modern Thai[14)]	S.D.[4)]
1. L	183.0	182.8	182.6	181.7	181.4	185.9	180.5	181.6	180.8	189.7	179.7	181.6	182.5	173.3	5.28
5. LB	103.8	101.7	101.6	103.1	102.3	105.4	104.4	101.6	101.3	104.1	97.8	101.9	100.6	99.4	4.18
8. B	143.0	142.6	143.1	142.0	139.3	141.3	143.6	141.6	139.7	144.5	148.9	144.5	149.1	144.3	5.59
9. B′	96.9	96.0	94.5	95.4	93.8	96.2	92.9	91.8	90.8	94.4	92.8	90.5	94.4	92.4	4.73
17. H′	140.9	134.7	136.6	139.1	139.3	138.1	143.3	138.8	139.2	132.4	127.5	134.5	132.3	136.6	4.58
40. (GL′)	99.9	99.9	100.1	100.4	97.8	105.0	100.7	98.0	95.8	104.0	96.4	95.1	97.4	96.7	6.22
45. J	143.1	139.4	141.6	136.2	134.5	137.3	139.0	136.2	134.3	141.3	140.2	139.7	142.1	133.6	5.07
48. G′H	66.1	72.4	71.0	72.5	71.8	69.7	74.7	72.4	76.2	74.9	75.7	73.7	77.2	69.9	4.18
51. O_1	43.5	42.7	42.9	42.2	43.0	43.6	43.5	41.3	42.6	42.2	43.1	43.3	43.6	42.5	1.90
52. O_2	33.4	34.2	34.3	34.5	34.4	34.3	34.4	33.0	35.6	33.9	35.4	34.2	35.8	33.7	2.03
54. NB	27.8	27.1	27.1	25.9	26.0	25.7	27.4	27.0	25.7	25.9	26.3	27.0	27.4	26.6	1.91
55. NH′	50.0	53.1	51.4	52.3	52.2	50.5	54.2	52.8	55.1	55.0	55.2	54.9	56.3	52.5	3.10
43–1. FC	99.6	100.9	98.8	97.8	96.2	99.5	99.4	96.9	95.6	99.8	99.3	98.9	99.2	97.2	4.29
FS	16.4	15.6	15.2	16.3	14.7	16.9	15.0*	14.4	14.5	15.4*	13.6	11.8	14.9	16.2	2.08
57. SC	10.2	8.4	7.4	7.2	7.2	8.7	7.7	7.7	7.6	8.0	6.8	6.7	7.1	8.3	1.91
SS	4.6	2.3	2.3	2.7	2.5	3.7	2.3	2.2	2.7	3.3	2.8	2.1	3.0	3.0	0.97

* Calculated from the mean angle.

1) DODO, 1986; YAMAGUCHI, 1980. 2) KANASEKI, *et al.*, 1960; DOI & TANAKA, 1987. 3) Present study. 4) MITSUHASHI, 1958; YAMAGUCHI, 1973. 5) HARADA, 1954; DOI & TANAKA, 1987. 6) KOGANEI, 1893; YAMAGUCHI, 1973. 7) YEN, 1972; YEN, 1973; YEN, *et al.*, 1960. 8) Inst. of History, and Inst. of Archaeol., CASS, 1985. 9) SHIMA, 1955/56; ŌNISHI, 1941; CHEBOKSAROV, 1982. 10) DEBETS, 1951. 11) MAMONOVA, 1961. 12) ALEKSEEV, 1980. 13) SHIMA, 1955/56. 14) SHIMA, 1942.

Table 3. Shape distances (C_z^2) based on the 16 cranial measurements shown in Table 2.

	Jōmon E. Japan	Yayoi, Doiga-hama	Protohist. E. Japan	Modern Kantō	Modern Kyūshū	Modern Ainu	Neolith. N. China	Shang, Anyang	Modern N. China	Neolith. Baikal	Medieval Tr. Baikal	Mokhe, Troitskoe	Modern Mongol	Modern Thai
Jōmon		0.804	0.651	0.767	0.791	0.432	1.055	0.832	1.426	1.187	1.906	1.472	1.615	0.709
Yayoi	0.804		0.089	0.211	0.261	0.442	0.352	0.198	0.524	0.328	0.595	0.404	0.413	0.403
Protohistoric	0.651	0.089		0.196	0.228	0.400	0.275	0.198	0.572	0.418	0.719	0.398	0.472	0.461
Modern Kantō	0.767	0.211	0.196		0.076	0.262	0.226	0.162	0.321	0.470	0.977	0.652	0.656	0.328
Modern Kyūshū	0.791	0.261	0.228	0.076		0.334	0.153	0.153	0.202	0.574	1.008	0.503	0.663	0.381
Ainu	0.432	0.442	0.400	0.262	0.334		0.698	0.534	0.846	0.557	1.464	1.136	1.201	0.610
Neol. N. China	1.055	0.352	0.275	0.226	0.153	0.698		0.122	0.289	0.775	1.063	0.377	0.690	0.454
Anyang	0.832	0.198	0.198	0.162	0.153	0.534	0.122		0.306	0.461	0.931	0.397	0.591	0.399
Modern China	1.426	0.524	0.572	0.321	0.202	0.846	0.289	0.306		0.702	0.855	0.483	0.540	0.545
Neol. Baikal	1.187	0.328	0.418	0.470	0.574	0.557	0.775	0.461	0.702		0.625	0.558	0.487	0.939
Transbaikal	1.906	0.595	0.719	0.977	1.008	1.464	1.063	0.931	0.855	0.625		0.418	0.074	0.902
Mokhe	1.472	0.404	0.398	0.652	0.503	1.136	0.377	0.397	0.483	0.558	0.418		0.249	0.833
Modern Mongol	1.615	0.413	0.472	0.656	0.663	1.201	0.690	0.591	0.540	0.487	0.074	0.249		0.699
Modern Thai	0.709	0.403	0.461	0.328	0.381	0.610	0.454	0.399	0.545	0.939	0.902	0.833	0.699	

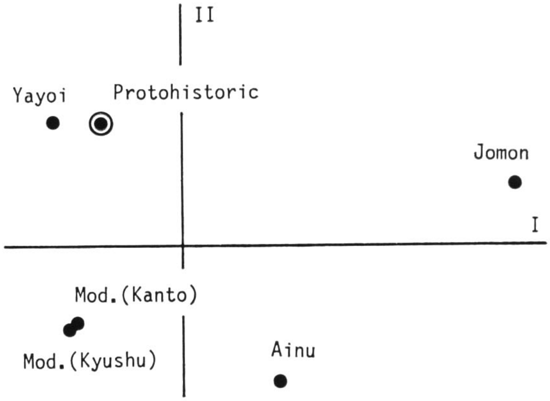

Fig. 1. Two-dimensional representation of the shape distances between six cranial series from Japan by means of a principal coordinates analysis.

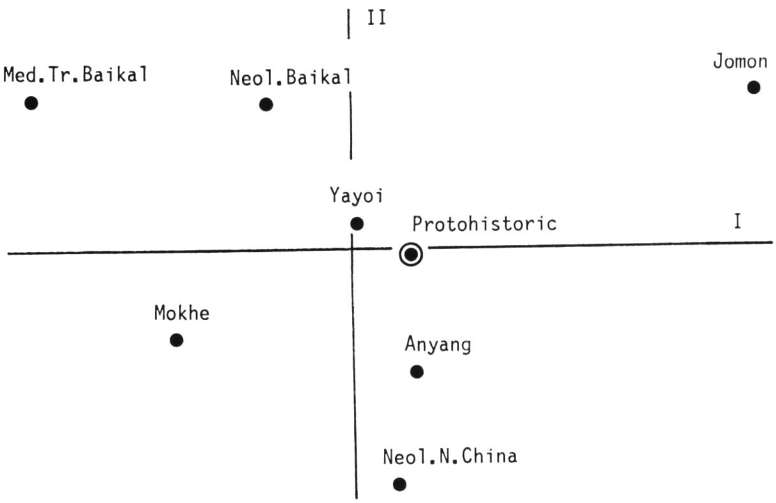

Fig. 2. Two-dimensional representatation of the shape distances between eight pre- and proto-historic cranial series from East and Northeast Asia by means of a principal coordinates analysis

Fig. 2 shows the approximate distance relationship between the eight pre- and proto-historic series from East and Northeast Asia. The closest to the cluster of the Yayoi and Protohistoric series of Japan is the protohistoric series from Anyang in North China. Although close resemblances were disclosed between the Yayoi or Protohistoric series of Japan and various modern and prehistoric series from North or Northeast Asia by HANIHARA (1985) and MIZOGUCHI (in press) through their analyses of Q-mode correlation coefficients or MAHALANOBIS' distances based on rather limited number of cranial measurements, only a moderately close distance has been found, in this study, between the cluster of the Yayoi-Protohistoric series of Japan and the Neolithic/Aeneolithic series from the Baikal districts, and no resemblance in particular has been recognized between the Japanese Protohistoric series and nearly contemporaneous series from Transbaikalia and the Amur basin (Troitskoe).

Discussion

The closeness revealed between the Protohistoric series from eastern Japan and the Yayoi series from Doigahama in cranial measurements corroborates the similar results obtained for measurements of the lower limb long bones (YAMAGUCHI, 1986) and for incidence pattern of some non-metric cranial traits (DODO, 1987). It is thus highly probable that a population which is considerably different morphologically from the indigenous Jōmon people, as represented by the Doigahama series in the early Yayoi period, has spread into the eastern part of Honshu by around the 8th century.

If the Yayoi series from several sites in western Japan, including Doigahama site, were largely composed of Mongoloid immigants from the Asiatic mainland (probably the Korean Peninsula) and their descendants, as advocated first by KANASEKI (1976) and supported later by BRACE & NAGAI (1982), HANIHARA (1985), NAKAHASHI, DOI, & NAGAI (1985), DODO (1987), and others, the result of the present study as well as those of YAMAGUCHI (1986) and DODO (1987) vigorously confirm the tentative conclusion, drawn from the analysis of nonmetric cranial variants, that the post-Jōmon process of mongoloidization of the Japanese population had been well advanced during the Kofun period even in eastern Japan (YAMAGUCHI, 1985 b).

In this connection, it should still be kept in mind that the skeletal remains excavated from burial mounds and cave-type tombs may not be an unbiased sample of the entire population in Protohistoric Japan. In order to evaluate the extent of representativeness of the present materials, it may be necessary to appeal to some archaeological way or other.

Recently a stimulative attempt to estimate the scale of the immigration during the Yayoi and Kofun periods from mainland has been published. Based on the estimates of the population size of Japan in pre- and proto-historic times given by KOYAMA (1979), viz. approx. 77,000 in the final Jōmon phase and approx. 5,400,000 in the end of the Kofun period, and also assuming the average annual population growth rate to have been 0.2 percent during the 1000 years from the beginning of the Yayoi period to the end of the Kofun period, HANIHARA (1987) has reached a tentative conclusion that the number of the immigrants was about one and a half millions in total, or about 1,500 per year.

The average growth rate, however, could have been somewhat higher than 0.2 percent, since the agriculatural settlers could push the frontier from Kyūshū to the east, exploiting the land much more intensively than the native hunter-fisher-gatherers. If the growth rate had been, for example, 0.5 percent, as known for colonizing peoples during the age of Colonialism (POLGAR, 1972), only 181 immigrants per year would have been sufficient to account for the population increase through the Yayoi and the Kofun periods. The crucial problem that remains to be solved in reconstructing the population history of Japan during the said periods seems to be how to attain valid estimation of the differential growth rates of the native and the immigrant populations.

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References

ALEKSEEV, V. P., 1980. Materialy po kraniologii mokhe. *In*: Paleoantropologiya Sibiri. 106–130. Moskva, Nauka.

BRACE, C. L., & M. NAGAI, 1982. Japanese tooth size: past and present. *Amer. J. Phys. Anthrop.*, **59**: 399–411.

CHEBOKSAROV, N. N., 1982. Etnicheskaya Antropologiya Kitaya. 301 s., 68 tab. Moskva, Nauka.

CONSTANDSE-WESTERMANN, T. S., 1972. Coefficients of Biological Distances. viii+142 pp. Oosterhout, Anthropological Publications.

DEBETS, G. F., 1951. Antropologicheskie issledovaniya v Kamchatskoi Oblasti. *Trudy Inst. Etnogr.*, **n. s. 17**: 1–263.

DODO, Y., 1986. Metrical and non-metrical analyses of Jomon crania from eastern Japan. *In*: AKAZAWA, T., & C. M. AIKENS (eds.), Prehistoric Hunter-Gatherers in Japan (Bull. no. 27, the University Museum, the University of Tokyo). 137–161.

DODO, Y., 1987. Supraorbital foramen and hypoglossal canal bridging: the two most suggestive nonmetric cranial traits in discriminating major racial groupings of man. *J. Anthrop. Soc. Nippon*, **95** (1): 19–35.

DOI, N., & Y. TANAKA, 1987. A geographical cline in metrical characteristics of Kofun skulls from western Japan. *J. Anthrop. Soc. Nippon*, **95** (3): 325–343.

HANIHARA, K., 1985. Origins and affinities of Japanese as viewed from cranial measurements. *In*: KIRK, R., & E. SZATHMARY (eds.), Out of Asia. 105–112. Canberra, The Journal of Pacific History.

HANIHARA, K., 1987. Estimation of the number of early migrants to Japan: a simulative study. *J. Anthrop. Soc. Nippon*, **95** (3): 391–403.

HARADA, T., 1954. Craniometrical studies on the south-western Japanese populations. *Jinruigaku-Kenkyū* (*Quarterly J. Anthrop.*), **1**: 1–51. (In Japanese, with English summary.)

Institute of History and Institute of Archaeology, CASS (eds.), 1985. Contributions to the study of human skulls from the Shang sites at An-yang. 377 pp., 88 pls. Beijing, Cultural Relics Publishing House. (In Chinese, with English summary.)

JŌ, I., 1938. Anthropologische Untersuchungen über die Skelettreste aus den protohistorischen Hügelgräbern in Japan. *Jinruigaku Shūhō* ((*Anthropologischer Bericht*), **1**: 1–324. Kyoto. (In Japanese, with German tables.)

KANASEKI, T., 1976. Nihon Minzoku no Kigen (Origin of the Japanese People). v+397 pp. Tokyo, Hōseidaigaku Shuppankyoku. (In Japanese.)

KANASEKI, T., M. NAGAI, & H. SANO, 1960. Craniological studies of the Yayoi-period ancients, excavated at the Doigahama site, Yamaguchi Prefecture. *Jinruigaku-Kenkyū* (*Quarterly J.*

Anthrop.), **7**: suppl. 1–36. (In Japanese, with English summary.)

KOGANEI, Y., 1893. Beiträge zur physischen Anthropologie der Aino. I. Untersuchungen am Skelet. *Mitt. Med. Fac. Univ. Tokio*, **2**: 1–249, 6 Tab., 5 Taf.

KOYAMA, S., 1979. Jomon subsistence and population. *Senri Ethnological Studies, Nat. Mus. of Ethnol.*, **2**: 1–65.

MAMONOVA, N. N., 1961. Kochevniki Zabaikal'ya—XIII vv. po dannym paleoantropologii. *Trudy Inst. Etnogr.*, **n. s. 71**: 207–241.

MARTIN, R., 1928. Lehrbuch der Anthropologie. 2. Aufl., Band 2 (579–1184). Jena, G. Fischer.

MITSUHASHI, K., 1958. Anthropologic studies of the skulls of the inhabitants of Kanto district in Japan. *Chiba Igakukai Zasshi* (*J. Chiba Med. Soc.*), **34** (1): 247–283. (In Japanese, with English summary.)

MIZOGUCHI, Y., n. d. Affinities of the protohistoric Kofun people of Japan with pre- and protohistoric Asian populations. *J. Anthrop. Soc. of Nippon*, **96**. (In press.)

MORISAWA, S., 1976. Regional differences in measurements of the human skulls excavated from the Kofun. *Niigata Igakukai Zasshi*, **90**: 32–47. (In Japanese.)

NAKAHASHI, T., N. DOI, & M. NAGAI, 1985. Kanenokuma iseki shutsudo no Yayoi jidai jinkotsu (Human skeletal remains of the Yayoi period from Kanenokuma site). *In*: Shiseki Kanenokuma Iseki (Historical Monument Kanenokuma Site), 43–145. Fukuoka-shi. (In Japanese.)

ŌNISHI, M., 1941. Anthropologische Untersuchungen der einzelnen Abschnitte der Schädeln von den Mongolen, Chinesen und Koreanern. I. Teil. *Zinruigaku Sōkan, A, Anthropology*, **3**: 1–102. (In Japanese, with German summary.)

POLGAR, S., 1972. Population history and population policies from an anthropological perspective. *Curr. Anthrop.*, **13** (2): 203–211.

SHIMA, G., 1942. Taijin oyobi hokubu raojin no taishitsujinruigakuteki kenkyū (Physical anthropological studies on the Thailanders and the Northern Laos). *In*: Iwai, S., & S. Kitamura (eds.), Taikoku no Shippei to sono Shinryō. 29–135. Tokyo, Kanehara Shoten. (In Japanese.)

SHIMA, G., 1955/1956. Kraniologische Data der Chinesen, Koreaner und Mongolen. *Osaka City Med. Journal*, **2** (1): 85–107; **2** (2): 44–68; **3** (1): 114–141.

SUZUKI, H., 1969. Microevolutional changes in the Japanese population from the prehistoric age to the present-day. *J. Fac. Sci. Univ. Tokyo, Section V. Anthrop.*, **3** (4): 279–308, 7 pls.

WOO, T. L., & G. M. MORANT, 1934. A biometric study of the "flatness" of the facial skeleton in man. *Biometrika*, **26**: 196–250.

YAMAGUCHI, B., 1973. Facial flatness measurements of the Ainu and Japanese crania. *Bull. Natn. Sci. Mus., Tokyo*, **16** (1): 161–171.

YAMAGUCHI, B., 1980. A study on the facial flatness of the Jomon crania. *Bull. Natn. Sci. Mus., Tokyo, Ser. D*, **6**: 21–28.

YAMAGUCHI, B., 1985 a. Kokka seiritsu zengo no nihonjin, V. higashi-nihon (Japanese people in the Protohistoric period. V. Eastern Japan). *Kikan Jinruigaku*, **16** (3): 70–82. (In Japanese.)

YAMAGUCHI, B., 1985 b. The incidence of minor non-metric cranial variants in the Protohistoric human remains from eastern Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. D*, **11**: 13–24.

YAMAGUCHI, B., 1986. Metric characters of the femora and tibiae from Protohistoric sites in eastern Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. D*, **12**: 11–23.

YAMAGUCHI, B., n.d. Higashinihon no kofun-ōketsubo shutsudojinkotsu no ganmen heitando keisoku (Facial flatness measurements of the crania from Protohistoric burial sites in eastern Japan). *In*: Nagai Masafumi Kyōju Taikankinen Ronbunshū. Fukuoka. (In Japanese.) (In press.)

YEN, Y., 1972. (The Neolithic human skeletal remains from Ta-wen-kou.) *Kaogu Xuebao*, **1972** (1): 91–122, 12 pls. (In Chinese.)

YEN, Y., 1973. The Neolithic human skeletal remains from Hsi-hsia-hou. *Kaogu Xuebao*, **1973** (2): 91–126, 12 pls. (In Chinese, with English summary.)

YEN, Y., C. Z. LIU, & M. GU, 1960. Report on the skeletal remains from the Neolithic site at Bao Ji, Shensi. *Vertebrata Palasiatica*, **4** (2): 103–111, 2 pls.