Dental Evidence on the Origins of the Ainu and Japanese

Abstract. *New dental anthropological evidence on the questions of Ainu and Japanese origins illustrates the utility of diachronic dental information obtained from skeletal populations for microevolutionary and human origins investigations. Data from skeletal and dental collections of Shang Dynasty Chinese and from Jomon period and recent Ainu Japanese, together with information on recent Japanese dentition from published accounts, indicate a correlation between the ancient Chinese and modern Japanese and between the prehistoric Jomon people and the Ainu.*

The value of dental morphology for long-term evolutionary reconstructions was demonstrated by Weidenreich (*1*) in his study of the dentition of *Sinanthropus*. However, most microevolutionary studies of human dentition tend to be synchronic or, if diachronic, are often plagued with archeological sampling problems (*2*). Although synchronic studies provide useful indirect clues about possible past evolution and relationships between groups (*3*), the preferred evidence, especially where migrations are involved, comes from direct observations on sequential and ancestral populations. Only rarely are human skeletons with their genetically determined dentitions recovered in large numbers with reliable dates clustered in a narrow time range.

Such are the characteristics of the 277 usable An-yang Chinese dentitions from the late part of the Shang Dynasty around 1100 B.C. (*4*). The 101 Jomon dentitions are placed in the Middle to Late Jomon Period, or about 1000 B.C. (*5*). The Ainu and Japanese dentitions are recent and living samples that range in size from 85 individual Ainu with minimal admixture to 2010 Japanese teeth. Figures 1 and 2 show representative specimens.

Table 1 shows the frequencies of nine commonly studied morphological features of the permanent tooth crowns. The number of traits studied is limited by the availability of published descriptions of recent Japanese teeth. There are many other traits of the crowns and roots that could have been compared had information been available for the present-day Japanese. I have used published Japanese data where observational criteria match those used here to describe the An-yang Chinese, Ainu, and Jomon dentitions.

Examination of Table 1 reveals the general similarity of the An-yang Chinese and Japanese, and an equal similarity between the Ainu and Jomon dentitions. Although the Ainu dentition is generally more like that of the Jomon than like those of the Chinese or Japanese, in eight out of nine instances the Ainu possess trait frequencies between those of the Japanese and Jomon. This is suggestive of some gene flow between Ainu and Japanese. Recent studies on living Ainu show that admixture is increasing (*6*).

Table 2 presents the results of chi square tests for the various possible comparisons between groups. These calculations provide statistical support for the readily visible Ainu-Jomon and Chinese-Japanese dichotomy. In view of the known prehistory of Japan, the obvious conclusion to draw from this dichotomy is that the Ainu are descended from the prehistoric Jomon people, and the recent Japanese are probably not. Instead, the Japanese may be descended from the post-Jomon, Yayoi agriculturalists. Japanese prehistory shows the Yayoi period begins at 200 to 300 B.C. It is a time of cultural and technological influence from China (*7*). Writing, bronze and iron metallurgy, rice agriculture, and other adaptive and artistic elements were introduced from China. The amount, areal extent, and kinds of changes in Yayoi material culture and settlement pattern suggest significant Chinese immigration during Yayoi times, not simply the effects of isolated Chinese traders establishing mercantile relations.

Although physical anthropologists have recognized many differences in the skeletal anatomy of the Jomon and post-Jomon people (*8*), not all have concluded that the living Ainu are descended from the prehistoric Jomon, and that the living Japanese are not. The reason for this is doubt about numbers of immigrants. As Suzuki (*9*) phrases the problem:

> Although the author does not disregard the powerful cultural influence from the Asian Continent on Japan at the Kofun Age, he would like to pose a simple question regarding the metisation theory: could there have been so many immigrants from the Asian Continent at the Kofun Age as would have effected such simultaneous and far-reaching changes in the physical characteristics as actually occurred between the Jomon and Kofun Ages in an estimated six to seven million inhabitants of the Japanese islands, at the time when seafaring was so difficult and dangerous, as it is recorded in the Japanese history?

These reasonable reservations (with regard to migration size and seafaring) can be countered if it can be shown that the Chinese sent out large maritime expeditions.

Hsieh (*10*) has reviewed available Chinese writings on geographical exploration. He documents the historical occurrences of at least four imperially sanctioned maritime expeditions outside of China, each made up of several thousands of individuals. Hsieh reports that the A.D. 1405 Chinese expedition to Southeast Asia included 27,800 persons transported in 62 large ships. The A.D. 1431 expedition to the Red Sea and Africa included 26,755 Chinese soldiers, sailors, cooks, medical staff, and other specialists. This pattern of large expeditions extends back to at least 219 B.C.

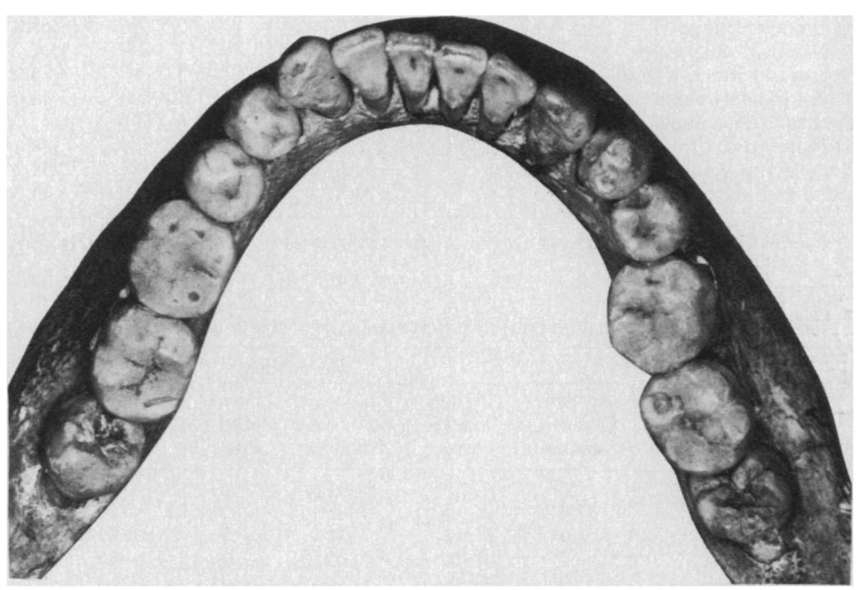

Fig. 1. An-yang Chinese male (HPKM 127). Incisors have trace grade lingual and labial shoveling. Canine distal accessory ridge is absent. First premolar has no lingual cusps; second has two cusps. Molar groove patterns are: M1, Y; M2 and 3, X. No protostylid or cusp 6 or 7 expression occurs. M1 and 2 have two roots each. M3 are impacted and carious; five teeth in all are carious. There is no mandibular torus and no dental chipping, but heavy intertooth wear occurs.

According to Hsieh, at this date the Ch'in emperor authorized a Taoist named Hsu Fu to organize an exploratory expedition consisting of several thousand young men and women, including artisans and navigators as well as needed supplies of grain, seed, and livestock. This expedition set out from Lang-yu, located only about 200 miles from An-yang on the China coast. It did not return, although Hsu Fu came back in 210 B.C. to request more archers, which were granted. Hsieh, among others, believes the description of the lands reached by the Hsu Fu expedition best fits the Japanese island of Honshu, about 700 miles west of Lang-yu. Wei (*11*) has reviewed this expedition in great detail and suggests that the founder of the Japanese Empire, Emperor Jimmu Tenno, was Hsu Fu.

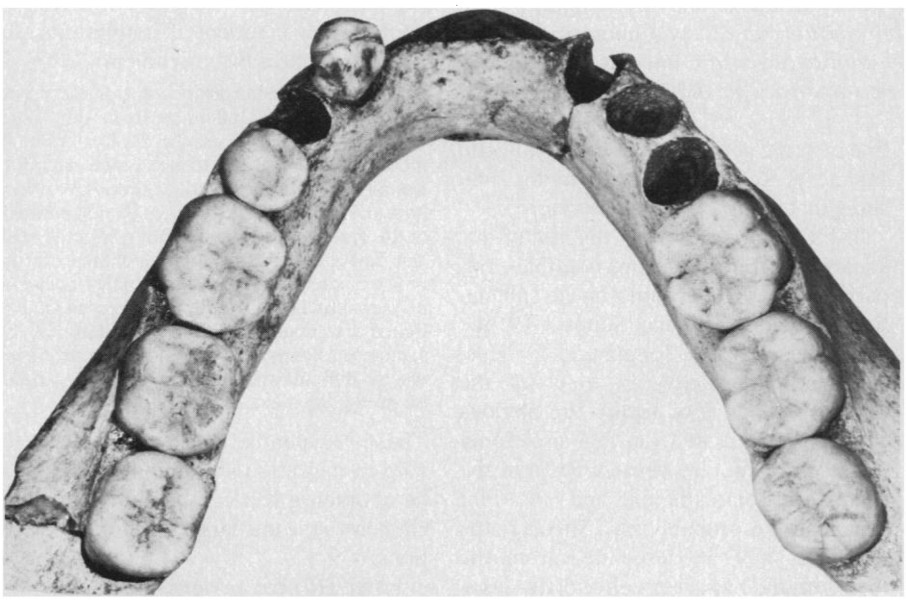

Fig. 2. Jomon female (1521.15). Incisors were intentionally ablated (as were maxillary canines and first premolars) around age 15 to 25 years. P1 has no lingual cusp; P2 has two cusps. Deflecting wrinkle is present on M1 but absent on M2 and 3. Groove patterns are: M1 and 2, Y; M3, X. There is no expression of protostylid or cusp 7. Cusp 6 is present on all molars. M1, 2, and 3 have two roots each. There are no carious teeth, no dental chipping, but heavy intertooth wear is present. Trace grade of mandibular torus occurs bilaterally.

Table 1. Dental trait frequencies in north China and Japan given as percent of sample. The size of the sample is in parentheses. In the trait descriptions, M signifies a molar and I signifies an incisor. The bars above or below the number of the tooth indicate whether it is an upper or lower tooth.

Trait*	An-yang Chinese†	Recent Japanese	Recent Ainu‡	Jomon†
I$\underline{1}$ shovel, marked form	43.6 (62)	43.8§ (356)	7.9 (51)	0.0 (27)
I$\underline{1}$ double shovel	32.4 (142)	87.9‖ (481)	5.9 (51)	3.2 (31)
M$\underline{1}$ hypocone, large	82.7 (203)	81.2¶ (2010)	65.8 (76)	63.8 (58)
M$\underline{1}$ Carabelli, cusp form	8.3 (157)	6.5# (444)	1.3 (77)	2.2 (46)
M$\overline{1}$ groove pattern, X type	4.1 (97)	6.6¶ (392)	3.3 (61)	3.2 (63)
M$\overline{1}$ cusp 6, all variants	31.0 (58)	25.3#(1046)	29.8 (62)	58.0 (50)
M$\overline{1}$ cusp 7, all variants	11.8 (153)	6.7# (60)	4.3 (70)	1.5 (67)
M$\overline{1}$ protostylid, all variants	35.4 (147)	18.5** (108)	23.1 (65)	34.4 (64)
M$\overline{1}$ deflecting wrinkle	87.5 (8)	31.6¶ (209)	51.2 (43)	54.2 (24)
Unweighted x̄	37.4	34.2	20.9	24.5

*Trait definitions can be found in (*2*, *14*). †(*15*). ‡(*16*). §(*17*). ‖ (*18*). ¶ (*19*). #(*20*). **(*21*).

Table 2. Chi-square tests of intergroup differences. A probability of >.05 is not significant.

Trait	Probability					
	An-yang Chinese–Japanese	An-yang Chinese–Ainu	An-yang Chinese–Jomon	Japanese-Ainu	Japanese-Jomon	Jomon-Ainu
I$\underline{1}$ shovel	> .05	< .01	< .01	< .01	< .01	> .05
I$\underline{1}$ double shovel	< .01	< .01	< .01	< .01	< .01	> .05
M$\underline{1}$ hypocone	> .05	< .01	< .01	< .01	< .01	> .05
M$\underline{1}$ Carabelli	> .05	> .05	< .05	> .05	> .05	> .05
M$\overline{1}$ X groove pattern	> .05	> .05	> .05	> .05	> .05	> .05
M$\overline{1}$ cusp 6	> .05	> .05	< .05	> .05	< .01	< .01
M$\overline{1}$ cusp 7	> .05	> .05	< .05	> .05	> .05	> .05
M$\overline{1}$ protostylid	< .01	< .05	> .05	> .05	< .05	< .05
M$\overline{1}$ deflecting wrinkle	< .01	> .05	> .05	< .05	< .05	> .05
Percent significant	33.3	44.4	66.7	44.4	66.7	22.2

The correspondence between Chinese written history and Japanese archeology is too great to dismiss as simply due to chance. However, this cultural correspondence does not prove that the appearance of Chinese culture in the Yayoi and subsequent Kofun periods was transported and established by actual Chinese people. This proof must come from identification of biological affiliation.

I propose that the dental characteristics given in Table 1 meet this need for biological evidence. Teeth are well known for their evolutionary conservatism and high genetic component in trait occurrence (*12*). Even though no scientific evidence exists to show that environmental factors can cause a dental trait to occur or fail to occur, it is probable that environment, mainly preeruptive environment, does have some effect, at least on bilateral size symmetry (*13*). However, there is reason to suspect that the Hsu Fu expedition essentially carried a Chinese environment to Honshu.

The large number of men and women said to be expeditionary participants would have eliminated the need to find mates among the aboriginal Jomon people, although some such activity could have occurred, according to the dental characteristics. The large size of the expeditionary party would have also reduced the chances of genetic drift and founder's effect. If we accept the Hsu Fu account, the dental evidence supports the likelihood of many immigrants. Little dental change is evident for the 2200 years involved; such change would be expected had significant interbreeding with Jomon people taken place, or if the number of Chinese was less than that needed to counter drift. Subsequent migration from China in the Kofun period also would have helped.

In sum, I believe that the dental evidence offered here can be interpreted in only one way. The dentition of recent Japanese are too much like that of the 3100-year-old An-yang Chinese and too dissimilar to recent Ainu and prehistoric Jomon to mean anything other than that modern Japanese could easily be descendants of migrants from north China. The Ainu are probably descended directly from the Jomon population.

In addition, the dentition of the An-yang Chinese and the Jomon, including features not reported here, are still similar enough to conclude that both populations were derived from an earlier proto-Mongoloid gene pool in eastern Asia. Neither Ainu nor Jomon have dentitions supportive of a Caucasoid origin hypothesis. The dentitions of the Chinese and Jomon, placed as they are at approximately 3000 years ago, have two to three times as many significant trait frequency differences as do the Chinese-Japanese or Ainu-Jomon pairs (Table 2). This hints at a pre-Yayoi period of 6,000 to 9,000 years (10,000 to 7,000 B.C.) of genetic isolation between the Asian mainland and the Japanese island populations. Such a period would date approximately from the time of the flooding of the continental shelf connecting Japan and the mainland. It was not until Yayoi times that identifiable genetic links were reestablished; these appear to have been minor. Table 1 suggests a low but almost equal amount of gene flow in both directions between the Ainu and Japanese. The magnitude and nature of the microevolutionary dental differences between north China and Japan by 1000 B.C. are worth remembering when considering various dates, sources, and migration numbers for the peopling of the New World and Pacific areas, as well as when considering the origin and antiquity of the Mongoloid geographic race.

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Hierarchical Relations Among Female Hanuman Langurs (Primates: Colobinae, *Presbytis entellus*)

Abstract. *Female hierarchies are stable over short periods but fluctuate from year to year. In general, young females rise in rank over older and often larger female relatives, even though old females remain active in troop defense. This previously undescribed dominance system can be plausibly explained with reference to inclusive fitness theory and the concept of reproductive value.*

Although hierarchical relationships are nearly universal among social mammals, little is known about factors determining rank. There are two known systems of status determination: rank determined by size (and therefore age) (*1*), and rank determined by genealogy (*2*). Among the better studied primate species such as Japanese and rhesus macaques, for which longitudinal information is available, daughters rank just below their mothers with younger daughters above older daughters. Once established, these positions in the hierarchy are relatively permanent and may have important consequences for a female's reproductive success (*3*). In both size-determined and nepotistic ranking systems, the dominant animal, either by virtue of greater size or powerful relatives, simply defeats subordinates when challenged. We propose a third type of ranking system for langurs, in which females are ranked in accordance with reproductive value (*4*). Individual reproductive value declines with age, and older female langurs defer to younger ones. Since such a system depends to a large extent on the compliance of low-ranking animals, it is only expected to occur in groups composed of close relatives.

Hanuman langurs are semiterrestrial primates that feed on fruit, seeds, and leaves. Ranging from high altitude in the Himalayas southward to Sri Lanka, langur populations can be found throughout the subcontinent of India. Langur troops are composed of overlapping generations of close matrilineal relatives accompanied by one or more fully adult males who have entered the troop from outside. The ouster and replacement of resident males has been observed at all sites where observations have continued over two or more years (*5, 6*). Whereas the male composition of a langur troop is transient, females remain together throughout their lives in the same home range. Previous studies described hierarchical relations among these females as unpredictable and poorly defined (*5, 7, 8*). Nevertheless, analysis of female-female displacements recorded during five annual 2- to 3-month study periods between 1971 and 1975, totaling 1503 hours of observation, at Mt. Abu, Rajasthan, reveals that the direction of displacements among females in this population is predictable over short periods.

"Displacement" occurs when one animal approaches another and the animal approached withdraws. Typically, approach occurs in conjunction with threats or actual contact. In most observed displacements (83 percent) the displaced animal relinquished access to some exhaustible food resource. Of the displacements related to food, some 33 percent occurred naturally while 67 percent were provoked by artificial provisioning (*9*). Displacements also occurred over positions that did not directly involve access to food (11 percent of observed displacements) and over access to infants (6 percent). Direction of displacement was consistent regardless of context.

Observations on female-female displacements were concentrated on three troops living in the vicinity of Abu town. The B-5 troop was composed of a maximum of 24 individuals (in 1972 and 1973) and as few as 18 (in January 1974, just after a male takeover). The B-3 troop contained as many as 22 individuals (in 1971) or as few as 15, including nine adult females (in 1972 just after a takeover). The B-6 troop contained five to seven adult