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Richard L. Jantz, Major Professor

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Drops, Trickles, Waves, and Tides: North Pacific Anthropometrics and the Peopling of North America

A Thesis
Presented for the
Master of Arts
Degree
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Stephen David Ousley

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For

James Wilbur Gilmore

1925 - 1985

Quantum Meruit

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ABSTRACT

It is widely accepted by scholars that North America was settled by Asian immigrants. What is not at all clear is how it proceeded. Many researchers have looked at the relationships between Amerindian groups based on genetic, linguistic, non-metric, anthroposcopic, anthropometric, or craniometric data, each with tradeoffs in reliability and application, with widely divergent results. Fewer have examined Amerindian relationships with Asiatic groups, mainly due to a lack of data from Siberia. The Jesup North Pacific Expedition (1897-1902) was intended by Boas to provide material for trans-Pacific comparisons. It uncovered tantalizing ethnographic similarities between groups many thousands of miles apart, from the Northwest Coast of America to the Amur river in southeast Siberia.

The anthropometric data collected by the Jesup North Pacific Expedition was never analyzed as Boas intended, namely, to ascertain biological relationships between peoples on both sides of Bering Strait. This was due primarily to the immense time involved in statistical analyses in the pre-computer days, but also because few sophisticated statistical procedures were available early in this century. Despite these acknowledged handicaps, Boas made sure anthropometrics were collected.

More recent approaches utilizing biological data have produced the ubiquitous "wave" theories. The vast majority of these are merely "reasonable assertions" based

on statistically unreliable results made believable through an appeal to linguistic or archaeological authority. The best known of the wave theories comes from Greenberg, Turner and Zegura (1986). They maintain that analyses utilizing linguistic, dental, and blood marker data independently point to three waves of humans migrating into the New World. The dental analysis, however, is methodologically and statistically flawed, the linguistic analysis is oversimplified, and the genetic data are inconclusive. It is far from a valid holistic analysis.

A modern analysis of the Boas anthropometric data, integrated with archaeological, linguistic, and ethnographic evidence, much of which comes from the Jesup expedition, reveals patterns of sporadic and recent gene flow between groups across the North Pacific independent of mother tongue. This multidisciplinary analysis gives results opposed to linguistically based "waves" that were cut off from Siberia after the submergence of Beringia.

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The Origin of Amerindians and the Jesup North Pacific Expedition

The character and origin of American Indians have been debated since the Magellan Expedition of 1519-21, when scholars realized that America truly was a "new" world separated from Asia (Huddleston 1967). Most early writings dealt with the nature of Indians and whether they could be christianized. As to the origin of American Indians, most writings of the next 200 years adhered closely to Christian theology, some claiming they were the lost tribes of Israel, Solomon's sailors, or descendants of the peoples of Atlantis, while others expressed notions of a second "Adam". But what happened in the New World during the flood?

The advanced civilizations of Peru and Mexico were explained in diffusionist and monogenic terms: Cultural relationships implied biological relationships. Many writers utilized ethnographic evidence such as circumcision, manner of dress and manners, and linguistic similarities with French, Spanish, Latin, and Greek to prove an Atlantic connection to the Old World (Huddleston 1967).

The first scholar to take an objective look at the origins of Amerindians, published in 1590, was Joseph de Acosta. He worked only on the assumption that the Indians must be descendants of Adam, and thus, have an Old World origin. He

reasoned that since the American natives did not have compasses or loadstones, they could not have navigated there on purpose. Accidental shipwrecks were also out of the question due to the variety of fauna in the New World. It was inconceivable that travellers would maintain wolves, foxes, and tigers on a long unexpected voyage. If there was a second "Adam", there also had to be a secondary genesis of the great variety of animals. He decided that a land connection, somewhere yet undiscovered, in the far north or far south, linked the old world with the new. A connection for animals, however small, would also serve for men (Acosta 1590, cited in Huddleston 1967).

Acosta also proposed that the early peoples of America came not as a migration, but as a long-term continuous flow of groups of primitive hunters driven by hunger, population pressure, or dispossession. The natives had later adopted agriculture and their own customs, abandoning most if not all of their former conventions. Therefore, the fashionable practice of comparing current aspects of culture to look for connections had no validity: Any similarities would be coincidental and shed no light on the origins of the Amerindians. Acosta did not produce a definitive answer to the origin question, but he did formulate the considerations any answer would have to take into account. Influenced by Acosta, Enrico Martin wrote in 1606 that the likely route to the New World traversed northeast Siberia and northwest America, but these regions were barely known. It would be another 200 speculative and confusing years until researchers undertook more "objective" studies

utilizing archaeological evidence, and still later for studies involving archaeology, ethnology, and anatomy (Huddleston 1967).

Though American anthropology was founded on the existence of the Amerindians, the theories of Amerindian origins in the 19th century suffered from inadequate evidence and immature sciences. By the late 1800's, strides made in geology and stratigraphy, and the introduction of evolutionary theory had produced convincing amounts of evidence for technological evolution (Wilmsen 1963). Appreciation of gradual change over long periods of time established trait lists and chronologies, but new methods were needed to explain cultural development and to compare contemporary cultures. Linguistics, ethnography, and physical anthropology came into use to evaluate the contemporary relationships of peoples, and thus, provide insight into their past relationships. In comparing technology, biology, and culture, however, anthropologists still thought in terms of diffusion. The Amerindians' apparent lack of close cultural, technological, and biological relatives led some to conclude that Amerindians were autochthonous to the New World, and others, like Brinton, that they migrated from Europe across a land bridge (Boas 1903; Brinton 1891).

In 1897, Boas began the Jesup North Pacific Expedition (JNPE), named after its financial patron, Morris Jesup, who was president of the American Museum of Natural History (AMNH) in New York. Boas designed the JNPE to be holistic:

archaeological, ethnographic (including recordings of songs, myths, and tales), linguistic, material culture, and biological data were to be collected. To assess the degree of independence from the Old World, and test Brinton's claims, it would make sense to compare cultures on either side of where the two continents are closest: The Bering Strait. For Boas, then, it was a foregone conclusion that the ancestral home of the American Indian was in Asia. The results were to be used to assess the relationships of the Americans, especially the Northwest Coast inhabitants, to the tribes of Asia (Figure 1).

The Northwest Coast was chosen, according to Boas, because Eskimo and Tlingit groups had already been studied (Boas 1903). Jesup and the American Museum also wanted impressive museum pieces, and there was great interest and demand for Northwest Coast art (Cole 1985). The American Museum already had extensive Eskimo and Tlingit collections. Also, the Northwest Coast area had been near and dear to Boas' heart since he borrowed $500 to travel there in 1886 (Cole 1985:147). Research and art collection would proceed simultaneously. Boas and five others collected data in British Columbia and Washington, and three researchers, Waldemar Jochelson, Waldemar Bogoras, and Berthold Laufer, covered northeast Siberia and the Amur region. For cultural information, they excavated sites to recover artifacts and skeletal remains, collected folk tales, grammars, recorded songs and stories, took thousands of photographs, and obtained objects of material culture

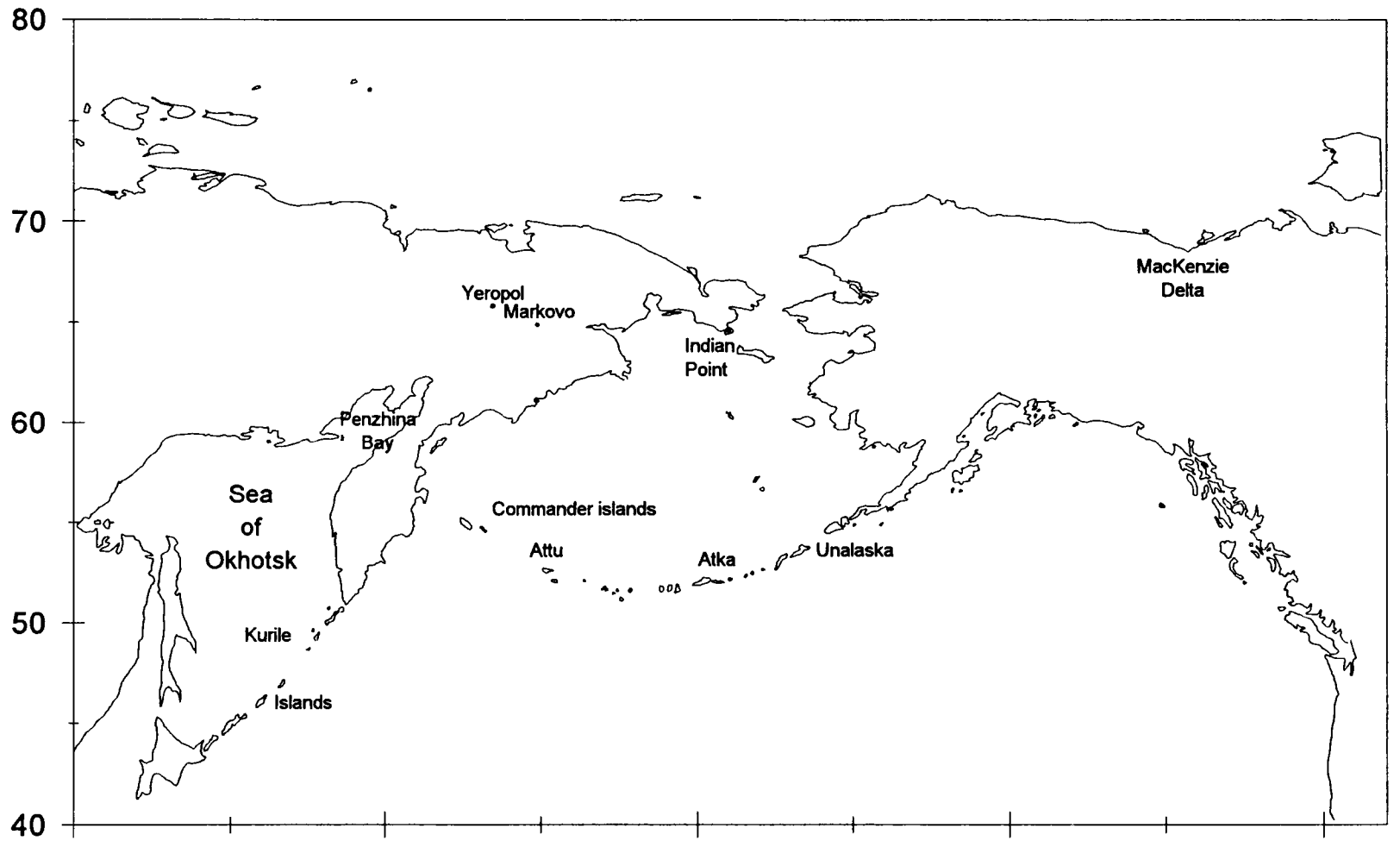

Figure 1: North Pacific Geography and JNPE data collection.

including masks, boats, and small huts. The cultural information gathered by the JNPE would reveal extensive shared culture traits between Northwest Coast and Siberian groups.

At the time of the Jesup expedition, organized physical anthropological research was virtually non-existent in Siberia. There had been sporadic anthropological expeditions since 1733, but the biological aspects were wanting. Several adventurers travelled around the country and reported general observations of one or two groups, and took notes of the physical appearance (anthroposcopics), such as body build, nose type, and beard growth (Levin 1963). These data were highly subjective, as were the ethnographic data. In a far-ranging expedition of 1843-44, A. F. Middendorf reported collecting extensive head and body measurements and portraits of types among many peoples, but nearly all of his data were lost (Levin 1963). The craniology of Siberian peoples received a great deal of attention, but studies were limited to very small samples of selected peoples, and approached from the anatomical point of view: Features and anomalies were noted, and "type" assigned, but few craniometrics were taken (Levin 1963). Siberia was not only ripe for a well-rounded research effort, but time was also running short: The new Trans-Siberian Railway was bringing European influences deeper and deeper into the hinterland (Cole 1985).

Likewise, the Northwest coast needed biological investigation. Boas had collected skulls and skeletons from there in previous years for the Field Museum, but very little biological data was available for the area. Even today, there are very few comparable biological data from both sides of the North Pacific.

Because of this, many archaeologists and ethnologists have merely picked the ethnic analysis that conformed to their hypothesis from the multitude of opinions (e.g. Harper and Laughlin 1982; Levin 1963 has many more examples). Soviet physical anthropological studies have merely defined physical types and categorized peoples into these types. Even the few anthropometric and craniometric studies have been devoted to categorizing peoples, and most of these were based on few measurements (Alekseev 1979). Due to the apparent lack of appropriate data, Alekseev (1979:67) wrote "it is impossible to determine whether the Chukchis are closer to the Buryats or the Evenks". There has been no thorough (multivariate) analysis of how Siberian groups are related to each other (cf. Howells 1973, 1989), nor to Amerindians apart from an unpublished work by Brennan and Howells, who utilized Hrdlicka's limited measurements.

Franz Boas, Statistics, and Anthropometrics

> "the anthropometric method is a most important means of elucidating the early history of mankind and the effect of social and geographical environment upon man"
>
> "every result obtained by the use of anthropometric methods should strengthen our confidence in the possibility of putting them to good use

for the advancement of anthropological science"

"Let us await further evidence before committing ourselves to theories that cannot be proven"

(Boas 1912a:562)

By his actions, Boas was clearly sincere about the first two quotes above. To assess biological relationships, anthropometrics and anthroposcopics were collected as part of the JNPE. He could not live up to his third quote, but he was not alone.

Morphological assessments were included in all expeditions Boas directed because he believed that the physical differences between populations illuminated their relationships in the present, which in turn reflected their origins and relationships in the past (Boas 1911, 1929). These differences were expressed "in exact terms" if they were recorded biometrically, not descriptively (Boas 1894a:313). Anthropometrics fit this criterion and probably reflect Boas' training as a physicist and a statistician: Boas had doubts about the applicability of Mendelian inheritance, based on isolated experiments, and preferred statistical analysis (Kroeber 1943). He also used metrics to cast doubt on the typologists' claims of racial trait immutability (Boas 1896, 1899, 1902a, 1916).

Boas was ahead of his time in believing that measurements had more inherent information than typologies and other nonquantifiable observations. According to him, anthropometrics were necessary because peoples living in close proximity tended

to resemble each other too much for mere descriptions. Noting these subtle distinctions increased the number of types and made them more arbitrary. Ignoring them left out important local variation. Depending on the number of types acknowledged, virtually any analysis could be made (Boas 1912a). Not only are categorical/typological data highly subject to interobserver error, they also limit the applicability of many statistical procedures and tests of significance.

Boas was also one of the first to see the potential of measurements in studies of human growth and population relationships, and one of the first to employ correlations in human data (Boas 1892, 1894a, 1894b, 1895b, 1897, 1899). He used many statistical procedures while they were still in their infancy, and had to compute them with pencil and paper as well. Little of the potential of the anthropometric data collected under his direction has been tapped. The few studies that Boas published were limited to a few tribes and a few measurements. Correlation, regression, and multivariate methods were either much more time consuming or non-existent. The limited statistical procedures and their tedious computation were undoubtedly barriers to a comprehensive analysis. It is not surprising, perhaps, that his JNPE work focused on the ethnographic data. Boas never summarized the physical data. There is no doubt that this influenced his subsequent Amerindian origin theories.

The Advantages of Anthropometrics

Research since Boas' time has affirmed the value of anthropometrics in estimating population relationships. Anthropometrics represent what most people can observe when looking for specific traits, but they have also been shown to be better, more "exact", as Boas (1894a) claimed. Friedlaender noted that the anthroposcopics he recorded on Bougainville did not differentiate the groups well because anthroposcopic variation was minimal. He also detected "observational 'drift'", his changing anthroposcopic criteria as the study proceeded (Friedlaender 1975:221).

Friedlaender studied the population of Bougainville using blood data, anthropometry, dermatoglyphics, and odontometrics. He found that of all these measures of biological distance, anthropometrics corresponded best to local language groups, even better than language to geography. The anthropometric analysis also detected recent intermarriage between groups that spoke different languages. Intermarrying groups showed a closer relationship to each other with more overlap than groups that did not intermarry. Based on these observations, he concluded that anthropometrics reflect genetic patterns, at least on Bougainville (Friedlaender 1975).

The value of anthropometrics has been clarified in other parts of the world as well. Williams-Blangero and Blangero (1989), who gathered data in Nepal, detected differential migration in the sexes by a higher Wright's F_{st} for women when analyzed by residence vs. birthplace. This pattern was confirmed ethnographically. Spielman

and Smouse (1976) showed that anthropometrics were better than blood markers at separating residents of different Yanamamo villages and evaluating the relations of villages to each other. Relethford *et al.* (1980) found that anthropometric relationships reflected geography and differential migration in Irish villages, and anthropometric relationships reflected geographical relationships on Hvar island, on the Adriatic (Rudan *et al.* 1986). Anthropometrics have proven valuable in animal studies as well. The Cheetah has been shown to be genetically depauperate, and craniometrics show significantly less variability than other large cats as well as higher levels of asymmetry, reflecting higher levels of homozygosity (O'Brien *et al.* 1983; Wayne *et al.* 1986).

There are clear advantages in using the Boas anthropometric data. Boas trained the researchers who trained others collecting data in the field. Since all measurers were trained in the same methods, interobserver error should be minimized (Jantz *et al.* 1992). Boas personally measured over 2000 of the Amerindians in the Boas Data base, and over 350 in this study. Alexander Axelrod, trained by Boas, measured the vast majority (over 1100) of the Siberians, and worked closely with the other measurers in Siberia. Sex, age, and ethnic identity were recorded, as was place of birth, residence, and pedigrees. The majority of groups in the Boas data were measured around the turn of the century, at most 10 years apart, eliminating the effects of secular trend, admixture, and subsistence change. All three were factors of forced collectivization in Siberia and produced dramatic changes in the Evenki and

other Siberian groups, as Comuzzie *et al.* (1993) discovered. While modern blood samples are often collected from "pure" or "admixed" individuals, blood quantum was recorded down to 1/32 on Boas' data sheets.

Thus, the Boas data seems ideal for comparison to New World migration theories utilizing other methods, as well as forming the basis for new interpretations. This thesis, then, will be a test of the application of anthropometrics to anthropological and historical problems in the North Pacific, yet must also be seen as an addition to an extremely small data base of valuable biological data in the North Pacific.

Chapter 2

Amerindian Biological Data and Theories

Data, Analysis, and Theories from the JNPE

Boas began formulating an origin for Amerindians with a minimalist view like Acosta. He reasoned that Amerindians had been in the New World a long time by the presence of a great many physical types. These types must have evolved in relative isolation, and linked to them, distinct cultures: Boas could not disassociate race and culture. "These [evolutionary] changes imply mixture of blood as well as exchange of cultural achievement." (Boas 1903:74; emphasis added). However, in the introduction to *The Handbook of American Indian Languages* he wrote that one cannot expect agreement of population relationships using linguistic, physical, and cultural data (Boas 1911). Boas had seen first hand that language did not distinguish cultures or types on the Northwest Coast. Struck by the heterogeneity there, he discerned at least three distinct types in the area: A northern type, including the Haida and Tsimshian; a Kwakiutl type, made up of the Bella Coola and the Kwakiutl; and a Thompson River type, which included the Thompson and Lillooet tribes (Boas 1899b). The poor correlation of biological and cultural attributes was due to differential cultural, linguistic, and physical histories which obscured the origins and interactions of the groups at hand. He wrote:

> "If we ... eliminate the hypothetical assumption of correlation between primitive type, primitive language, and primitive culture, we recognize that any attempt at classification which includes more than one of these traits can not be consistent." (Boas 1911:10)

Boas pointed out that disagreement between these measures come about because physical types can persist with changes in language and culture, language can remain unchanged while physical type changes, language and type can change, or type and language can remain while culture changes. For Boas, though, all three were correlated in the Pacific Coast of America and Siberia (Boas 1910). He assumed that cultural changes or persistence could only come from invention and contacts with *neighboring* peoples (Boas 1911:10). This was a crucial error that led to the "Americanoid" theory.

The JNPE established a foundation for cultural comparisons in the north Pacific. Using this data base, researchers have shown that there were extensive similarities in folklore, religious ceremonies, tradition, myths, and decorative motifs (Fitzhugh and Crowell 1988). Animism, shamanism, subterranean dwellings, and body armor were widespread on both sides of the North Pacific. Further, there were many parallels between "Shang, Chou, Old Bering Sea Ipiutak, and ethnographic Amur River and Northwest Coast culture art", and "semihuman beastly faces" as an art motif linked peoples from the Pacific Islands and China through Siberia, to the Northwest Coast groups and Mesoamerica (Fitzhugh 1988:311,312).

But the similarities went further and deeper than material culture and art. Jochelson (1908) compared Koryak myths with Eskimo and Amerindian myths, and found more episodes in common between the Koryak and Amerindians. More significantly, he found that out of 122 myths episodes, 73 were shared with the Tlingit and other northern Northwest Coast Amerindians, 65 occurred in southern British Columbia tribes, 35 in Athapascan tribes, 27 in Washington coast tribes, 12 in Eskimos, and 10 in Algonkian. There was a diffusional cline bypassing the Eskimo. Jochelson concluded that either the closest tribes had a common origin, or that the myths had a common origin and were borrowed. He could not decide between the two because the anthropometric data had not been analyzed (and would not be until now). In either case, groups from Siberia and the Northwest Coast had been in close contact at some time:

> "the folk-lore which has been investigated justifies us in saying that the Koryak of Asia and the North American Indians, though at present separated from each other by an enormous stretch of sea, had at a more or less remote period a continuous and close intercourse, and exchange of ideas." (Jochelson 1908:360)

Boas was convinced more than ever of the external relationships of the Amerindians after the JNPE. He saw strong ties between both sides of Bering Strait:

> "Comparisons of [physical] type, language and culture make it at once evident that the Northeast Siberian people are much more closely akin to the Americans than to other Asiatics" (1905:99)

Boas proposed that Asians first migrated across a land bridge to America and were cut off by glaciers for a time, allowing differentiation of the distinctive American types. Later, when the glaciers retreated, the land bridge was opened up again and Americans flowed back into Asia until they met Mongoloids migrating from the south and west (Boas 1903; 1905; 1912b). The peoples on either side of the Pacific were then separated at the Bering Strait by an "Eskimo wedge", by a people culturally and morphologically distinct who originated in Central Canada (Boas 1910).

Boas interpreted the extensive ethnographic similarities the only way he could: The peoples had a common origin. After all, the Northwest Coast and Siberian groups **are** very far apart geographically, separated by the dissimilar Eskimo (preventing diffusion), and the cultural similarities **are** too great to be parallel inventions. The ethnographic evidence was so overwhelming that it was inconceivable for Boas to envision any other explanation, so he accepted physical similarity based on second hand reports. Amerindians had to have evolved in the New World over a long time because they were so heterogeneous. The Eastern Siberians, different from typical "Mongoloids", represented a small part of American heterogeneity, that on the Northwest Coast. A back migration from East to West across the North Pacific was the logical result of all of Boas' assumptions (Boas 1929).

Jochelson, convinced by Boas, was the first to call these returning migrants "Americanoids". A reverse migration was not without some supporting evidence in the form of faunal migrations from the New World to the Old (Jochelson 1926a). Many researchers began publishing culture traits that Amerindians and Siberian groups had in common.

The Americanoid theory was one of the few times in Boas' career that he engaged in theorizing without a consideration of all available evidence. Boas based most of his conclusions on the ethnographic data, with which he was very familiar. He never analyzed the Siberian anthropometrics that he made sure were collected, but deferred to the typologies and general observations that had impressed him so much. Boas produced no statistical summaries or tables of the JNPE anthropometric data (though at some time, someone calculated Siberian summary statistics recently discovered at the AMNH). The long anticipated volume on physical anthropology that would further tie all research together was never started. Boas never even published a summary of Siberian and Aleutian data by Dina Jochelson. The reaction of Boas and others parallels earlier ideas of trans-Atlantic contact in relying on diffusionist explanations based on similar traits. This trend would continue in myriad ways up to the present. The Americanoid theory died long before Boas, though not due to better theories based on sound data and analysis.

Data and Theories since Boas

Data from archaeology, linguistics, and ethnography, as well as nationalism and international relations have influenced biological interpretations in the North Pacific. The origin of the Eskimo was in Siberia for most Russian scholars, and in Arctic North America for North American scholars, since each had access to their own specimens and data. Levin (1963) credits Debets for noting that the Koryak, Siberian Eskimo, and Chukchi were described by Soviets, who compared them to more typical "Mongoloids" like the Evenks and Yakuts, while the American Eskimos were described by Americans used to looking at Amerindians. Thus, the Eskimo would seem to have more "Mongoloid" features than Amerindians. This unfortunate tradition continues today (Spuhler 1979; Laughlin and Harper 1988).

The Aleutians: Cul-de-sac or Thoroughfare?

Much of the American literature has concentrated on the relationship between Aleuts and Eskimos on the one hand and Amerinds on the other. This is not only because of their perceived differences, but also because these areas have been accessible to American scholars throughout the cold war. Biological research has been hampered by treating Eskimo and Aleuts as a single group due to linguistic connections, and treating a sample of Aleuts as representing **all** Aleuts from **all** islands. Few have used Siberian data. As a result, most American scholars have viewed the Aleutian Islands as "a cul-de-sac where the ancestors or precursors of the modern Aleuts developed their technology in isolation from other peoples" (Black

1983:49).

William Laughlin represents this viewpoint the best. Earlier, he acknowledged signs of admixture in the eastern Aleuts based on blood data comparisons from modern Aleuts from various islands, Aleutian mummies, Eskimos, and Amerindians. Laughlin also noted differences in cranial morphology and allowed for cultural input from Asia, and he accepted Hrdlicka's separation of "pre-Aleuts" and "Aleuts", but changed the labels to "paleo-Aleuts" and "neo-Aleuts" to stress their perceived continuity (Laughlin 1951). Bank (1953) viewed the two Aleut physical types as evidence for possible admixture in the eastern Aleutians from mainland Alaska groups. Bank also reported finds from a stratigraphically excavated site, Amaknak, that were possibly "quite old" based on the artifact types of Laughlin. However, the crania were broad, unlike Hrdlicka's pre-Aleuts. Either the artifact seriations were incorrect, Hrdlicka dated the skulls incorrectly, or there was too much variation in either or both to date the finds. Considering his better excavation techniques, Bank cautiously concluded that there was apparently a good deal of diversity in the Aleutians, and in any case, due to the scarcity of sites that had been excavated stratigraphically, researchers should proceed with caution:

> "Forthcoming reports of archaeological work may clarify the picture of Aleutian prehistory, but these reports will be most useful if workers avoid semantic juggling and too hasty conclusions in favor of a new examination of data site by site." (Bank 1953:49)

Laughlin's later work at the Anangula and Chaluka sites changed his earlier view. Laughlin now believes the "Aleuts, Survivors of the Bering Land Bridge" (Laughlin 1980), evolved *in situ* with no significant outside influences (Laughlin 1963, 1975; Laughlin and Harper 1988). Of course, Amerindians are also survivors of the Bering Land bridge.

Laughlin (1963,1979) used archaeological, linguistic, osteological, and blood data, as well as negative evidence to make his case. He again emphasized the similarity of Aleuts to Eskimos as earlier, but claimed that the Aleut and Eskimo became differentiated in southern Alaska. He believes that the Anangula site (circa 8500 years B.P.) shows a unique core and blade industry, closer to Japanese and Siberian finds from 9000-13000 years B.P. than finds from the Denbigh complex in Norton Sound. He also believes the Anangula site is unique to other Alaskan sites attributed to Eskimo. For Laughlin, the age of Anangula, its uniqueness, and because it represents populations ancestral to modern Aleuts, the split between Eskimo and Aleut occurred around 9000 years B.P. (Harper 1980; Laughlin 1979; Laughlin and Harper 1988). The Anangula tradition shows continuity with the Aleutian tradition (2500 years B.P.), according to Laughlin, who also thinks the occupation at Chaluka was continuous over 4000 years with little or no changes in artifacts. He admits that bifacial tools became common and harpoon heads show considerable variation, but claims that there were no adaptive advantages to the harpoon types.

Laughlin also reinterpreted the physical data he used previously. He sees evolution in a cline of the cranial index from Greenland, with the most dolichocephalic skulls, through the Aleutians with the most brachycephalic. He still maintains that early Aleuts were more dolichocephalic, the later Aleuts brachycephalic and low headed, with a preservation of the earlier eastern inhabitants of the Aleutians in the western Aleutians because of their dolichocephaly. Citing dental and his own anthropometric studies, Laughlin sees continuity between the latest Chaluka finds and modern Aleuts (Laughlin 1963,1979).

On the whole, Laughlin sees Aleuts and Eskimo more similar to each other and Asians than to Amerindians. According to Laughlin, the Aleuts are linguistically allied with the Eskimo, and their relationship to the Chukchi, Koryak, and Kamchadal is next closest (Laughlin 1979). He envisions a Beringia filled with "contiguous isolates" who may have exchanged genes and traits, but the center was in southern Alaska (Laughlin 1963:644). As Beringia submerged, the peoples gradually separated and no major migrations occurred after the Bering Strait was formed, as seen in site continuity.

Given the linguistic similarities between Eskimo and Aleut, if Eskimos and Aleuts ***are*** biologically closer to each other than to Amerindians or Siberians, **and** their closeness is not due to recent gene flow (implying *in situ* evolution), **and** if the Anangula site is ancestral Aleut **and** differentiated from all other (ostensibly Eskimo)

Alaskan sites, there would be a good case for their North American differentiation. But there are problems with each of these necessary conditions, as well as the linguistic assumption.

The cranial morphology of the Aleuts (and changes over time, whether real or helped by Hrdlicka's morphological dating), highlight the differences with Eskimos even using the cranial index (see below). Eastern Aleuts are more brachycephalic, as are southwest Alaska Eskimos and Amerindians, than most other Eskimo groups. Basing population relationships on two or three measurements is untenable, however. Thorough cranial analyses reveal a closer affinity of Aleuts to Athapaskans (see below).

Ethnographic data point to both ancient and recent trans-Pacific cultural connections involving the Aleutians. The distinctive Aleut subterranean house with the entrance in the center of the roof are nearly identical in design to houses of the Kamchadal on Kamchatka (Gurvich 1988). Black (1983) points out that Soviet scholars including Vasilievski, Arutiunov, Sergeev, and Dikov see western (Kamchatka, Kuriles, sea of Okhotsk coast, Chukotka, Amur) and eastern (Alaskan, Northwest Coast) cultural flow into the Aleutian chain using mainly ethnohistorical and ethnographic data. This school of thought sees cultural influences radiating from NE Asia as well as China and Japan. They believe that there were extensive contacts between Aleutians and the Asian peoples at various times, similar to the minority

opinion held by Americans de Laguna and Collins. Most American archaeologists agree that there was significant post-Anangula Aleutian contact with Alaska, but not with Asia, despite ethnographic evidence (Black 1983).

Some diffusions and gene flow did not have to be intentional, either. Ocean currents bring ships from Japan and China into the Aleutian areas and Northwest Coast areas. Between 1782 and 1833 there were six recorded Japanese junks that reached the eastern Aleutians and the northern and southern Northwest Coast with goods and survivors (Quimby 1985). Based on these records, Quimby calculates that there could have easily been almost 200 wrecked junks in North America from the time of their invention to 1750. Japanese slaves were found among Amerindians on the Northwest Coast at time of contact (Jett 1983). There are other curious details in the Aleutians. Korean amber was found in an eastern Aleut burial. The Aleut term for iron is different from the Eskimo term , and is related to an archaic Chinese term (Naert 1962, cited in Black 1983). The term for copper, however, is the same as in Eskimo (Black 1983).

Laughlin's archaeological data has been enhanced by the paucity of Aleutian archaeological finds and the resultant abundance of negative evidence. Until 1938, when he and Laughlin could find no archaeological sites on the Commander islands, Hrdlicka believed that eastward migrations from Kamchatka into the Aleutians were possible (Harper and Laughlin 1982). More recent finds, however, suggest at least

periodic occupation (Dikov 1977,1979, cited in Black 1983). Soviet Archaeologists have not supported Laughlin's connection of Anangula site artifacts to finds in Siberia unless they were indirectly transmitted through earlier interior cultures. Also, the Anangula-Aleutian tradition continuity has not been accepted by many archaeologists (Black 1983; McCartney 1984).

More importantly, the Anangula site does not represent a unique complex as Laughlin maintained (McCartney 1984). Ackerman (1992, citing Ackerman 1985a, 1985b, 1987) has discovered that this complex, with a mix of micro- and macroblades, was present in many southwestern Alaska sites and a few north Alaskan sites, both with and without bifaces. This complex is an intermediate between the Nenana/Denali complex and the Northern Archaic tradition (between 9/8000 and 6000 B.P.), and is derived from the Sumnagin culture in Yakutia (10,600-6200 B.P.), which followed the Diuktai culture. So instead of signifying a unique cultural complex with ultimate origins in Asia, Anangula represents one of many sites indicating technological if not population movements from Asia around 9000 B.P. This movement was technologically independent of interior Alaskan groups, and populations may have already been present on the coast (perhaps already maritime oriented, but these sites would be submerged), having migrated from the interior (Ackerman 1992a).

There is also archaeological evidence that the Aleutians were not isolated in later prehistory. According to Ackerman (1992), two sites near Juneau, Ground Hog Bay (9200 years B.P.) and the Hidden Falls site (9500 years B.P.), predate the Anangula Blade site. Particulars of these radiocarbon dates were not provided, however. These sites could only be reached by boat, have abundant mollusks and fish, and are cut off from larger land areas by mountains, suggesting a maritime adaptation, though acidic soils have not preserved faunal remains. These sites show a link to earlier Alaskan cultures derived from the Diuktai culture (35,000-10,500 years B.P.) in Siberia. The earliest subsistence evidence from southeastern Alaska comes from the Alexander Archipelago at the Chuck Lake site (8200 years B.P.). Mollusks and bottom fish were the most numerous fauna, and Salmon and mammals were rare. The microblade cores are typical of a localized northern Northwest Coast type. Thus, the area across the southern Alaska coast (Anangula, Ground Hog Bay, and Chuck Lake) showed distinctive culture areas at 9000-8000 years B.P. In the late prehistoric period, however, ground tool industries appeared at Anangula and became prominent on the Northwest coast and in the Alexander Archipelago almost simultaneously. When coupled with the ethnographic similarities noted by de Laguna (1947), Ackerman concludes that there was "a pattern of widespread communication possibly prompted by trade across a cultural continuum that extended from the Aleutians to the Northwest Coast" (Ackerman 1992:23)

Laughlin maintains that the harpoon type differences over time at Anangula were merely stylistic, changing faster than the environment, and claimed that it made no difference to the hunter or hunted what type of harpoon was used (Laughlin 1963). However, zooarchaeological remains indicate a probable increasing role of fish in their subsistence over time, according to his table 1 (Laughlin 1963:639). The percentage of fish bones (NISP) excavated rose from 13% of all bones from level III to 44% from the more recent level I; pinnipeds shrank from 40% to 20%; and sea otter (the distinctive Aleutian catch) decreased from 25% to 7%. Barring intense taphonomic effects, there is evidence of subsistence change at Anangula.

The linguistic ties between Eskimo and Aleut, while indicating a common origin, have masked important differences. Linguists maintain that Eskimo and Aleut split from proto-Eskimo-Aleut between 3000 and 6000 B.P (Dumond 1987; Krauss 1988; Woodbury 1984). Recently, Leer (1991) uncovered unique core grammatical elements in Aleut that were borrowed from northern Northwest Coast languages, suggesting that there were intense contacts between Aleuts and peoples on the northern Northwest Coast.

A syntactic phenomenon, promiscuous number marking (PNM), is unique to Haida, Eyak, and Aleut, and weakly expressed in Tlingit. Within this group, a particular kind of PNM, clause-promiscuous number marking, is found only in Haida, Eyak and Aleut. These features tie Aleut closest to Haida and Eyak, with Tlingit and

Athapascan more distant. Pacific Gulf Yupik is an outlier, because it doesn't share these traits with Aleut and northern Northwest Coast groups. Aleut, Eyak, Tlingit, and proto-Athapascan also lack labial obstruents (stops/consonants), and the Haida have few. They are common in Tlingit and most other Northwest Coast tribes. Further, confirming the evolutionary relationship, the distinctive Aleut anaphoric system is the result of superimposing PNM on a Uralic type anaphoric system (like Eskimo). There have also been suggestions of Aleut contact with people who spoke Altaic languages (Black 1983).

Asian languages, northern Northwest Coast languages, Eskimo, and Athapascan show head-final syntax (XSOV) and have a well defined focus position at the beginning of the sentence. In contrast, the vast majority of Northwest Coast languages to the south are verb-initial (VSO) languages (Wakashan, Salishan, Tsimshian, Quilleute, and Coastal Penutian). Thus, XSOV ties Asian languages and northern Northwest Coast languages together, in contrast to the more southern VSO languages (Leer 1991).

Word borrowing has been used as evidence for or against linguistic contact (Laughlin and Harper 1988). However, Aleuts did not loan or borrow words with other northern Northwest Coast tribes. Eskimo and Aleut did not share or borrow many words from NaDene. Ingalik Athapascan culture and phonology was heavily influenced by Central Yupik, but there are few aboriginal borrowings. Due to the

great distance between the Aleutians and the northern Northwest Coast, a more similar language was probably spoken on Kodiak island, meaning the Eskimo speakers there are relative latecomers to the area. In any event, there were probably other transitional languages between Aleut and Eyak. Leer's conclusion is that all of these languages were in constant contact, but fragmented by repositioning, intrusion, and extinction. Dumond (1987) recently wrote that the history of the Aleutians and much of western and southern Alaska are best explained by allowing language "capture", based on archaeological and physical data.

If Eskimo-Aleut differences have been ignored, Aleut heterogeneity has been as well. Laughlin and others have ignored Aleut differences which extend far beyond the cranial index. Many researchers have proceeded on the assumption that **an** Aleut sample is **the** Aleut sample, or pool samples from different islands even if the sample size of each is sufficient: "all Aleut teeth originated from the same region with its single Aleut culture" (Turner 1985:59; Turner 1983; Greenberg *et al.* 1986). There are significant differences in material culture and dialect between various Aleutian islands, especially on Kagamil (Black 1983). Until the Russian occupation, there were seven different endogamous "tribes" of Aleuts with their own dialects, traditions, and name for themselves. These tribes were at constant war with each other and Eskimos until the Russian occupation and subsequent population decimation. Most Aleuts dislike Eskimos to this day (Robert-Lamblin 1979). Under the Russians, the tribes relaxed their endogamy and began intermarrying with each other. The

differences between east and west Aleuts have persisted, though. Song duels are used to settle complaints in the middle of the Aleutians, while eastern Aleuts have a judicial system. Also, the eastern groups have a decimal system of numeration, unlike the western islands (Black 1983).

Faced with probable subsistence, possible morphological and artifact changes, cultural diffusions from Asia, probable northern Northwest Coast communication and trade networks, differentiation within Aleuts and between Aleuts and Eskimos, and grammatical borrowings from Amerindians indicating intensive contacts, it is hard to defend *in situ* evolution of the Aleuts.

Much of the ethnographic data is difficult to deal with because there are no statistical methods to segregate direct contacts, parallelisms, and convergences. Convergences, parallels, and borrowings can plague linguistic analyses as well (Diamond 1988). Opinions and assertions are often the best one can hope for, even after many more sites are excavated. The cultural similarities between Asian, Aleutian, Eskimo, and some Amerindian tribes should be acknowledged, even if some are convergences. Early on, however, fluted points set Amerindians apart from all other Old World lithic traditions. So where did Amerindians come from, and out of which people? The more plentiful biological data was supposed to provide clues.

Biological Data

With mounting evidence for early occupations in the New World, there was once more a growth in data collection and theories explaining where and how the immigrants came to America. Technology played a role in radiocarbon dating, electrophoresis, and gene sequencing techniques. Nonmetric traits, blood genetics, and mtDNA were added to traditional cranioscopic and craniometric analyses. With them came more statistical analyses, though in most instances, more incorrect applications and interpretations as well.

Birdsell (1951) saw Amerinds as a hybrid population, arising from Mongoloid and "archaic caucasoid" elements in Asia from the Amur region. The Ainu and Murrayans represented the Old World descendants of the "Amurians", while the Pomo, Yuki, and Coahilla were the New World descendants. Birdsell's theories and other possible homelands for Amerindians could not be tested, though. Due to the lack of reliable data, especially from Soviet Asia, American scholars had to explain both internal and external Amerindian relationships based almost entirely on American data, often in a typological framework, using sporadic Russian anecdotal information. The resultant observed heterogeneity within Amerindians when compared to "Eskaleuts" led to notions of "waves" of migrations into the New World.

Neumann (1952) utilized a few craniometrics, many cranial observations, and nonrandom sampling to discern eight aboriginal physical types representing waves

which explained Amerindian variation. He noted the unique cranial morphology of the "Inuid" variety, the Eskimo, who were set apart from all Amerindians and Aleuts. He saw the Eskimos representing a late radiation because of their wide distribution and continuous occupation based on archaeological evidence. He believed that Inuids were originally derived from northern Otamid (Paleoindian) varieties. Thus, Eskimos originated in Canada, but showed affinities to Asians because of gene flow.

Neumann viewed Aleuts as members of his "Deneid" type who adopted an Eskimoan language and lifeways. His Deneid also included Northwest Coast peoples, and in his wave models proto-Aleuts were Amerindians. He proposed a late Deneid wave that explains the cultural similarity between NW coast and Siberia. The Deneid migrated into the Alaskan peninsula, one group expanding in the Aleutians, the other continuing onward into southern British Columbia. The Denieds were later separated by the expanding South Alaskan Eskimos, and the groups in the Aleutians differentiated into Aleuts while the other formed the Northwest Coast groups. This explained the close relationship between Northwest Coast, Aleut, and Koniag Eskimo. He also saw possible gene flow from Tungus and/or Deneid to the Alaskan Eskimos, who also showed affinities to Athapaskans.

As for Soviet typologists, Levin, citing evidence from Debets and others, believed that there was a Bering Sea physical type including Eskimo and Chukchi, and that the "Kamchatka" types, the Eskimo, Chukchi, Kamchadal, and Koryak, are

closely related, being morphologically dissimilar to Amerindians, Aleuts, and southern Asian Mongoloids from Japan, Korea, and China (Levin 1963). This stands in contrast to perceived "Mongoloid" features in Eskimos by American researchers (cf. Szathmary and Ossenberg 1978).

Craniometrics have the potential for answering questions of Amerind origins and relationships across the Bering Strait. Unfortunately, there are not many well preserved crania of Paleoindians, and the collections of Siberian crania in various Russian museums have apparently not been measured thoroughly since Hrdlicka collected measurements (Hrdlicka 1942, 1944). Craniometric analyses have primarily been conducted with data within each continent, and both American and Soviet studies have lacked adequate sample sizes, statistical rigor, or both (Levin 1963; Steele and Powell 1992). There have been successful areal studies of craniometric variation (Heathcote 1986; Jantz 1973; Key 1983; Ubelaker and Jantz 1979; Utermohle and Merbs 1979), which revealed protohistorical relationships, but these have not encouraged others to assess wider North American relationships outside of recent efforts by Steele and Powell (1992) and Brennan and Howells (n.d.) using a limited number of measurements.

Brennan and Howells worked with Hrdlicka's published measurements and were able to assemble a data base of 9 measurements from 80 male groups stretching from Florida to Central Siberia. The relevant major clusters produced by the analysis

were:

I: Plains Indians (Sioux, Cheyenne, Arikara), Pre-Aleuts, Ostiaks, Buriats, Gilyak, Ulchi, Tungus, Yukaghir, and some other Amerindian samples.

II: Apache, Navaho, Northwest Coast "Indians", Aleuts, Koniags, and Kodiak Island (corresponding to Neumann's Deneid type).

III: The most divergent group, though heterogeneous, composed of northeastern Alaska, north Alaskan, Siberian, Greenland, and Baffin Island Eskimo, pre-Koniags, and Chukchi (Neumann's Inuid type).

These results, based on less than ideal measurements, show a fundamental separation of Pre-Aleuts, Aleuts, and Eskimos. Aleuts clustered with Northwest Coast groups, rather than their linguistic relatives. Other smaller scale craniometric studies in Alaska have produced similar results.

Zegura (1978) analyzed Eskimo and Aleut craniometrics. The male Aleut sample from Kagamil island was well separated from all Eskimo samples, while female Aleuts clustered loosely with Sugpiak speakers on Kodiak and Chirikov island who were distant from all Yupik speakers from south and west Alaska. The three outlier groups were on the whole quite distant from each other as well as being

differentiated from other Eskimo groups.

A similar finding was expressed in Utermohle and Merbs (1979). Using seven measurements and Penrose shape distances, they analyzed 21 samples of Eskimo crania from Siberia to Greenland from different time periods, two Chukchi groups, and both old and recent Aleuts. Hrdlicka might have done an excellent job of separating two "types" of Aleuts, for the Eskimo showed regional clusters well separated from recent Aleuts and Koniag Eskimo, and the "older" Aleut were closer to Siberian groups.

Heathcote (1986) collected craniometric data from Eskimos, Aleuts, and two Amerindian groups. In a canonical discriminant analysis, he correctly allocated 228 of the 231 skulls into the 9 groups, and all of his distances were significantly different from zero at $p < .003$. The two craniometrically closest groups were an Athapascan sample from the lower Yukon river and a Lower Kuskokwim Eskimo group, which are also closest geographically. As in Zegura's study, the Kagamil Aleut sample was closest to the Kodiak Eskimo; they were also closer to the Athapascan sample than to most other Eskimo groups. The Athapascan sample, from the middle Yukon river, was much closer to Yuit Eskimo samples especially, and was close to all Eskimo and Aleut samples than to an Iroquois sample.

Craniometrically, Aleuts have been shown to be distinct from all Eskimo groups but the Kodiak, and to show greater affinity to Amerindian groups from the Alaskan mainland. Multivariate analyses utilizing more samples, especially Aleut samples from different islands, are desperately needed. The craniometric studies in Alaska have provided much needed information to assess population relationships. Unfortunately, there have been no efforts to systematically collect and analyze Amerindian craniometric data as Howells (1973, 1989) did for the world. In contrast to craniometric studies, there has been no shortage of large-scale Amerindian blood analyses, largely due to the early publications of Emoke Szathmary.

Szathmary and Ossenberg (1978), using both blood genetics and discrete cranial traits, were the first to explicitly examine the Eskimo-Aleut-Indian relationship with new data. Their data and conclusions stand in opposition to the many claims of Eskimo-Aleut biological similarity. The blood marker results showed that North American Eskimos are closer biologically to Amerindians than to Asian groups including Siberian Eskimos. The Aleuts were allied with the Siberian Eskimo and Chukchi, but most of the Aleut sample came from the Commander islands, settled by diverse groups including Aleuts from various islands, Eskimos, Russians, and Gypsies transported by Russia in the 19th century (Antropova 1964c). Unfortunately, the only Siberian populations with genetic information were the Chukchi and Siberian Eskimo. It may not have mattered if there had been more. Very few of Szathmary's distances were significantly different from zero at the .05 level of significance. They

interpreted this insignificance positively, stating that "There is, then, no statistical validity to the claim that Eskimos are closer to classic Mongoloids than are American Indians", (1978:674), and further, "the clustering of Eskimos and Na-Dene speakers must indicate either that they are offshoots of the same ancestral population or that extensive and ancient gene flow produced convergence between them prior to their dispersal" (1978:683) However, with so many insignificant distances, the distances themselves and the dendrograms are unreliable. There are not enough significant differences between populations.

Ossenberg's nonmetric distance matrix and dendrogram, however, show a greater separation of Eskimos from the Amerindians and Aleuts. While the nonmetric Aleutian sample is more representative than Szathmary's Aleut sample from the Commander islands, Ossenberg did not have access to any Siberian populations. Her pooled Aleutian samples, including Paleo-Aleut from Chaluka, showed greater affinity to NaDene groups and greater distance to Eskimo groups. She hinted at the possibility of an inundation of the Aleuts by Northwest Coast Amerindians leading to their similarity. This clearly contradicts Laughlin's ideas of isolated Aleutian evolution. All of Ossenberg's distances are significantly different from zero. However, distance statistics used by Ossenberg (Smith's Measure of Divergence (MD) and Mean Measure of Divergence (MMD) for nonmetric data) have been shown to be "conceptually and statistically flawed", producing unreliable results because the statistical model does not reflect the biological model (Blangero and Williams-

Blangero 1991:51, 1993). Additionally, nonmetric studies and the MD statistic assume no covariance between traits, when in fact, there are significant genetic correlations between nonmetric traits, even when there are low phenotypic correlations (Cheverud and Buikstra 1981; Corrucini 1974). There are also indications of sex and age differences in a variety of populations (Corrucini 1974; Zegura 1975), and the scoring of bilateral traits can also be problematic (Szathmary and Ossenberg 1978). Ossenberg maintains, however, that the early studies tested too many cranial nonmetrics, including meaningless, correlated, or functionally based traits. She prefers a small number of highly informative traits (personal communication, N. Ossenberg). But how can traits be judged as to whether they are informative?

Recently, Ossenberg conducted a more extensive analysis of Eskimo, Aleut, and Indian groups (Ossenberg 1992). Her methodology was admirable and all too rare in New World origins research: Her data would stand on its own. Since her data were from archaeological materials, she determined groups by where the skulls were found, rather than assigning languages and larger geographic units, and let the chips fall where they would. As before, she found a clean separation of Eskimos and Aleuts, with the Aleuts very close to Northwest Amerindian groups. Her results, though derived from the MMD, are thought provoking. With samples from 6 Aleutian islands, she found a cline of Aleut affinities to her northern Athapascan sample and an overall closeness of Aleuts with Tlingit and Haida samples. She

interpreted the data as evidence for a very different prehistory of the North Pacific. Instead of favoring recent admixture, she now sees the Aleut-Northwest Coast closeness as evidence of a common origin. She envisions an early (9000 years B.P.) wave ancestral to the Aleuts, NaDene, and other northwest Amerindians, and a later wave which gave rise to the Eskimo. A nagging problem is the origin of linguistic affinity between Aleuts and Eskimos. She concludes that more recent population expansions and admixture have probably obscured genetic attempts at deriving ancient population migrations, and that skeletal samples have a tremendous untapped potential. Blood studies have dominated since Szathmary and Ossenberg (1978), however.

Szathmary (1979b) incorporated data from several Asian populations to try to test three theories of Eskimo origins, the Eskimo wedge theory of Boas, Levin's theory of Siberian-Eskimo affinities, and the "Dorset hypothesis", the idea that Eskimos originated from or received extensive gene flow from subarctic Amerindian groups. Once again, however, there were no significant distances between many groups, not even between Ainu and Negroid. Szathmary opined that Eskimo and Indian origins and affinities probably cannot be solved using blood markers. Still, once again, Eskimo-Indian distances were small, if unreliable, especially between the Western Alaskan Eskimo and NaDene groups.

In a later study using more Asian groups and 14 loci, which Szathmary still considers inadequate, her data show once again Athapaskan and Eskimo affinity, and a separation of southern Siberian groups (Nentsy, "Mongoloids", and Ainu) from the Chukchi and Siberian Eskimos (Szathmary 1981). She interpreted the relative closeness of Chukchi, Eskimo and Athapaskan as evidence for a common origin or recent gene flow between populations. It seems that the latter was a possibility, for some of the Athapaskans in her sample were close both genetically and geographically to the North Alaskan and Central arctic Eskimos. Any recent gene flow, of course, would obscure similarities and differences present before.

Szathmary (1979a) also looked at the Indian-Eskimo relationship in greater detail using published anthropometric, craniometric, and blood data. She noted the problems of combining anthropometric data as much as 80 years apart and from different measurers. These problems along with demonstrated secular changes in face measurements convinced her that an analysis would not be reliable. However, she analyzed the cephalometric data using Penrose shape and found curious results: Aleuts were much closer to Athapaskans, Labrador Amerindians, and Eskimos from St. Lawrence Island and Southwest Alaska than they were to other Eskimos. Szathmary wrote that no shape distances were significant from zero at a .05 level of significance, making the matrix and resultant dendrogram unreliable. However, nearly all are indeed significant on reanalysis, because Szathmary had applied an incorrect statistic to test the distances (R.L. Jantz, personal communication). Using Penrose's (1953)

approximation of the Mahalanobis distance and the significance test for distance from Zegura (1974), all Aleut distances are significantly different from zero. The Beaver distances to the Kuskokwim, Southwest Alaska, St. Lawrence Island, and Carrier samples are not, due to a small Beaver sample size and small distances. The distances and dendrogram are reliable, then, with one caveat: The Aleut sample was measured much later than the other samples. When Aleut data collected by the Jochelsons in 1910 was plugged into the formula for estimating Penrose distances, the former closeness of Aleut and Labrador Indians disappeared, and the Aleut showed strongest affinities as before to Southwest Alaskan Eskimo samples and Athapaskans. The blood data, using 25 loci, showed that NaDene speakers were closer than Algonkians to most Eskimo groups. Once again, however, there were few blood marker distances significant from zero at the .05 level of significance.

With so many distances between populations not significant from zero, ambiguous results and conclusions are inevitable. The unreliability of genetic distances and fragility of dendrograms based on blood data is illustrated by another study that used much of the same data that Szathmary and Ossenberg (1978) used. Ferrell *et al.* (1981) obtained quite different results due essentially to different estimates of frequencies for the Duffy locus. Their results separated Amerindians and Eskimo groups better than Szathmary and Ossenberg, but they did not give the standard errors for the genetic distances, many of which could not have been significantly different from zero.

Szathmary (1981) also pointed out other weaknesses of blood data and some assumptions which turned out to be untrue. For example, the sampling error for blood data is high. Repeated samples from the same village can show significantly different results, in both very prevalent and rare genes. At times, this can change the population relationships dramatically, and higher sampling errors could be due to the nature of prevalence data. The estimation of White admixture and subsequent correction are other contentious issues (Greenberg *et al.* 1986; Williams *et al.* 1985). Avoiding admixed individuals tells us nothing about the effects of admixture, and by not counting the number of admixed individuals, there are no independent estimates of the occurrence of admixture.

As to gene flow, drift, and selection, Szathmary (1981) acknowledges research that has shown that in the absence of selection, groups differentiate genetically only when gene flow is very low between groups. However, Sukernik *et al.* (1981) found highly significant heterogeneity in Reindeer Chukchi groups, and believe that drift, stabilizing selection, and diversifying selection are at work within these subpopulations. Certainly local admixture could play a role as well. They did not calculate pairwise Nei distances and standard errors, however, so the statistical significance of the differences for each group is uncertain. Rychkov and Scheremetyeva (1977) found that there is normalizing, diversifying, and directional selection acting on different loci in Siberia. Certain gene frequencies, ABO, Rh, Diego, Ss, and P, have been shown to correlate with climate (precipitation, altitude,

and various temperature means) in North America (Suarez *et al.* 1985b, 1985c). Some of the genes showing diversifying, directional, or normalizing selection were interpreted as being under another type of selection in other papers among different populations. These nonrandom variations obscure population relationships.

While some loci can show definite population differences, such as ABO distributions in Eskimos vs. Amerindians, when integrated with other blood data for a more complete picture, differences between groups are not as apparent, and many other loci are needed to get statistical significance, if it is possible at all. Unfortunately, data from 20 or more loci are available for few Amerindian tribes (Szathmary 1993). Some marker distributions are inexplicable except for random drift: Albumin Naskapi, found in Amerindians, is also found in Eti Turks, Bengalese, and rarely in Japan (Szathmary 1993). While the use of anthropometrics anticipates, recognizes, and appreciates covariation, blood genes may also covary (linkage disequilibrium), thus confounding the estimation of population distances. Higher overall anthropometric covariances may actually help in distinguishing groups (see below). Genetic variation may ultimately be a matter of how many loci, sequences, or genes one looks at, or does not look at: There are largely unexplored hypervariable regions of DNA that can discriminate at the individual level (Chakraborty 1992).

While some researchers advocated a 20 locus minimum for stable dendrograms, Cavalli-Sforza *et al.* (1988) needed ***120*** genes from 42 loci to get

significant distances between 38 pooled area or tribal population blood frequency averages, which they correlated with language. Such area designations as "North America" and language groups as "North Amerind" homogenize the considerable heterogeneity present in each, though they did analyze the NaDene separately. For example, Scott (1979) saw large genetic diversity in his rather small samples of Athapaskans, and concluded that based on the genetic data, one would never suspect a similar language or common origin. He concluded that "The simplest explanation may be that gene frequencies are unreliable indicators of ethnic relationships" (pg. 246).

While Szathmary responsibly admits that blood data can produce equivocal results, this has not stopped other researchers from confidently proposing evidence for waves and Amerindian-Siberian relationships using inappropriate or inadequate samples. Williams *et al.* (1985) saw evidence for three migrations in G_m allotypes from Piman, Pueblo, Pai, and Athapascan groups. They would probably find evidence for more migrations if they sampled more groups. The standard errors for nearly all distances are **two times** the distance figures; ***one*** distance out of 45 was significant at the .05 level. These distances may even be overestimates. Szathmary reanalyzed the Williams *et al.* data and found that Athapascan samples were indeed closer to Eskimos and Chukchi (Szathmary, comment in Greenberg *et al.* 1986). When differences are insignificant any number of reasonable assertions can be formed, even with diligent scholarship. When statistical, behavioral, and logical

realities are abandoned, even worse analyses can come about.

For example, Schanfield (1992), utilizing GM and KM allotypes, concluded that there were at least four migrations into the New World. This may be partially due to the fact that he divided his samples into four groups: "Eskaleuts", South American, NaDene, and other Amerindian, because "it is generally accepted that the Eskaleuts and the Nadene are linguistically and culturally distinct from each other and from other non-Nadene Amerindian populations" (pg. 395). Schanfield's "Eskaleuts" are unique in biological research in that they are made up entirely of Eskimo samples. While maintaining that the markers of the GM-KM system are the most useful of all polymorphic systems in differentiating human populations, he admits that in nearly all of his samples, within-group variation is higher than among group variation. He believes that the variation is random, however, and merely uses the mean values for all samples. He provided no distance matrix or standard errors, but did generate a dendrogram which he misinterpreted. Even when four groups of heterogeneous Inupik "Eskaleut" were plotted by language, they were more tightly clustered with Canadian and U.S. Athapascan speakers, but he insists that they are closer to the Chukchi. He then cites other blood marker and mtDNA research as support for his results. His dendrogram could be interpreted to show anywhere from 1 to 6 "waves" if it were stable, which is doubtful. Even when resorting to "genetic typology", similar to the typologies of early craniologists, his data belie his conclusions.

Another approach to genetic data paralleling Hrdlicka's morphological dating (see below) has been tried as well. Harper (1980), despite Scott's warning of Athapascan heterogeneity, compared mean frequency differences of Athapaskans, Eskimos, and the Aleut sample data from Scott (1979). Harper looked at the mean distances between the 8 Athapaskan groups and 5 Aleut and Eskimo groups (which he says are 40 unique distances, but are 20 unique distances, and most likely not significant). Lost to Harper was that within-group divergence was almost as high as the between group divergence, and in fact, the difference between Yupik and Inupiak were less than the average difference within each (typical, as we have seen, for blood data). He treated the within and among group divergences schizophrenically: "While between-group differences reflect the bifurcation point between two groups, the within-group differences provide an estimate of the precursor time available to accumulate and organize genetic variation." (p. 550).

If within-group divergence is nearly as great as the among-group, at best, the mean distances are questionable, and a larger sample is needed, or at worst, there is little justification for the group labels: the groups are not being differentiated by the data at hand. Also, mean differences based on seven loci could change greatly with additional loci. This did not deter Harper, who went on to calculate divergence times for Athapaskans based on the questionable 9000 years B.P. date for the Eskimo-Aleut split. He then calculated the date of origin for ***all*** North American populations (represented by the split of Eskimo, Aleut, and Indians of Alaska) since in his view

one source explains all Amerindian variation. He arrived at a figure of 18,000 years B.P. and wrote that his results were supported by linguistic data not presented. No matter how they were arrived at, Harper's conclusions *seem* like reasonable assertions based on other research.

On a more positive note, Suarez *et al.* (1985a) applied a mapping approach to gene frequencies, giving contour maps of the first principal component scores. These have produced pictures that indicate relative isolation of Eskimo groups and Athapascan groups, but with large concentric clines of gene frequencies. There were no significance tests, and gaps in data collection were smoothed over, but the images paint a picture of the relationships noted by Spuhler (1979) of clines due to local gene flow.

More complicated and technologically sophisticated studies involve mtDNA analysis. Three kinds of mtDNA data are used in analysis: Restricted fragment length polymorphisms, restriction site data, and nucleotide sequence data. Each shows varying rates of mutation and differentiation. A generally high mutation rate (purportedly the only source of variation), which overempowers drift, has actually produced confusion, however. Some maintain that dramatic founder effects and bottlenecks are shown in Amerindian mtDNA, because some rare Asian haplotypes are prevalent and some tribes have their own distinctive mtDNAs (Schurr *et al.* 1993; Shields *et al.* 1992; Szathmary 1993; Wallace *et al.* 1985).

Schurr *et al.* (1993) interpret the mtDNA diversity as evidence for greater time depth in the New World, and propose an initial colonization from 17,000 - 34,000 years B.P. Other researchers found remarkably high amounts of mtDNA variation within one tribe. Ward *et al.* (1991) found 28 lineages within the Nootka, representing over 60% of the diversity of Japan or sub-Saharan Africa. This parallels earlier findings that within-tribal genetic marker variation is 60-80% of the total regional or continental variation (Neel and Ward 1970). According to their calculations, all of the Nootka lineages split before the formation of Beringia, and two split as early as 78,000 years B.P. They concluded that these data do not support founder effects in the peopling of the Americas (as in Wallace *et al.* 1985), but rather, "the migratory expansions of early human populations that led to the formation of major ethnic groups most likely did not result in genetic differentiation within groups." (Ward *et al.* 1991:8724). This also implies that the migrating groups brought a great deal of genetic diversity with them. Should large numbers of heterogeneous groups be considered a "wave", or a series of "trickles"?

Some of the differences of opinion above are due to different results depending on whether one uses high or low resolution restriction analysis, limited or D-loop sequencing analysis, or a combination of these (Melnick *et al.* 1992). But can researchers analyze more than just methodological artifact? The consensus is that different areas of mtDNA have different mutations, and there are manifold ways of looking at each of these areas.

Many authors consider the high mutation rate to be a strength, especially for intraspecific studies (Torroni *et al.* 1992), it also means that samples of Amerindian groups based on linguistics or culture area such as "NaDene", "Northwest Coast", "Wakashan", or even "Haida" may not have validity as representative mtDNA groups. Virtually all tribal bands would have to be sampled because of the high mutation rate, and may link groups that are not phylogenetically close, or split groups that are actually closer (as in the Nootka). If more groups are sampled and haplotypes discovered, there is the danger of each isolated group being too unique, clouding the overall relationships. It is also quite possible that within-group variation may become more of a problem as more sites are sequenced.

The high mutation rate of mtDNA has been assumed to fall between 2-4% per million years, and has been used to date divergences, for example, within NaDene and Amerind-speaking Amerindians. Torroni *et al.* (1992) found that the high sequence divergences within Greenberg's "Amerind" linguistic group pointed to an initial occupation of between 20-40,000 years B.P., implying an early pre-Clovis occupation of the New World. The age for the NaDene entry was given as 5-10,000 years B.P. However, as Torroni *et al.* later noted, "This standard rate of human mtDNA evolution does not incorporate any variance components. Therefore, *a 95% confidence interval for the rate would be considerably broader.*" (n.d.a.:16; italics added). It is likely that the inclusion of confidence limits would produce overlap in the dates, nullifying the earlier Amerind date.

Torroni *et al.* (n.d.a.) get into a muddle due to their association of biology with linguistic classifications: The Haida do not have a "NaDene specific" site loss (based on Dogrib, Navajo, Tlingit (n=2) and Apache samples). Because of this, they believe that the causes are due to drift after Haida separation from the rest of the NaDene. Based on the fact that the Haida are the most linguistically divergent NaDene tribe, they decide that the Haida separated before the site loss. But why do they expect a tenuous linguistic association to reflect biology? Likewise, an mtDNA incompatibility does not mean that Haida should not be considered a part of the NaDene. They are combining different universes of criteria, one subjective, one more "objective", that should not be expected to agree (Boas 1911). There is no Haida "problem" to resolve. Their NaDene and Amerind samples are also inadequate for a reliable "NaDene specific" site loss, if one exists, and this category is reminiscent of Turner's "NaDene" dental group (see below).

Torroni et al. (n.d.b.) gathered data from numerous Siberian groups for comparison to Amerindian mtDNAs. This was the first time mtDNAs from Amerindians and Siberians were compared. The authors' chronology is notable, for they found that America was colonized 5-10,000 years *earlier* than Siberia based on sequence divergences. They did warn that comparing 3 Siberian populations with 16 Amerind will tend to underestimate the Siberian divergence time, but this was not acknowledged in their earlier chronologies (n.d.a.) based on 4 NaDene and 20 Amerind samples. In sum, mtDNA chronologies are too dependant on sample size

and are much less precise than has been reported.

A second liability of mtDNA is the phylogenetic tree forming operations. These come about by linking haplotypes that are most alike, and represent the least number of mutations between the ancestral condition and modern forms, using maximum parsimony (Szathmary 1993). Thousands of differing trees are possible, and one solution is not **the** solution, as the proponents of the Eve hypothesis found out (Hedges *et al.* 1992). Tree formation depends on the sequence in which data are entered, and trees must also be rooted by an "outgroup" (Hedges *et al.* 1992). In fact, published trees can be the overall average (consensus trees) of thousands of generated possible trees (Torroni *et al.* n.d.a). There are new statistical standards for trees, the **consistency index** and the **retention index**, which measure the relative amount of homoplasy in a tree construction. Neither of these indices has been reported with the usual significance of .05, or even .10, but the minimum critical values have not been established for these indices (Torroni n.d.a.; T.Schurr, personal communication). UPGMA is one of the more common but problematic methods of mtDNA tree formation. UPGMA trees are hard to interpret because they assume a constant nucleotide substitution rate and cannot handle parallel or convergent evolution or admixture (Melnick *et al.* 1992). Also, as Szathmary (1993) notes, the trees formed so far are not stable, with bootstrap results not significant at the .05 level. Often, only the first few branches will be statistically significant. Once again, both recent European and older inter-Indian admixture will distort relationship trees

(Spuhler 1979; Szathmary 1993). "Anomalous" linkings based on mtDNA would still have to be judged by historical relationships, linguistics, geography, archaeology, and other biological data. It is likely that most anomalous trees are not published, while many "reasonable" trees are.

Some relevant observations can come from mtDNA studies, as certain sites show deletions and divergences which may link them to other groups. However, Ward *et al.* (1992) looked at mtDNA relationships between Amerind speakers (Nootka and Bella Coola), a NaDene isolate (Haida), and Inuit (Greenland Eskimos). They obtained curious results: Average sequence divergence between the Haida and the Amerind groups was less that between the Amerinds themselves; a phylogeny failed to segregate the language groups; and Haida and Greenland Eskimo showed the closest relationship when compared to 5 Amerind tribes based on average sequence divergence. They interpreted this to mean that Haida and Eskimos shared a recent common ancestry, and that Amerind is much older than previously thought. As usual in mtDNA studies, sequence divergences are interpreted as chronometers. What they could actually be measuring is the degree of female migration between any two groups (if the distances are significant, which is doubtful) and even the validity of linguistic labels such as Amerind. There seems to be little justification for using linguistic labels as biological ones, pooling samples based on language groups, as mtDNA researchers do. Should the Haida be classified as "Amerind" (or "Eskaleut") because of *biological* information, or does language not accurately reflect biology?

The close relationship between Haida and Greenland Eskimo is unexpected and probably not due to gene flow, unless it was indirect through other Eskimo groups. Thus, either mtDNA divergences do not reflect true biological affinities or language does not reflect biology or both. It is likely once again, however, that intragroup variation was so great that the group divergence means were not significantly different from zero, and do not require explanation.

If researchers sample tribes sufficiently as Ward *et al.* did earlier (1991) by sampling 63 Nootka, they are bound to find more lineages because of probability. If more groups are sampled, there will likely be evidence for more than the 2 or 3 "waves" found in Torroni *et al.* (1992). While maintaining that their mtDNA data points to two migrations (Eskimo data were not available), Torroni *et al.* note that there is a possibility of a third source of mtDNA in Amerindians. Their study utilized data from only ***167*** Amerindians representing 8 tribes, with ***3 of the tribal samples represented by two or less members***. There will undoubtedly be evidence of more "migrations" in the future given small sample sizes and the acknowledged "qualities" of mtDNA.

One glaring oversight in mtDNA research may be an underappreciation of history. With researchers finding so much diversity and immense time depth in Amerindian tribes now, what would they have found before the numerous epidemics decimated Amerindians around the country? On the Northwest Coast, even at the

time of the JNPE, some groups had mortality rates in excess of 75% (Ousley 1993b).

Many studies cited in Melnick *et al.* (1992) have indicated that for humans, in contrast to macaques (due to macaque female sedentism), many mtDNA haplotypes are shared between distant human groups, and intrapopulation variation is roughly equivalent to interpopulation variation. About 90% of the total human variation is found in individuals of the same geographical "race" and only 10% between "races", comparable to the nuclear DNA pattern. Compared to anthropometrics, where small numbers of immigrants may affect the overall mean slightly, new tribe members would bring in entirely new lineages, greatly affecting attempts to "age" tribal and intertribal divergences, especially when coupled with small sample sizes. The mtDNA data may ultimately reflect very high inter-Amerindian admixture in all groups rather than great divergence times alone.

The biggest flaw of mtDNA researchers may be their avoidance of the humans that have been carrying these mtDNAs around. Human behavior contributes a significant part of the apparent genetic diversity. It would seem that small amounts of intertribal admixture after migration could produce the divergent interpretations above, and a great deal of confusion. Suppose an average of two or three females from other tribes emigrated into a tribe every 25 years for 500 years. This is an extremely conservative estimate especially for the Northwest Coast, where many groups raided quite distant settlements for women and children (Drucker 1965). The

immigrants would possibly bring in different mtDNA lineages which their daughters would maintain. mtDNA results may actually reflect extensive female migration, and if so, tribes are invalid groups for comparison.

As Melnick *et al.* note, "human mtDNA population structure seems to indicate the historical presence of significant female dispersal, either individually or within larger kin groups" (1992:202). Several studies have employed high resolution restriction site mapping and nucleotide sequencing of the D-loop in aboriginal hunter-gatherer samples and shown lower within-group variation and higher among-group variation. What is really measured in these cases, however, is female sedentism. When these techniques are applied to more widespread populations such as Bantu, European, or East Asian, there are indications of mtDNA admixture and female dispersal. Melnick *et al.* conclude that "the distribution of human mtDNA does not accurately reflect the overall pattern of genomic similarities and differences in aboriginal human populations." (1992:204). mtDNA analysis is clearly inappropriate for assessing relationships between interacting and dispersing migratory populations.

It is clear that biological analyses have been judged by their conformance to other nonbiological data, rather than the reliability of their own data. "Reasonable assertions" of relationships have thus dominated. In this spirit, three researchers conducted a multidisciplinary review of the peopling of the New World.

Greenberg, Turner, and Zegura

The most often cited reference to a wave hypothesis that explains the migration and distribution of Amerindians is that of Greenberg, Turner, and Zegura (1986). The authors maintain that there is a vast amount of linguistic, dental, and genetic evidence that inexorably leads to the conclusion that there were three waves of emigrants to America. With some disagreement on timing, they envision an early Paleoindian wave, a later Na-Dene wave, and a most recent Eskimo-Aleut wave.

The simplistic linguistic classification proposed by Greenberg, which masks great amounts of variability, is widely disputed by linguists (Morell, 1990). Linguistic differences are **not** genetic barriers, whether due to bilingualism, slave taking, or other human mating behaviors (Campbell, comment in Greenberg *et al.* 1986; Drucker 1965). Patterns of human genetic variation (if also insignificant) are correlated with language, but correlations with geography are about the same (as is the correlation between language and geography) (Spuhler 1979). The gene maps of Suarez *et al.* (1985a) show clines from distinct centers radiating differently depending on which principal component axis is plotted. Greenberg also crafts a circular argument: By defining Amerind as one language group that includes widely divergent elements, Greenberg concludes that this group must have been in the New World the longest, represented by the Paleoindians.

The review of equivocal genetic data presented by Zegura affirms that three waves are reasonable assertions. More elaborate biological hypotheses had been worked out by Turner several years before, however (Turner 1983, 1985, 1986a).

There are many problems with Turner's methodologies. I will not dispute the phylogenetic value or conservatism of dental traits, though they are threshold traits and the MMD is inappropriate. Their validity is questionable when one is analyzing a highly variable migrating species over thousands of years represented by isolated cranial samples with uncertain chronologies, however. Turner has no idea what languages his skeletal samples spoke, but it is clear that he expects provenience to reflect language, and language to reflect biology. This two stage displacement must produce errors: Using a designation such as "Na-Dene dental group" shows this optimistic association, and it comes as no surprise that this group is not the same as Na-Dene speakers.

Because Eskimos and Aleuts are members of the Eskimo-Aleut Phylum, Turner succumbed to a circular argument appealing to linguistic authority, similar to mtDNA divergence problems: Since Eskimo and Aleut were in the same [tautological] language family but quite differentiated compared to Amerindians, they needed more time to diverge, and since they had to diverge in the New World, they had to be there quite early. This conclusion runs counter to Greenberg's linguistic analysis, which found greater diversity and thus age in Amerinds. Neither appreciated the fact that

languages may not diverge at constant rates, and may not equal biology, even when unjustifiable categories are manipulated.

Turner's groupings are questionable even linguistically. His Amur group, for example, combines the Tungus, Tunguso-Manchurian speakers, with the Gilyak (Nivkhi), who speak a paleoasiatic language. His "Na-Dene" group includes probable Eskimos and samples from the Columbia river, Greenberg's Amerind (Szathmary, comment in Greenberg *et al* 1986). His Eskimo group pools Yupik speaking St. Lawrence Island, and Inuit speaking northwest Alaskan and East and West Greenland Eskimos, each with sample sizes large enough to be treated independently. Turner (1985) admits his Buriat sample doesn't belong:

> "I have included the Buriats with the other northeast Asians because of location and presumed language. But **dentally, the Buriats are on the whole more similar to the Amur samples. The Buriat have a complex population history**, which seems to align them with northeast Asians even though they are geographically closer to the Amur samples." (Turner 1985:59, emphasis added).

High quality biological information is supposed to provide more facts to help reconstruct population histories, **not** be rearranged to fit current scenarios. His "Buriats" may even be *Nivkhi*, for the Nivkhi range was much greater than today. Turner's groupings are bound to distort relationships due to averaging widely divergent groups. His Northeast Asia group disappeared in later analyses. There were also "anomalously" close groups, such as Archaic Canada and the Southwest

United States due to Navaho and Apache admixture with the latter groups. A more informative procedure would be to conduct a cluster or discriminant analysis **at the sample level** and see how they classify, as Ossenberg (1992) did. There is no justification for Turner's ever-changing groupings.

Turner (1985) cites archaeological links between the Amur and Aleutian areas that support his early Eskimo-Aleut wave. Turner sees artifactual continuity from Anangula to Japan and the Amur, which means biological continuity: Artifacts equal people. Since Aleuts also equal Eskimo due to linguistics, here was his early wave demanded by a divergent dental pattern. But the artifact similarities, if real, would equally support an "archaic Caucasoid" or "proto-Salish" emigration from the Amur region, or simple technology transfer to peoples *already in the Aleutians*. Anangula could have also been on a common migration route for many New World peoples.

Turner's early migration falls apart if the Eskimos and Aleuts split in Siberia, or if Anangula is not ancestral Aleut, or if there was significant initial or subsequent Amerindian admixture with Aleuts, or if the Aleuts were biologically more like Amerindians to begin with, as Ossenberg (1992) suggests. Turner should have examined relationships between Eskimos and Aleuts instead of forcing together widespread and greatly divergent groups (Figure 1 in Greenberg *et al.* 1986).

Turner was the most influential proponent of the MMD because he was among the first to apply it to such a large and valuable sample. He has recently submitted data for a more reliable quantitative analysis (John Blangero, personal communication). This may matter little until he uses groupings justified by the data alone.

For a moment, however, let us suppose that the MMDs are reliable and test some of his hypotheses. Turner (1985:47-48) explicitly delineates his interpretations of the MMDs, and my responses below each are based on data in Turner (1983, 1986a) and Greenberg *at al.* (1986):

> "The following points are essential to the [three wave] scenario.
>
> Both Aleut and Eskimo are slightly more like Northeast Siberians than like any Indians."

Aleuts consistently show the smallest MMD to Athapaskans.

> "Both Aleut and Eskimo are more similar to Greater Northwest Coast than to other Indians, Eskimo slightly more so than Aleut."

Aleuts are closer than Eskimos to Athapaskans, and Gulf of Alaska Eskimo are closer to Northwest US and Canada Amerinds.

> "Both Aleut and Eskimo are three times more alike than either is like North or South American Indians."

Depending on which groups make up the average, relationships can be obscured the way one wants them to be. Once again, the fact that Aleuts are closest to Turner's Athapascan sample is more significant than either's distance to an "average" North or South Amerind.

> "Eskimo are slightly more like the Amur group than like Northeast

Asians. Aleut are equally similar to Amur and Northeast Asia."

The Amur sample is closer to Athapaskans than Eskimo or Aleut, Eskimos are closest to NE Siberians, and closer to Athapaskans than to Amur. Aleuts are much closer to Siberians than Amur.

Turner's later data do not support his earlier analysis using slightly different groupings. Turner's greatest fault, however, may be that he cannot interpret his own dendrograms. In Figure 1 in Greenberg *et al.* there is a clear dispersion of the Na-Dene, with Northwest U.S. and Canada samples closest to Gulf of Alaska Eskimo, and the Athapascan sample closest to the Aleut. What happened to his "wave" of Eskimo-Aleut? Based on the dendrogram, the colonization of the Americas, Siberia, and southern Asia could be explained by the single migration of Amur peoples. To this point, Turner states that since he provided the MMD matrix, "Study of this matrix will reveal three New World clusters" (pg. 494). But aren't dendrograms supposed to essentially summarize the MMDs without having to examine all of them? Nonetheless, a study of the matrix reveals that the closest group to Aleuts is the Athapascan sample. Turner claims that an earlier (Turner 1986a) dendrogram shows the three waves better, and in this dendrogram, due to different groupings, Eskimo and Aleut are closest together, barely separated from other Amerind groups, but one could reasonably see one to four waves. In this study, as in others (Turner 1983,1985), the Aleuts have the lowest MMD to Athapaskans.

What is still needed is "A ***Comparison*** of the Linguistic, Dental, and Genetic Evidence [data]" (Greenberg *et al.* 1986), not a manipulation. The various data

("facts") can only be used as *evidence* if they are not distorted. As Crawford 1992) puts it,

> "It is our obligation as scientists to examine the evidence dispassionately before concluding which explanation is the most likely. As additional data surface, we should be willing to change our minds and accept the dictates of the evidence. Theories that are disproven or at least shown to be unlikely should be discarded for the most likely explanations. Colleagues who continue to argue their personal positions, despite the *evidence*, retard scientific progress. There is no room for personality cults in science!" (pg. 278; italics added)

Whether due to questionable methodologies, uncertain provenience, fragile dendrograms, statistical unreliability, or "personality cults", there is little biological **evidence** for assessing population relationships in the North Pacific. The few promising but limited craniometric studies lack either sufficient measurements or geographical range. Cranial nonmetric studies by Ossenberg point to a nontraditional view of North Pacific prehistory largely because she has been the only researcher with appropriate samples and useful data for answering these questions.

It is unlikely that new genetic methods will produce meaningful results: mtDNA studies confirm that within-group genetic variability is too great. Results based on the reliable analysis of data from appropriate samples must be the starting point for proposing ancient movements and relationships. It is clear that new data and new analyses are needed to reliably assess population relationships in the North Pacific and ascertain possible scenarios for the peopling of the New World. Any new analysis should take significant nonbiological data into account as well.

Chapter 3

Other North Pacific Considerations

In the 1940s and 50s, a few brave scholars attempted to compile ethnographic data from the North Pacific for cross-cultural relationships. The recent reexamination of North Pacific ethnographic and material culture in *Crossroads of Continents* (Fitzhugh and Crowell 1988) reveals more enigmatic yet important cultural ties across the North Pacific. The most important similarities among all groups involve subsistence, especially sea mammal hunting.

Whaling

Whaling is a short term, intense hunting method that is highly ritualized and cloaked in secrecy in the North Pacific. Many rituals associated with whaling link cultures in an arch from Hokkaido to the Southern Northwest Coast. The strongest similarities in whaling practices are seen in the Northwest Coast and Aleutians-Kodiak areas, with possible ties to the Kamchatkan-Kurilian area, and between eastern Siberia and the Eskimo of the northern Arctic. The southern Northwest Coast area has traits reminiscent of both traditions. What is striking is the highly ritualized practices with extensive preparations and tabus. Ceremonies honoring many captured animals, ritualistic "feeding" or "watering" of the game, and ritualized treatment of certain animal parts unite all of these cultures, especially when applied to whales. The differences between them highlight their different influences on each other.

Heizer (1943) provides evidence that a whale hunting technique involving aconite poison possibly originating in the Kurile islands and Kamchatka spread to the Eastern Aleutians and Kodiak area. In both areas, hunting involved one or two men to a boat. Whales would die and wash ashore some days after being speared. Each hunter's spear had markings which could be traced to his village and to him. When a whale washed ashore at a village, they notified the community from where spear came and shared the meat. There is also an association of high status, supernatural power, and the dead with whaling (Lantis 1938). Whalers entered into a ritualized cult practice involving mummies or skeletons, and dipped whale lances into the decaying corpse of a dead successful hunter, or into extracted fat or grease from the body for "luck" and to disguise the use of aconite which was a trade secret. Aconite poison is used more extensively in Asia, for war and bear hunting, but present only in the Aleutians in association with whale hunting, so the two must have diffused together, according to Heizer (1943). On the southern Northwest Coast, the Nootka shared ideas of the supernatural power bestowed on whalers who bathed with corpses and had access to human remains, but did not use aconite poison, instead practicing whaling techniques closest to the Eskimo (Arima 1988).

Aconite whaling stands in contrast to all non-Kodiak area Eskimo, Chukchi, Koryak, Japanese, and southern Northwest Coast whaling involving the use of floats. This type of hunting involves eight to ten man crews using toggled harpoon heads with float lines attached. After the first hit, the whale would tire of fighting the float

and eventually surface to a hail of more harpoons with float lines. Before long it would be too exhausted to dive and was killed with lances. Compared to Aleutian hunting, each whale was obtained faster but required more men (Heizer 1943).

There may be biochemical reasons aconite is not used north of the Aleutian region. Aconite toxicity decreases with greater latitude, and the plants north of the Aleutians are not toxic enough to be used. While the Ainu have three poison plants they use, the Kuriles and Kamchatka have two, and the Aleutians only one. Heizer also proposed that Tlingit groups may have practiced whaling, but probably feasted on beached whales that were poisoned, with resultant sickness and possibly deaths, as were recorded in Kamchatka. This may have led to taboos against eating whale meat among the northern Northwest Coast tribes (Heizer 1943). At any rate, they do not hunt whales, despite their availability (Rousselot *et al.* 1988).

On the whole, the closest affinities in north Pacific whaling are between the Nootka, Quinaelt, Makah, and Kodiak island and eastern Aleut area. The whale was given a drink in these areas after transport to the hunters' village (Lantis 1938; Rousselot *et al.* 1988). The dramatic similarities between Nootka dugout canoes and Alaskan Eskimo *umiaks* (skin covered boats) extended to zigzag carvings in the canoes in the same location as the lacing for the skin in the *umiaks*. Nootkan whalers applied magical substances to whaling harpoon blades, which also bore distinguishing marks of ownership as in the Aleutians (Arima 1988). Drucker (1955) also believed

that the Kwakiutl at one time hunted whales, thus making whaling on the Northwest coast a Wakashan phenomenon. Whalers in these northeast Pacific rim areas were initiated with instruction in rituals, songs, obtained whaling power from human bodies, "fed" and preserved corpses of high status males or successful whalers, bathed in a river with these corpses before hunting, extracted fluids from the dead for "poison", and collected body parts for amulets or talismans. In contrast, North Arctic Eskimo groups believed that none of their whaling implements should be unclean or have any association with death (Lantis 1938). The canoe of a family that had a recent death could not be used until the first whale of the season had been caught (Heizer 1943).

The whaling season lasts about 2 months of the year, but preparations by these whalers begin months earlier with bathing and whipping. During the preparation time and hunting season, various tabus were observed by whalers and their wives, and broken tabus were confessed to before the hunt. They also kept women away from their boats in general and observed sex tabus while preparing for the hunt. The Nootka also engaged in "passive" whaling, erecting shrines with human remains or carved statures that were supposed to summon the whales to them (Rousselot *et al.* 1988).

There are also possible terrestrial diffusions, for Tanaina Shamans used human ashes to make poisons for hunting spears and points (Osgood 1933). Nootka shamans

boiled human fat to get oil to use against other shamans, and Chukchi Shamans used human remains for poisons and spells (Bogoras 1910; Curtis 1916, cited in Lantis 1938). In fact, Chukchi shamans would retrieve bits of flesh from the dead in ritualized ways to prevent their vengeance on him. One way was to pretend "that the corpse is a seal on the ice" and the shaman is "throwing the harpoon" as he thrusts his knife (Bogoras 1910:480). It is not certain if the point at which the knife enters is where the flesh is removed, but the association of sea mammals, poison, and the dead is clear.

Lantis (1938) also noted peculiarities to Eskimo whaling practices from the Bering Strait to Hudson Bay that united them and set them apart from the southern whaling groups, one of which was the active role of women in the whaling hunt or on the shore when the hunters returned. In contrast, the behavior of the wives of whalers was fairly uniform among the Nivki and in the Americas south of Bering Strait during the hunt. The wife of a whaler during the hunt would have very limited activities, some staying in bed and fasting, others avoiding cooking and sharp implements. All groups believed that the wife, if she behaved properly, enticed the whale to her, whether through her actions (in the north) or her supernatural power and knowledge of whaling secrets (in the south). A calm wife insured a calm whale (Heizer 1943; Black 1973). The use of aconite, the behavior of the whaler's wife, and the association of the dead with whaling power particularly illuminate the ancient interrelationships between North Pacific whaling cultures south of Bering Strait.

There were other trans-Pacific whaling similarities too. The whalers of Siberia and the southern Northwest Coast returned the leftovers of a whale feast to the sea. They also believed in familial ownership of whaling rights, songs, and idols (Lantis 1938). Whalers from the Northwest Coast and the Aleutians always approached from the left side and thrust in their spear behind the left flipper. Both areas also relied on songs sung by the whalers to direct the whale to shore (Rousselot *et al.* 1988).

Other Ethnographic Connections

The Northwest Coast and Siberia also share resemblances in the bear cult:

> "The offering of food made to the bear is not characteristic of the Algonkian ceremonies but connects the Nootka and Kwakiutl of the Northwest coast of America with the Asian Eskimo, Koryak, Kamchadal, Gilyak [Nivkhi], and Ainu, all of whom lay considerable emphasis on this practice." (Hallowell 1928:147)

Black (1973) noted that the Nivkhi have diverse traits in common with both the peoples of Siberia and the New World. Nivkhi Sea mammal hunts were preceded and accompanied by extensive rituals, and they buried sea mammal parts in a place of honor for the Master of the Waters, like practices honoring certain whale parts on the Northwest Coast and in northeastern Siberia (Black 1973; Lantis 1938). The carved Nivkhi house spirits (*tyv-yz*) in miniature houses are eerily similar to the Nootka statues in whale shrines (Black 1973:46; Rousselot *et al.* 1988:171). The Nivkhi also had hunting and fishing areas specifically reserved by lineage. They were fierce

warriors and used thick plant cord armor, vests, and helmets, as did the Northeast Siberians and tribes of the northern Northwest coast. Like northern Northwest Coast Amerindians, the Nivkhi lived in slat houses. Status in Nivkh society was defined by hunting skills, dog teams, and slaves acquired through raids on distant villages or bought from the Chinese or Ainu (Black 1983).

At one time there was considerable overlap in the territories of the Nivkhi and early Koryak, who interacted with the proto-Eskaleut in the northern Okhotsk Sea. This ancient proximity may explain some remarkable similarities between them. The Nivkhi, like the Koryak and Chukchi, believe that each lineage has its own fire to maintain and keep from contacting other fires. The oldest male in a lineage would be the keeper of the ancestral flint; splits in a lineage involved dividing the flint and tinder. The Chukchi and Koryak have a sacred drill and fire board. New Nivkhi houses were prepared by ceremonial lighting by the oldest male using the lineage fire. Candles, lamps, and the hearth could only be lit by agnates. Chukchi and Koryak hearths could only be lit by males of the same lineage. All three tribes "feed" the fire, throwing bits of food or tobacco in, and after being lit, the fires are tended by the wife. The Nivkhi dead were cremated, as they were among the Chukchi and Koryak. The Nivkhi and Eskimo also use dogs to pull their sleds (Black 1973; Jochelson 1908).

There are also several significant traits that unite Aleuts, Eskimos, Nivkhi, and the Nootka. There are indications that autopsies were performed among the Nivkhi to determine the kind of evil spirit that caused the death and then remove it, lest further harm be done to the lineage (Black 1973). Likewise, the Nootka conducted autopsies or dissections in case of unexplained death and more often than not found evidence for magical slaying. Autopsies were conducted by many Koryak and Chukchi groups, by Aleuts, and some south Alaskan Eskimo as well (Drucker 1955; Jochelson 1908). The role of the dog as a spiritual being associated with lineages is common among the mentioned groups and the Kwakiutl. The Nivkhi, unlike other Amur tribes, do a good deal of wood carving. Raiding distant habitations, sometimes hundreds of miles away, for wives and slave capture, has been noted above in the Nivkhi and in much of the Northwest Coast area (Black 1973; Drucker 1976; Settles 1987). The Aleuts, Koniags, and Pacific coast Eskimo frequently raided each other for these reasons (Owen *et al.* 1967).

Collins (1937) was one of the first Anthropologists after Boas and Jochelson to attempt an overview of North Pacific culture traits using archaeological and JNPE data. Since Boas, though, the emphasis has been on traits transmitted from coastal Asian cultures, because of their more specialized cultures. Collins noted that the south Alaskan and Kamchatkan cultures developed largely independent of northern Alaskan Eskimo cultures, and were largely unaffected by the waves of technological change from Siberia such as the Norton, Birnik, Punuk, and Thule cultures. He also

suggested that south Alaska and Kamchatka had cultural contacts based on de Laguna's excavations in southern Alaska. He proposed culture flow based on geography: an Eskimo route across the Bering Strait to Labrador and Greenland; and a Kamchatka-Aleutian-Northwest Coast route that ran through south Alaska. While noting the similarities in Aleutian and Kamchatkan house construction, he also wrote that the differences between the Kamchatka and Koryak houses were due to the latter's similarity to Eskimo houses south of Bering Strait.

There were many other examples of Siberian - Aleutian similarities which were concentrated in Kamchatka, not found further north, and which appeared to have come from the east. Because the Aleut showed an Eskimo culture, if also "aberrant", Collins proposed that it was the Aleutians, owing to their navigational skills, that pushed west along the chain and established contacts with the Kamchatka residents. Collins was certain that occupation sites would eventually be found on the Commander Islands. The Aleut connection emphasized the connections between Kamchadal and Koryak in the west and Aleutians in the east, which also had contact with the Northwest Coast Amerindians. The Aleutian route, for Collins, made much more sense than the Bering Strait route, since the Eskimos had very different cultures and influences. At this time, however, the Canadian origin of the Thule Eskimo was still in vogue. In just a few years, Collins' work on St. Lawrence Island would unearth very old Eskimo sites, older than sites in central Canada. These finds meant two things: The Canadian origin of the Eskimo was very doubtful, and the Eskimo

wedge had occurred a good deal earlier than Boas thought, forcing connections between the Northwest Coast and Siberia further into antiquity (Chard 1960). With so much time since contact, how could the modern North Pacific similarities be explained?

Jenness (1940) realized that Collins' discoveries meant that the only fairly recent migrations across Bering Strait would have been Eskimos. Given that "The evidence of ethnology is rather confusing." (pg. 6), Jenness started his searched for an ancestral source for migrations with physical data. He related that Hrdlicka considered the northern Northwest Coast Amerindians "indistinguishable" from the Nivkhi and other Amur tribes (pg. 5). But ethnography was ultimately all he could work with:

> "the social organization based on wealth, the talent for sculpture, and the music... appear so deeply seated that almost involuntarily we associate them with some invading people, a people whose original home lay somewhere, perhaps, around the Amur river" (pg. 7)

De Laguna (1947) proposed the idea of *circum-Pacific culture drift* from as far as Mongolia to the American Plateau based on trait lists of commonalities and apparent diffusions in both directions. A selection of the commonalities she found include: **elevated/above ground coffin**, Athapaskans and Northwest Coast, western Alaska, Aleutians, Yakut, Yukaghir, Evenk, Amur area; **Animal or human images placed on graves**, Evenki, Amur, Northwest Coast, in simpler form they were also

used by west Alaskan Eskimo and Athapascan, and related to Aleutian human figures diffused from the Ainu along with slavery and slave sacrifice, which also spread to the western Eskimo and southern Northwest Coast; **cremation**, Athapaskans, northern Northwest Coast, Plateau, Chukchi, Koryak, and Nivkhi; **mummification**, Ainu, Aleutians, Pacific Eskimo, some Northwest Coast Indians; **Stone saw**, apparently diffused from the Mongolian Neolithic to the Ainu, Katchemak Bay horizons, to the southern Northwest Coast and Plateau. Some of the diffusions she noted from Asia to America were: **elevated storehouse**, from the Amur area, through NE Asia to the Bering Strait Eskimo and some Athapascan tribes; **spiral decoration on knives**, from southern China, in Koryak trade goods, to Athapaskans and Northwest Coast; **Pottery styles** originating in Mongolia and neolithic China, found in Kamchatka and among the Ainu, which others have linked to the Northwest Coast. De Laguna contended that the four-post roof was a diffusion from America to Asia, spread from early Plains peoples and Oregon and Plateau tribes, in a modified form in the MacKenzie Eskimo, to the ancient Chukchi, Koryak, Kamchadal, and Nivkhi. She noted the presence of Eskimo place names on the western Chukchi peninsula, indicating that they were formerly more widespread. de Laguna would not go as far as Birket-Smith and suggest that the Pacific Eskimo regions were originally inhabited by non-Eskimos who were overwhelmed by migrating Eskimo. She concluded that the North Pacific had been populated by a common people who shared "Eskimo-like" ideas and innovations who in many regions were overcome by Eskimo intrusions, but these Eskimo groups were far from uniform and did not totally replace the resident culture:

> "No single modern Eskimo tribe of today can be said to have a culture that is completely 'Eskimo'; no single group in the past can be hailed as the original Eskimo; no one restricted area claimed as the home of Eskimo culture." (de Laguna 1947:285)

In this respect, like Jenness, cultural diffusion required significant diffusion of peoples. This was essentially Boas' Eskimo wedge hypothesis without a Canadian origin for the Eskimo.

Drucker (1955) also tried to explain North Pacific cultural continuity and the anomalous cultural position of the Northwest Coast Amerindians. Drucker worked with these assumptions: Northwest Coast culture was fundamentally different from the rest of western North America. Direct trans-Pacific contacts, either from Asia or Oceania, had little effect on Northwest Coast culture. However, there were clear indications of deep and superficial Asiatic cultural influences over a long time period. Therefore, the diffusion of culture traits and culture complexes had to have come through the maritime oriented Eskimo-Aleut of southwest Alaska. This was further bolstered by the fact that the northern Northwest Coast, at least, had to be settled initially by peoples with boating skills (echoed recently by Ackerman 1992a). Drucker emphasized both the intimate and ancient nature of this relationship, but there was only ethnographic evidence to test his conclusions, because of the lack then of physical data and no suggestions of a relationship between Eskimo-Aleut and Northwest Coast languages. He wrote:

> "Proposed: that the distinctive basic patterns of the Northwest Coast culture, from Yakutat Bay to northwest California, were derived from the same subarctic fishing and sea hunting base of the coasts of Bering Sea and Southwest Alaska that gave rise to the various Eskimo and Aleut cultures." (Drucker 1955:64)

In contrast to de Laguna, Drucker envisioned the Eskimo as a conduit, not a wedge. Also, he did not require that gene flow had to accompany recent culture flow. Drucker decided that the Wakashan areas of the Northwest Coast, which were also the least influenced by interior groups, represented the oldest culture, and had the most shared features with Eskimo-Aleut.

Drucker emphasized cultural continuities between Eskimo-Aleuts, especially in south Alaska, and Northwest Coast tribes. The maritime economy centered on fishing in all groups where fish were available, but sea mammal hunting was a highly ritualized and prestigious activity. Wood was worked extensively in areas where it was available, and where it was not, bone, horn and ivory were worked. The oldest Eskimo houses were the familiar rectangular houses of the Northwest Coast, and toggled harpoon heads were common to Eskimo and Northwest Coast Amerindians. When Drucker looked at traits present in the Bering Sea Eskimo as well, he regarded some as ancient or at least pre-Thule, and some as East Asian traits that were diffused by the Thule movements. Some of the latter include wooden dishes, wooden boxes with convex sides, twined basketry, ritualistic use of urine as a detergent, trophy heads in war, potlatches, and grave monuments. He regarded the presence of ancient and more recent features as evidence for extensive contacts over a long time period.

There were also cultural traits differentially shared by the Pacific Eskimo, Aleut, and the Northwest Coast tribes suggesting varying ages and degrees of contact. Adze styles, stone mauls, tambourines, wooden hats, bone needle cases, and throwing boards were present in all. The use of elaborate masks in rituals was an especially strong tie between Eskimo-Aleut and the Kwakiutl and Nootka, as was the manufacture and use of complicated puppets to be used in rituals. Drucker also cited excavations on the Fraser river that revealed early sea mammal hunting and Eskimo elements including toggled harpoon points, ground slate points, labrets, and typical Eskimo knives including ulus (Drucker 1955, citing Borden 1951, 1954).

Chard (1951,1960) examined contemporary and JNPE North Pacific ethnography and the scant physical assessments to test various models of population and culture movements. Though acknowledging the nautical skills of the Aleuts and Kurilians, he, like Drucker, maintained that the Eskimo were a much more significant link. He also added some ethnographic elements to consider. Chard noted that the Kamchadal and Eskimo had an elaborate system of taboos including a tabu on cooking animals from land and sea in the same pot. This is reminiscent of the Nivkhi Master of Waters/Master of Land dichotomy (Black 1973). Chard cited Thalbitzer (1941) who noted archaeological indications of former close contacts between Koryak and Eskimo. Chard also cited Soviet typological studies indicating that the closest affinities of Koryak and Chukchi were to Eskimo and Aleut, in his view, "shattering" Boas' Americanoid theory (Chard 1951:30). Due to a decreasing cline of Eskimo

influence from Chukotka to the Amur, Chard proposed "the former existence of a coastal population of Eskimo all the way from Kamchatka to Bering Strait, which was later submerged by the inland Paleo-asiatic tribes." (1960:238), and further,

> "I now propose that we visualize an ancient arc of related culture and population around the entire rim of the North Pacific from Kamchatka to Puget Sound, along which related traits may have readily diffused in either direction." (Chard 1960:238)

Chard sees culture flow through widespread related populations. The early Eskimo were more generalized than the later Eskimo, and their basic features and adaptations were more applicable to a wider geographic range. Chard also proposed the differential diffusion of traits based on ecology: The older, more general traits diffused readily, while the Bering Sea cultures that spread far into arctic North America, specialized for that particular environment, were not as readily adopted by southern peoples. This recognition was an important step in trying to make sense of the vast body of ethnographic data and material culture.

While Drucker claimed Eskimo-Aleut transmissions were later phenomena conveyed from Northeast Asia, Chard emphasized that it was the earlier, less specialized proto-Eskaleut beginnings which it held in common with the Koryak that were diffused. The similarities between Northwest Coast Amerindians and East Siberians were due to an early proto-Eskaleut expansion. The Northwest Coast Amerindians and Siberians did not share a common origin, but shared participation at

either end of a cultural pipeline (Chard 1960). He then makes an important point:

> "I believe that this hypothesis has the advantage of accounting for the situation on both sides of the Pacific - which any satisfactory explanation must be prepared to do. The day is past when New World culture history can be viewed in a vacuum... At any rate I offer this proposed solution to the problems raised by the Jesup Expedition as a working hypothesis." (Chard 1960:239)

The idea of the cultural continuum, started by Boas and modified through reexamination, has been revitalized only recently due to trans-Pacific collaboration made possible by better relations between the U.S. and the former Soviet Union. This cooperation culminated in the tour and publication *Crossroads of Continents* (Fitzhugh and Crowell 1988). Based on primarily Jesup materials and more recent if limited archaeological data, Arutiunov and Fitzhugh (1988:129) write "It would appear therefore that Bering Strait was never a hindrance to the passage of materials and ideas among populations living along both its shores." Like Chard, they appreciate differential trait transmission, but unlike Chard, concluded that much linguicultural transmission came via the Aleutians, the culture most influenced by Kurile-Amur-Kamchatkan ideas:

> "Thus it seems that over the past 4,000 years at least, Asian influences via Bering Strait may have been most important in North American **arctic** prehistory, stimulating numerous cultural changes if not population influxes in Arctic Small Tool, Dorset, and Thule periods, **while being of less consequence in the Bering Sea and Pacific culture history** where American populations were larger, more diverse, and better fed. These areas seem to have resisted northern influence during most periods, and the presence of slat and rod armor, oil lamp

types, and other cultural traits speak more strongly for **Aleutian** rather than Bering Sea links with Asia."
(Arutiunov and Fitzhugh 1988:129, emphasis added)

Indeed, the early Eskimo-Aleut culture could have been the foundation for Northwest Coast Amerinds, while continued contacts with some groups were more frequent. Holland (1992) found evidence in southern Alaska of exchange of exotic materials, tool technologies, dogs, and other cultural ideas in the area from the Aleutians to Prince William Sound. Clark (1992) described the changes on Kodiak island at 3000-4000 years B.P. as "Neo-Eskimoization" (pg.11), receiving cultural and genetic inputs from the Bering Sea area while also participating in Southern Alaska cultural exchanges. These exchanges extended to the Straits of Georgia and probably continued until greater settlement sizes, violent warfare, and perhaps resource shortages became more widespread leading to fort constructions starting around 1500 years B.P. (Dumond 1987; Moss and Erlandson 1992). The distinctiveness of later Eskimo culture and adaptations prevented many cultural traits from being diffused to the Subarctic Athapaskans and Algonkians. Thus, "Eskimo" culture has been unearthed from Hokkaido and the Kuriles to the Fraser river basin (Befu and Chard 1964; Borden 1979).

Linguistic Data

Linguistic ties across the North Pacific were brought out by Swadesh (1952,1962,1971), and Shafer (1952), who saw numerous links between the New

World and the Old World including Athapascan and Sino-Tibetan. Swadesh proposed wide ranging links between Old World and New World languages, including a link of Uraltaic, Nivkh, Ainu, and Wakashan (Swadesh 1962). The practice of glottochronology, though, is rife with potential errors, especially when dealing with languages that have been separated for more than a few thousand years. As Leer (1991) pointed out, the Aleut borrowed very few Amerindian words, yet shared a unique grammatical construction. The bulk of trans-Pacific linguistic associations, as well as many on either side of the Pacific, have been very tentative ones.

Ruhlen (1987) recognizes a Chukchi-Kamchatkan family of languages which includes Itelman, Koryak, and Chukchi among its members. He believes that the most probable connections this family has are to the Eskimo-Aleut family and Gilyak language. Swadesh (1962) also saw links between Eskimo-Aleut and Chukchi-Kamchatka. While Gilyak, the language of the Nivkhi, is an isolate, Greenberg (1987) places Gilyak in a proposed Chukchi-Eskimo division of Eurasiatic languages. There have not been any proposed higher level North Pacific linguistic relationships that many historical linguists have agreed on (Krauss 1988; J. Leer, personal communication).

On the American side, the NaDene language phylum is composed of curious elements: Eyak is linked to Athapascan, and Tlingit is gramatically similar to Eyak, which is why it is considered a NaDene language. Much of Tlingit vocabulary is a

hybrid of extinct dialects or languages probably related to Tlingit (Leer 1990). Haida, thought by Sapir to be related to Athapascan, Eyak, and Tlingit, is composed of two widely divergent dialects largely incomprehensible to each other. Boas and many current researchers have doubted this relationship (Krauss 1988).

Koryak and Itelman also show very different dialects, and some say the labels hide different languages within each. Chukchi is the most uniform language in Siberia, and even much of Koryak, Kerek, and Chukchi could be considered as "a single complex or chain of dialects" which shows less variability than within Itelman (Krauss 1988:147). The greater linguistic diversity in southern Siberia has been used to suggest that the languages expanded northeastwardly. The Chukchi population expanded considerably only in the 19th century, however, after adopting reindeer breeding. The Chukchi language is similar to Eskimo and Koryak, though other groups near the Chukchi also speak Chukchi as their second language, for the Chukchi are linguistic "imperialists": They never adopt the foreign term for foreign inventions, but instead create a new word of their own. Few Reindeer Chukchi speak a second language due to their economic prestige due to assets in reindeer. The number of reindeer and the required grazing areas expanded dramatically in the century before the JNPE, extending the Reindeer Chukchi area of occupation well into areas of the Reindeer Koryak, Kerek, Yukaghir, and Evenki. The greater range required by reindeer breeders, the linguistic "imperialism" of the Chukchi, and the superior economic and defensive status of the Chukchi have been factors in the

assimilation of various tribes by the Chukchi and their linguistic uniformity (Antropova and Kuznetsova 1963; Bogoras 1909). Despite their linguistic uniformity, perhaps reflecting local assimilation, Reindeer Chukchi groups show remarkable genetic differentiation according to Sukernik *et al.* (1981).

While Swadesh used a great deal of comparisons to link languages together, the other authors that have constructed "superphyla" have merely joined together languages like the paleoasiatic languages, because they are so unlike the other languages around them. Yet they are also quite different from each other, and very old. In fact, they were present in Siberia a longer time than the Tunguso-Manchurian speakers (Krauss 1988). The differentiation between them must have taken time. Why put them together?

Within Eskimo-Aleut, the deep division between Eskimo and Aleut is attributed to the loss of intermediate languages. The distribution of Yupik speakers should be noted. According to Krauss (1988), Yupik can be divided into Central Siberian Yupik, spoken in southern capes (Indian Point) of the Chukchi peninsula and Naukanski, spoken in the northern capes (Naukan); Central Alaskan Yupik, spoken just south of the Seward Peninsula to the Alaskan Peninsula; and Pacific Gulf Yupik, spoken on the Alaska Peninsula, Kodiak island, and in the coast near Prince William Sound. Yupik was probably spoken in an area from Prince William Sound to the southern coasts of Chukotka, and the modern dialects show a cline along the entire

distribution: the nearest neighbors of each dialect are intelligible to its speakers. Chukchi expansion on the Chukchi peninsula then compressed the Eskimo areas, and Inuit speakers displaced Yupik speakers from the Seward Peninsula. Inuit is the most widespread Eskimo language, consisting of three dialects which range from Alaska across all of northernmost Canada, to Greenland. This great range reflects the recent Thule expansion, which probably consisted of earlier forms of Inuit (Krauss 1988; Woodbury 1984).

Leer's study (1991) is an example of the kind of intense areal studies that can glean important information about relationships between languages. More of this sort of work is needed, rather than the mere classification of language families like Greenberg, whose work tells us nothing about important relationships at the local level. Linguistic classifications in the North Pacific have too greatly influenced biological interpretations of data, as we have seen. Leer's work also reveals a critical weakness of the "language equals biology" school of Cavalli-Sforza *et al.* (1988). Their work was critiqued by Bateman (1990a,1990b), whose criticisms were supported by non-Stanford researchers in the comments. Instead of letting the biological or linguistic data speak for themselves, Cavalli-Sforza *et al.* (1988) pool languages and biological data into classifications such as "North Amerind". The end result is a pretty picture of a reasonable assertion, that language and biology are related. The idea seems reasonable enough. Groups that split up and develop their own languages will show affinities to their original language, similar to gradualism in

evolution. However, evolutionary change produces organisms which are reproductively isolated from other species. While different species cannot interbreed, peoples of different languages can interbreed and share linguistic elements, which would be the biological equivalent of sharing genes across species. The language equals biology school fails to recognize that linguistic barriers are not reproductive barriers, and vice-versa. Groups branch out, but unite with other groups and recombine with other original groups, and language may not reflect the biological history of peoples (Bateman 1990a,1990b). Also, many groups that split are not random samples of the gene pool, but rather, lineages or several clans. These groups may show greater linguistic/dialectical affinity with each other as well, given no written records or education. Perhaps it is no wonder that there is no widely accepted classification of languages, and no statistical tests to score linguistic affinities (Diamond 1988). In a worldwide comparison, significant linguistic and biological variation is ignored in the process, and it is not at all certain what the data from Cavalli-Sforza *et al.* mean.

"Big Picture" analyses look impressive, but ignore large amounts of variation (as shown by Byrd 1993). Depending on which groups are selected as representing North America, many different results could be obtained as with Turner (1985,1986a; Greenberg *et al.* 1986). Of course, if one defines groups by language, language trees are produced. Cavalli Sforza *et al.* (1988) used eleven groups who speak a unique language. They also used genes which are under selection and significantly correlated

with climate. Despite the homogenized frequencies, the dendrogram of 42 areas and populations is not stable. Bootstrapping produces different branches too frequently (Cavalli-Sforza 1988). In a later paper, (Cavalli-Sforza *et al.* 1992) used different statistics to assert highly significant results, but there are still curious links between Eskimo and north Turkic populations, and many similarities between geographically close groups of different language families (Bantu-Nilosaharan, Southwest Asia-Iran, Mongol-Samoyed, New Guinean-Australian, and Indian (Indo-European)-Southeast Indian (Dravidian)).

In contrast, Harding and Sokal (1988) noted that genetic distances in Europe reflected geography better than language. While some members of phyla that were distant tended to be closer, groups from very distant linguistic phyla usually clustered together if geographic distances were small.

Another form of biolingual equilibrium is illustrated by glottochronology. A dramatic illustration that glottochronology is unfortunately not dead is given by Nichols (1990). While demonstrating that the density of languages can be related to many factors, including resource availability, resource exploitation, microenvironments, and topological and geographical factors, Nichols calculates an entry time for native Americans based on language diversity. She noted the far greater diversity in Amerind, which has over 100 stocks with the same variation as NaDene and Eskimo-Aleut. Based on the breakup of NaDene wave about 3000-5000

years B.P., or if Haida is included, about 7,000 years B.P., she concluded that if Greenberg's "Amerind" is a single genetic (in the linguistic sense) lineage, then the 140 language stocks represented would require at least 50,000 years to differentiate, and if Amerind is a few lineages, at least 20,000 years. She concludes that "the Clovis and received chronologies in Americanist studies are inconsistent with the linguistic ***facts***" (pg. 509, emphasis mine).

The only *fact*, however, is the great diversity of Amerindian languages. Or is that a fact? Perhaps dates between 10,000-14,000 do not fit the linguistic ***data***, or rather, her interpretation of the "data". The language classifications themselves are subjective, and it is quite possible that there are a great many more language classifications for Amerindians because they have been studied so extensively by Americans. Conversely, her "facts" could show that linguists have defined too many stocks in the New World.

Linguistic dating assumes a constant rate for new language generation, or at least an average rate. But languages do not mutate at a constant rate, and while language densities tend to be low in arctic environments, East Greenlandic dialects have changed much more than other Eskimo dialects (Woodbury 1984).

But should not great diversity be expected from reasonably diverse groups expanding into multiple continents roughly 10,000 miles from north to south and over

4000 miles wide in parts, filled with numerous rich environments? The Plains and Desert areas have relatively low language densities. The Plains Cree, for example, occupied an area larger than the state of Washington, while just on the coast of Washington, in an area smaller than 1/10 the Cree area, there were over 30 languages spoken. Does that mean that people were on the coast 300 times longer than in the Plains? Linguistic diversity, as Nichols pointed out, is significantly correlated to the local ecology. The greatest areas of linguistic density in the world are on the Northwest Coast of North America, the Northwest Coast and inland of South America, and in the Pacific Islands, especially New Guinea (from map in Nichols 1990). It is quite possible that a coastal route of migration could have brought people to the New World on the coasts fairly early. But even if that did not occur, there is no validity in canonical pronouncements of diversification rates based on "genetic" ties between languages. Archaeology will have to provide relevant chronological information, while biology will have to provide **genetic** information.

The great linguistic diversity in the New World has too greatly skewed biological interpretations, and has tended to homogenize the Eskimos and Aleuts. Most often cited is the need (or proof) of great antiquity for languages. New Guinea, settled for some 40,000 years or more, is cited as an example of increased diversity and ancient occupation. Yet much of northeast Siberia, which must have been inhabited before the New World, shows only one language, Chukchi, if small Eskimo settlements are excluded. Interior Alaska has at least 8 Athapascan languages. There

are more factors than just time that contribute to linguistic diversity, as Nichols brought out but did not acknowledge in her analysis.

While linguists lament the decline of American Indian languages in favor of English, there are also important lessons to be learned from disappearing native languages. True, the economic advantages of speaking the language of a dominant culture as in the United States are much greater than in speaking a native language. But some groups have been quite pragmatic in what they speak for a long time, as Mithun (1990) notes. Citing McLendon (1980), she reminds us that even before European contact,

> "there was extensive intermarriage among the Eastern Pomo and neighboring groups, many of whom spoke other languages. The Eastern Pomo were accustomed to learning new languages, as many of them moved to the community of a spouse, and easily gave up languages that were no longer useful. Their view of their language was essentially practical" (Mithun 1990:1-2)

The central Pomo also married neighboring groups and adopted the language of the spouse. Later they learned Spanish and English. There are approximately a dozen fluent speakers left today, all of whom married nonspeakers and rarely speak their native language (Mithun 1990). Pomo genes have been preserved but the language has nearly died.

The phenomenon of native assimilation with Western contact has been

underappreciated precisely because the natives have been so pragmatic and flexible. A modern empire or powerful nation is not required to encourage assimilation, however. The Chukchi have assimilated various peoples simply because of their stubbornness and economic prestige. The Chukchi territory expanded considerably in the last few centuries, not because they were especially good reindeer breeders (the Evenki were considered better), but because they had a dominating culture and stubborn temperament. Even the cossacks could not subdue them, despite little or no apparent Chukchi political organization. The Chukchi did not accept foreign terms for items and rarely learned a second language. Anyone trading with them would have to learn at least the basics of Chukchi, and in fact, nearly all groups near them were bilingual. In assimilating the Eskimo, the Maritime Chukchi groups did adopt some cultural traits, especially related to sea mammal hunting, but traded the Chukchi language to the Eskimo (Bogoras 1909; Dolgikh 1965).

The "Siberian pattern" is one of free assimilation of groups. Evenki have been assimilated by Samoyed, Yakut, and Yukaghir groups, and Yukaghir have been assimilated in turn by Evenk, Yakut, and Koryak groups. The prevalent pattern seems to be that of inland groups assimilating coastal groups but not vice-versa. While Yukaghir assimilation influenced local Yakut cultures, there are no traces of Yukaghir culture in Chukchi groups, who forced out and probably assimilated Yukaghir groups (Arutiunov 1988; Bogoras 1909; Dolgikh 1965; Jochelson 1904). Some of the assimilation came by way of Chukchi bride price paid to Yukaghir

fathers in law, with up to 100 reindeer paid for a Yukaghir woman (Jochelson 1926b), reminiscent of Cronk's observations among the Mukogodo, whose young women were sold to Maasai herdsmen. The Mukogodo even adopted Maasai ways and began speaking *Maa*, the language of the Maasai (Cronk 1989).

Spuhler's 1979 piece has been cited as showing that language is correlated with biology, or that geography correlates better with biology than language, or that "The possibility of a third migration can be perceived" (Turner 1981:195). Spuhler made the best attempt to get significant differences in gene frequencies by employing discrimination function and canonical correlation analyses to Amerindian gene frequency data, so a careful reading and appreciation of Spuhler is in order.

While stating that language, culture, and biology are correlated, if weakly, Spuhler offered many caveats. He points out that local Indian-Indian gene flow can dramatically change distances, and that in Figure 7.3, a tree diagram, only 16 of 33 proximal nodes join tribes of the same language phylum (pg. 149). He cautions that his small sample sizes for some language groups, like two similar Salish groups and two divergent Penutian groups, may misrepresent the genetic diversity of their phyla as a whole (pg.153). He voices his suspicion that the Hupa took over an Athapascan language without absorbing many genes from them, based on their lack of association with them (pg. 154). Spuhler noted that on the whole, the Eskimo language and area had the most correct classifications, and the Algonkian and the Southwest did not.

The Thule Eskimo, however, classify in the Hokan language group and the Southeast culture area (Cherokee).

Also notable in the Eskimo-Arctic group are two samples of Aleuts, a sample from the Commander Islands, and a "Western Aleut" sample, collected from several other islands. In both language and culture area, the Commander Island "Aleuts", a mixture of Aleuts, Asians, and Europeans, showed higher probabilities of membership in the Eskimo-Arctic language phylum and culture area than the western Aleuts. Curiously, both Aleut samples and the Copper and James Bay Eskimo groups showed strong affinities to the Macro-Algonkian phylum and the Plains culture area. The Commander Islands Aleut sample was classified into the Macro-Algonkian phylum and the Western Aleut were nearly classified into the macro-Siouan language phylum.

Spuhler noted that the best genes for discrimination are the Rhesus groups and A and O blood groups, which have been shown to be under selection in other studies (Rychkov and Scheremetyeva 1977; Sukernik *et al.* 1981; Suarez *et al.* 1985a; O'Rourke *et al.* 1985). In his conclusion, he wrote

> "In a *few* cases, for instance, Zuni and the Keres in the Southwest and Nootka versus the Na-Dene tribes in the Northwest Coast area, members of language families remained biologically distinct from neighboring groups over long periods of time. The northern Athapaskans and Algonquians tended to mix freely... The form of genetic trees and maps depends on the history of genetic isolation, gene exchange, genetic drift, and probably some adaptation by selection to local and district environments." (pgs. 176-177; italics added)

On the whole, classifications by language are correct 33 of 53 times, or 62.3% if the Keresan and Wakashan (of the "unknown" language phylum) are included. Classification by culture area was correct 31 out of 53 times, or 58.5%. When one includes misclassifications by culture area into areas adjacent to the tribe's area, 37 out of 53 (69.8%) are correct. An analysis of variance confirmed that the Rhesus and ABO blood group genes contributed to discrimination, but also blood type B, R^2 and R differed less among groups, and gene frequencies for M, N, R^0, r, R^z, and r^y showed no differences across groups (pg. 158). Once again, differential selection is implied in blood groups. However, Spuhler did not provide a distance matrix or significance figures for distances. He did state, however, that in the nine language phyla, mean within-phylum variation was *less* than among-phylum except for the NaDane and Macro-Algonkian. It is doubtful, however, that many of the distances based on language phyla or culture area are significantly different from zero.

The low correlation between genetics and language noted by Spuhler and others, complicated by linguistic-geographical correlations, does not produce good inferences. The main lesson of Spuhler's work seems to be that more *post hoc* testing is needed, instead of assigning labels and expecting the assumed. His observation that Athapaskans and Algonkians apparently mixed more often is valuable biological and cultural information, and only detected when analyzed inductively.

Linguistics has dominated the interpretation of Amerindian and north Pacific biological data despite a lack of statistical analyses for linguistic data. People can change their language and their subsistence pattern, but both can leave traces of the former condition. Since there are conflicting methods of assessing the relationship between languages, and no tests of significance, ethnography should be used at least as often as linguistics in helping to interpret biological data. However, neither linguistics nor ethnography should dictate biological expectations or validity.

Even tribal designations may be suspect. As Moss (1992) points out (citing Townsend 1980), tribal names imposed in the northern Northwest Coast (Tlingit, Eyak, Tanaina, Chugash, Koniag, and Aleut) separate groups that are alike and brings together groups that are different. For example, the Tlingit are divided into 13 separate geographically defined groups, the Chugash into at least 8 subdivisions that were politically and geographically discrete, and the Aleutian islands were home to distinct subgroups. At the same time, the tribal designations separate groups that shared "social ranking based on wealth, inheritance, and kin relations, and the division of society into elites, commoners, and slaves" who "interacted with each other through marriage alliances, trade, slave-taking, raiding, and warfare" (Moss 1992:6). Yet, on the Northwest Coast, groups that raided each other would be united at dances and potlatches (Kennedy and Bouchard 1990). Where wood was available, it was worked, but though the Tlingit had access to whales, they did not hunt them. According to Townsend, the peoples of south Alaska are more accurately viewed as

large numbers of autonomous groups, and even the southern Northwest Coast had many divisions within their "tribes". Tribal designations by anthropologists in many cases are due to language alone and do not reflect sociological, cultural, or biological realities, especially on the Northwest Coast.

The Changing Archaeological Picture

Archaeological progress in verifying and studying ancient immigrants into the New World was regulated by Ales Hrdlicka. He maintained that Amerindian types, languages, and cultures were homogeneous (Hrdlicka 1925; Wilmsen 1965). Linked to this, he vociferously objected to the idea of great antiquity for man in America. Hrdlicka carried the ideas of evolution to extremes, practicing morphological seriation, undoubtedly in part because he avoided statistics, even stating that "statistics would be the ruin of anthropology" (Montagu 1943:115). This is surprising since he measured large series of crania and published an anthropometry guide (Hrdlicka 1920; 1939). He thought that earlier skeletons should "look" primitive, and later ones advanced, with no allowance for normal variation. Based on this dichotomy, he often aged specimens by morphology alone, in disregard of stratigraphy (Bank 1953; Black 1983; Stewart 1949; Szathmary 1979). His attacks on researchers who found (often equivocal) evidence for early man in America convinced most that man had arrived relatively late in the New World, or in the least, that the issue was not worth arguing about with Hrdlicka (Wilmsen 1965).

It was not until the Folsom discoveries, of artifacts very different from recent Amerindian groups, that convincing evidence was present to establish an early age for the first Americans (Wilmsen 1965). Extinct mammal bones had been found in association with projectile points before, but were dismissed by invoking a recent extinction for the mammals. The acknowledgement of the early presence of man in the Americas renewed interest in the questions of their origin. More recent archaeological finds, though, contradict early answers.

Greater archaeological efforts in the arctic have provided more data which reveal the character of Beringia. It is certain that Beringia was at least 1000 miles wide during its peak at about 20,000 years B.P. Either end of Beringia had many more trees for a longer time than central Beringia, which had a tundra steppe climate with grasses that would have supported sufficient numbers of herbivores for human consumption. In contrast, coastal populations would not have found migratory sea mammals on the iced over shores for much of this time period, and most of Alaska was climatically quite severe (Arutiunov and Fitzhugh 1988; Guthrie 1990; Hoffecker *et al.* 1993; Hopkins 1979).

Siberia is not well known archaeologically (Meltzer 1989). The oldest human occupation found in Northeast Siberia, at Ushki, on the Kamchatka peninsula, dates to 14,000 years B.P. As Arutiunov and Fitzhugh (1988) point out, no artifacts have been found in Chukotka or Alaska that are older than 11,500 years. Until recently,

the Bering strait was thought to be completely submerged by this time. Groups left on the American side of Bering Strait must have remained on the eastern side of Beringia as it was receding, or travelled across after it receded, either by boat or across the ice. Up to the cold war, there were friendly and unfriendly contacts and group migrations of Chukchi and Siberian Eskimos across Bering Strait (Bogoras 1909; Jenness 1934). Many winters one can still travel across the iced-over Bering Strait. The submergence of Beringia has not completely cut off America from Siberia.

It now seems likely that a land connection remained longer and the Canadian glaciers receded earlier. In a review of the latest information, Hoffecker *et al.* (1993) paint a different picture of the Beringian existence. It now appears that Beringia may not have been submerged until about 10-11,000 years B.P. The continuously open but inhospitable "ice-free corridor", if it existed, gave way to a wider separation of the Cordilleran and Laurentidian ice sheets by about 14,000 years B.P. This would have allowed groups to reach Meadowcroft Shelter (dated variously between 12-20,000 B.P.), near the southern border of the glacial fairly early. The timing here also makes more sense for any large scale population movements: If Beringia were cut off at 14,000 years B.P., and the earliest migrants were in Alaska at 11,500 years B.P., then all migrants to North America either intentionally walked eastward over the ice, which seems unlikely, or they travelled by water. If they travelled by water, what were they doing in Alaska in the middle of such a barren area?

Fladmark (1979) proposed a coastal route for some of the migrating peoples into the New World and compared its feasibility to the interglacial route. The "ice free corridor" has many problems, among which are an uncertain chronology, its size, and its suitability to support humans (Fladmark 1979). There are some indications that the corridor remained closed or was very narrow in the middle portion. This area especially would be full of small lakes, canals, and swamps without sufficient game, a far cry from the Beringian situation. Fladmark maintains that there were unglaciated coastal areas, now under water, that would have supported a range of terrestrial fauna or a maritime oriented people. He cites others that have remarked on the diversity of fauna on the Queen Charlotte Islands, including a resident species of caribou, and neither it nor the black bear could have reached the islands after the sea levels rose. At 16,000 years B.P., the north end of the Queen Charlotte Islands were deglaciated and had well-established plant communities (Easton 1992). The coast of southeast Alaska remained ice-free during the Wisconsin glacial maximum. Further to the south, evidence for conifer forests, shellfish, and bison, mammoth, and mastodon are found in interstadial and postglacial periods. The Japanese current, steered by Beringia, would have brought warm waters to the Northwest Coast. Fladmark also points out that sites that date to 9000 years B.P. coincide with the maximum post-glacial sea levels in Southeast Alaska (at the Alexander Archipelago), so older sites are most likely under water. Fladmark concluded that the inhospitable nature of any ice-free corridor compared to the available resources for people with watercraft would make the coastal route easier and faster to travel. Of course, if the

North American glaciers began receding earlier than previously thought (Hoffecker *et al.* 1993), the importance of a coastal route in explaining population movements diminishes somewhat.

The coastal migration route also finds support from the local archaeology of the Northwest Coast. There are very early dates for sites with microblades on the coast, from the northern Northwest Coast (Ackerman 1992a) to Namu, on the mainland north of Vancouver Island, dated to about 9100 years B.P. Nearly all of these sites show antler tools and continuity to the present. The Queen Charlotte Islands are thought to have been inhabited by at least 8000 years B.P., and the Drynoch site on the Thompson River is dated at about 7500 years B.P. (Borden 1979). All of these sites show a mixed economy, exploiting deer and fish, especially salmon, from the very beginning. The Namu excavations unearthed a large proportion (23%) of sea mammal bones including seals, sea lions, and sea otters. At the same time or before, apparently different peoples were resident in Oregon and Washington, in the area of Puget Sound. Some of these sites are Fort Rock Cave (13,000 years B.P.), the Manis site (12,100 years B.P.), Milliken (9000 years B.P.) and Glenrose (8150 years B.P.). These Amerinds used no microblades, but biface knives and leaf-shaped points, and a great many scrapers. Burins and simple bone tools were rare. They hunted large and small game, and exploited shellfish, but fishing and bird hunting was virtually non-existent. They avoided the mouth of the Columbia river, leading to the rugged coast, instead preferring to diffuse inland from

Puget Sound (Borden 1979). Several Northwest Coast languages are located in former ice-free refugia, such as the Haida, Wakashan, Tlingit, and Eyak (Rogers 1985).

Borden (1979) sees the coastal sites as evidence for population movements from inland north British Columbia to the coast, but as Suttles (1987) points out, the coastal cultures have no inland predecessors: Where did the coastal adaptations and microblades come from? Borden admits it is "remarkable" that the coastal groups, had they migrated from terrestrial hunting groups, quickly mastered boat building, navigation, and boatmanship enough to expand quickly, fish, and hunt sea mammals successfully (pg. 969). Suttles' (1987) argument utilizing archaeological data and the very capable marine exploitation is much stronger than Borden's literal interpretation of estimated radiometric dates. A coastal origin *may* also explain the greater diversity of languages on the Northwest Coast (Suttles 1987), but diversity, as we have seen, is a two-edged sword. It seems likely, based on archaeological data, that there were significant coastal migrations of peoples using microblades.

But why would groups migrate? The traditional picture of North Pacific migration is one of groups represented by large arrows heading inexorably to America (Borden 1979; Turner 1986a; cf. Meltzer 1989). As Anthony (1990:905) notes, however, "Migration is a process, not an event, and as the process unfolds it generates its own dynamics". Human migrations usually involve leapfrogging, return

migrations, and intelligence gathering, as well as migration streams represented by arrows (Anthony 1990). It seems likely that there were a great many stochastic movements throughout Beringia, at least initially, even with large numbers of migrating mammals. If Beringia began to fill up with people, or game became scarce, it is conceivable that groups would be forced to go to peripheral areas to hunt for food, but an intercontinental isthmus 1000 miles wide would seem to have plenty of refugia. It seems certain that steppe animals arrived in Beringia long before humans (Guthrie 1990). Some animals could have been driven east by higher human densities at the western end of Beringia.

There are indications that the lack of another resource - wood - may have prevented settlement in areas north of 60° north latitude for much of the Pleistocene until trees were distributed in those areas. Likewise, large areas of Beringia were treeless until small species of trees advanced into the interior, relatively shortly before it was submerged (Guthrie 1990). Human residence in cold temperatures is nearly impossible without wood, unless blubber or oil lamps are used, which later arctic peoples developed. There is also evidence for a rapid Upper Paleolithic migration of culturally uniform peoples across Beringia (Ackerman 1992b). Summing up, Hoffecker *et al.* conclude "Access to the Americas was controlled by Beringian environments and not by changing sea levels or continental ice masses" (pg.46).

Clovis hunters have been thought of as being the first inhabitants of the Americas, and their distinctive large fluted points date to about 11,000 years B.P. (Hoffecker *et al.* 1993). No fluted points have been found in Siberia, suggesting that Clovis points were an American Paleoindian invention with no known roots in the Old World. New complexes of the Paleoindian tradition have been discovered, however. Several non-Clovis sites in Alaska have been discovered which contain 11,000 year old tool kits, one designated the Nenana complex, which is similar to East Siberian toolkits. It has been suggested that Clovis could have been derived from this complex. The "Mesa site", which may represent another complex, was recently dated to about 11-12,000 years B.P. based on radiocarbon dates for charcoal pieces (Bower 1993). Some of these early sites have similarities to early sites in midcontinental North and South America (Hoffecker *et al.* 1993). It appears that at the beginning of the settlement of the Americas, there could have been at least three distinct coexisting lithic complexes (Bower 1993).

At about 11-12,000 years B.P. there was a dramatic warming trend in the North Pacific which favored marine life to the detriment of large tundra adapted land mammals such as mammoths and bison. An increase in temperature helped remove much of the coastal ice, making the coasts more suited for breeding grounds for seals, walrus, and sea lions, and making the oceans more hospitable for whales (Hoffecker *et al.* 1993; Arutiunov and Fitzhugh 1988). At about the same time, there appeared in Siberia (Uskhi) subsistence patterns based on fishing. All of the main features of

early North Pacific can be traced to the Diuktai Culture (35k-10.5kBP) that has links to cultures throughout north central Siberia, to Kamchatka, Japan, and north China, and are associated with exploitation of fish and terrestrial fauna (Chun and Xiang-Qian 1989).

Microblades, wedge-shaped cores, leaf-shaped or ellipsoid bifaces, and burins distinguish the Paleoarctic Tradition (Dumond 1977), also known as the Beringian Tradition (West 1981). The earliest finds in western Beringia are in Kamchatka at about 10,900 years B.P., and in eastern Beringia, Alaska has sites around 10,700 years B.P. The Alaskan microblades are part of the Denali complex (Dumond 1977; Powers and Hoffecker 1989). The Paleoindian Alaskan sites are distinct from the later (8500 years B.P.) Anangula blade site, which shows technological advances that led to later Siberian industries. Anangula was already separated from the mainland during occupation, and could only be reached by boat. Though considered a unique complex by Laughlin, Anangula has been shown, as mentioned, to share this complex with many southwestern Alaska sites (Ackerman 1992a). The advanced core procedure found in early southeastern Alaskan coastal sites had its roots in earlier late paleolithic Yakutia cultures. Since the earliest coastal maritime sites have a more recent technology than sites in the Tenana basin, there was either population or technological movement from Asia to Alaska (Ackerman 1992a).

On the Alaskan coast, early microblade sites have been reported by Ackerman

(1992a). Two sites, about 9000-9500 years B.P., are found in the Alexander Archipelago, accessible only by boat, so marine exploitation is suggested. These sites show tools apparently derived from late paleolithic Diuktai culture due to frontal fluted wedge-shaped microblade cores (Ackerman 1992a). Movement proceeded southward, and by 8200 years B.P., there was a Northwest Coast blade type reflecting a "distinctive cultural dynamic" (Ackerman 1992a:23).

Later, however, Ackerman and Dumond believe there were cultural links in the southern Alaska/northern Northwest Coast area during the late prehistoric period due to the near simultaneous appearance (around 5000 years B.P.) of ground stone tools in these areas (Ackerman 1992; Dumond 1987). After this technological diffusion, more complex societies, greater site size, and more diversified subsistence technologies appeared. Ackerman concludes that by about 5000 years B.P. there was a trade and communications network from the Aleutians to the Northwest Coast.

The history of peoples of the farthest north, in areas now occupied by the Eskimo, is a history of sometimes rapid technological and population movements over great distances. The Paleoarctic Tradition, characterized by large amounts of microblades, was not found east of north central Alaska, but by about 9000 years B.P. was distributed in an arc around the north Pacific extending from Hokkaido north along the mainland coast and the Kuriles, across Bering Strait, around the northern Northwest coast and down to southern British Columbia. Some sites in the

region of the Strait of Georgia, while not as old, had a microblade tradition that continued until about 400 A.D. (Dumond 1977).

These early microblade users were not Eskimos. There are only scattered early remains in American arctic regions between 10,000 and 7000 years B.P. The Old Bering Sea and early Arctic Small Tool Traditions, beginning at 5000-4000 years B.P., are considered by Dumond to represent the first proto-Eskimo-Aleut speakers to have arrived in Alaska. Dumond and Soviet archaeologists see similarities to earlier Norton and Choris cultures which they believe originated in northern Kamchatka and Chukotka, while most American archaeologists believe the cultures originated in western Alaska. Since the latter cultures show Asian influence, many of the cultural changes inevitably came from Siberia. The Dorset culture expanded from about 3000 to 1000 years B.P. The Dorset Eskimo reached Hudson Bay, Labrador, and Greenland (Arutiunov and Fitzhugh 1988; Dumond 1977).

Various Eskimo groups have adopted and adapted to the cultures around them as well as receiving impulses from the Bering Strait region. Oil lamps and semi-subterranean houses with sod roofs were widespread, extending to nearly all Eskimo settlements outside of Greenland. Various changes in tool technology came about and rapidly spread to other Eskimo groups. On Kodiak Island, for example, earlier influences came from the Bering Sea region, features such as the stone splitting adze and vapor sweat bath probably came from the northern Northwest Coast, and this

culture was later overwhelmed by the sea mammal intensive Norton stage, which preceded the Thule Tradition. The Aleuts apparently were influenced somewhat by technological waves but retained their distinctive material culture (Dumond 1977).

The Thule Tradition was a shift to total dependance on maritime resources, and included oil lamps, polished slate tools, extensive sea hunting implements, and kayaks and umiaks. The oldest Thule sites are on St. Lawrence Island and the nearby Siberian Coast in Siberia and are not older than 2000 years B.P. A warming trend helped the Thule Eskimos expand to Greenland, Baffin Island, and Labrador along with more sea mammals, especially whales. Any remnants of previous Eskimo groups and traditions in these areas were assimilated by the Thule migrants. Little influence is indicated from the former occupants. Dumond (1977) mentions suggestions that some Thule features, like the toggling harpoon head and the increased use of polished slate are influences from the southern Asian coast, or from the Pacific coast of Alaska, which showed these traits as well as oil lamps much earlier (Dumond 1977). It is quite possible that the south Alaskan traits diffused not only to the Bering Strait area, but also to the Okhotsk Sea coast via the Aleutians and Kamchatka.

The Eskimo culture, at least their dependance on sea mammals, spread farther than the Eskimos. By 3000 years B.P., the ancient Koryaks and Okhotsk cultures were sea mammal oriented, with Norton-like artifacts and pottery (Dumond 1977). Arutiunov and Fitzhugh (1988) saw Eskimo artistic influences from southern Asia as

well as on Northwest Coast Amerindians. The presence of Eskimo place names on the Kamchatka peninsula is evidence of their formerly greater range. Relatively recently, the connections between the Old World and the New World weakened, for bronze blades, certain tools, and reindeer breeding never reached America.

Archaeological finds associated with proto-Eskaleut groups in Siberia, in areas occupied by the ancient Koryak, seem to suggest a great influence if not a common ancestry (Arutiunov 1988b; Befu and Chard 1964; Vasil'evskii 1964). The Koryak and Chukchi are believed to have arisen from the same ancient groups, but the Koryak differ due to their close contact with the Kamchadal and proto-Eskaleut of Kamchatka. Their common history is expressed in Eskimo and Koryak mythology, belief, ritual, social structure, and funeral clothing (Arutiunov 1988b). The ancient Koryak territory also extends to areas of the north Okhotsk sea coast, where the Koryak overlapped with the Nivkhi, who were formerly more widely dispersed.

Archaeological evidence in the Okhotsk Sea area has established the Eskimo affinities of the early Koryak. The archaeological cultures show no affinities to Japanese or Ainu cultures, but rather, to cultures on the mainland to the to the north (Befu and Chard 1964). At around 4000 years B.P., the Koryak spread southward to the Okhotsk shore in Kamchatka and came into contact with proto-Eskaleut elements that still lived there. The Koryak culture was eclectic, with elements of caribou hunting and fishing coming from the expanded Nivkhi and ancient Eskaleut

influences. The mainland P'iagina finds, dating roughly between 3000 and 1500 years B.P. are attributed to the Koryak because of dwelling types, blubber lamps (which other local groups do not use), and the presence of Koryak place names in the area (Vasil'evski 1964). Both toggled and simple harpoon heads have been found in many sites on the Okhotsk coast. Sea mammal bones made up 90% of the recovered fauna, and arrow points and check stamp pottery were identical to Eskimo Punuk types.

In the Kurile Islands there were wide varieties of harpoon types found, especially in the southern islands, and in the north, ones similar to Aleutian types. Domesticated dogs showed cranial affinity to dogs from Sakhalin, and the pottery type is quite common in southern Sakhalin. Large numbers of sculptures of sea mammals were found throughout the islands and Hokkaido. The dispersed settlements in the northern Kuriles are testimony to the navigational skills of the Kurilians. Whaling was apparently conducted in a large boat with several crewmen, i.e. the Bering Strait style, based on wood carvings. Labrets were found in the Kuriles, but some claim they are from Aleuts transferred by the Russians in the 19th century. Other labret finds are supposedly more secure. Numerous burials were exposed and differences in social status are suggested by the widely varying amounts of grave goods (Befu and Chard 1964).

Based on archaeological and ethnographic information, there were interconnected culture flow networks in the North Pacific. Many isolated traits, depending on their practicality or applicability, could be eventually widely diffused. Much more work is needed in the North Pacific, especially in the Kamchatka and Okhotsk coasts and the south Alaskan coast.

Cultural diffusion, as Boas reminded us, can occur without linguistic change. Such a change has been documented in Newfoundland among English settlers who arrived in the 19th century (Firestone 1992). The settlers adopted many Eskimo garments and footgear, and continued to use them in the 20th century. These settlers even adopted the Eskimo taboo of eating seal and caribou together and some women carried babies on their backs. These diffusions occurred without significant gene flow. In other parts of Newfoundland, there was considerable admixture and more marked cultural integration (Firestone 1992). It seems clear that in extreme environments or periods of subsistence stress, migrant human groups that imitated or borrowed the successful adaptations of indigent groups would have a better quality of life, if not a better chance of survival.

The latest archaeological data seem to point to a rather late habitation for Siberia and Beringia, and thus, America. North Pacific archaeology is marked by sporadic discoveries of new sites (Ackerman 1992a; Bower 1993; Hoffecker 1993) which dramatically change the questionable support often cited in biological papers

(e.g. Laughlin 1963, 1975, 1980; Laughlin and Harper 1988; Harper 1980; Greenberg *et al.* 1986). Recent archaeological data have dramatically changed chronologies and events. New efforts in coastal and underwater archaeology may further illuminate the earliest migrations in the north Pacific, and erode more long-held beliefs (Easton 1992). As we have seen, the limited nature of North pacific archaeological data has greatly influenced biological research and interpretations.

In 1951, Chard recognized that Boas' "Americanoid" theory was based almost entirely on cultural information. He compiled and published summary statistics from Brodsky-Jochelson (1907) and other researchers because "the data of physical anthropology have been inadequate to confirm or deny this hypothesis, or to supplant it with a new one" (pg. 28). The observations of Soviet physical anthropologists seemed to refute Boas' ideas of the Eskimo "wedge", but there were no thorough analyses available. Using genetic data, Szathmary (1979b) could not adequately test the Eskimo wedge hypothesis. The situation today is much the same.

Attempts to verify or disprove migration theories have remained inconclusive. The well known multidisciplinary three wave hypothesis (Greenberg *et al.* 1986) fails in all areas of analysis due to an overreliance on linguistics. As we have seen, linguistic change can occur without biological change and vice-versa. Eskimo - Aleut biological affinities based on a close linguistic relationship remain controversial, and recent linguistic data indicate that Aleuts share linguistic elements with certain

Northwest Coast tribes. Do they show biological affinities? Ethnographic and archaeological data indicate that cultural networks were in operation between various north Pacific groups. Was there gene flow as well? The ideal data set to help answer these questions would include data collected consistently from many peoples and locations around the north Pacific, would have demographic information such as tribal identification and admixture, and be amenable to thorough multivariate analysis. Craniometric data have shown promise but there are insufficient samples available. Genetic data available today cannot provide reliable answers to these questions, and genetic data collected in the future may be of little use because of greater admixture in many tribes.

Some answers may come from skeletal data in future excavations, but there is also a source from the past, from anthropometric data collected from around the north Pacific 100 years ago under Franz Boas.

Chapter 4

Anthropometric Data Collection and Analysis under Boas

Data Sources

Boas collected and directed the collection of anthropometric data through various expeditions and funding opportunities (Table 1). His first official funding came from The British Association for the Advancement of Science (BAAS). The BAAS funded Boas' first anthropometric data collecting on the Northwest Coast. He collected the first measurements there on May 31, 1890 (Boas data sheet). Boas produced many summary reports for the BAAS with linguistic, geographical, and anthropometric data. In early 1891, Boas accepted a position to prepare exhibits for the 1893 Chicago World's Fair, which celebrated the 400th anniversary of Columbus' discovery of America. His work entailed organizing and supervising the artifact collectors on the Northwest Coast as well as travelling there to collect artifacts and anthropometric data (Cole 1985).

Table 1. Measurements in the Boas data base collected by Boas

Year	Number	Locations
1890	244	OR; WA; B.C. (British Columbia)
1891	646	Carlisle, PA; Hampton, VA
1892	47	OR
1894	493	B.C.
1895	195	CA
1897	459	B.C.
Total	2088	

There are also other sources for the Boas data. There is a Nivkhi sample measured on the Amur river and on Sakhalin Island in July of 1893 by Dr. D.S. Moncrieff, who also measured Northwest Coast tribes for Boas from 1891 to early 1893. Included with the Nivkhi data is a card that says "Dr. Moncrieff's data are unreliable". What this actually means, however, is uncertain. Moncrieff was an experienced measurer and the measurement locations are on Sakhalin island and the lower Amur. Most of the measured subjects had Nivkhi and a few had Russian-like names (Igor Krupnik, personal communication). Boas apparently never mentioned or analyzed these data, but of course, he never analyzed *any* of the Siberian data.

Eskimo from the Mackenzie Delta and Labrador measured in 1898 and 1901 are also included. Boas apparently talked A.J. Stone, a naturalist, into measuring Eskimos while he was collecting fauna in the MacKenzie Bay area for the American Museum (Boas 1901). There are anthropometric data collected by the Jochelsons in the Aleutians from 1909 to 1911 as part of the Aleut-Kamchadal Expedition of the Imperial Russian Geographical Society. There is also a Goajiro sample from Columbia. In all, there are data from over 18,000 American and Siberian natives.

Previous Analyses of Boas' Data

Some of the Boas anthropometric data have been analyzed using representative groups of North America (Jantz *et al.* 1992; Falsetti 1989), tribes in the same general area of America, such as the Northwest coast (Hall and McNair 1972), and within tribal

comparisons (Prince 1989; Stivers 1990; Sullivan 1920). What Boas had envisioned from the JNPE, however, was an analysis of groups on both sides of the north Pacific. Never before nor since has such an amount of wide ranging, high quality north Pacific data been available for use in answering questions of Amerindian origins and relationships. In contrast to the cultural data, no one ever published an analysis of the JNPE anthropometric data, perhaps as testimony to the vast amount of data collected and the statistical and computational rigor required.

Boas probably knew he could not finish a comprehensive analysis of the anthropometric data, because he was one of the few human biologists who used quantitative data responsibly. A thorough and responsible analysis might require years of calculations that would not be appreciated in a typological environment, as was the case with his studies of heredity (Herskovits, 1953). The most practical comparisons he could hope for would be done using means and indices. These would be of questionable value because Boas also recognized how correlation and covariance confound the ability to distinguish real differences between peoples. After briefly reviewing these problems and alluding to a need for multivariate statistical procedures, Boas even went so far as to write:

> "I have tried to point out in these remarks a few directions in which it would seem that our anthropometrical material may be made more useful and significant than it is at the present time... I am fully aware of the difficulties and of the vast amount of labor involved in carrying out any of the suggestions here outlined, but I fully believe that any labor devoted to this matter will be repaid by results interesting from a scientific point of view... and I hope that our deliberations may lead to a way of making the vast amount of anthropometric work that we are doing more useful in scientific and practical lines" (Boas 1902:180)

Boas realized that a comprehensive analysis would require better statistics, and with them, an even greater amount of labor. Despite this recognition, Boas had wanted Jesup to fund more data collection beyond 1902, but since Boas had not begun a summary volume, Jesup would not, and even threatened to halt funding of publications. Boas begged him not to and Jesup relented, but their relationship grew colder (Freed *et al* 1988). Finally, Boas resigned from the American Museum in 1905 to teach at Columbia University and took the anthropometric data with him, but devoted most of his time to cultural anthropology. His biological studies then centered on childhood growth and differences between Europeans and U.S. immigrants and their children. All of his anthropometric records were kept in his office until 1942, shortly before his death, when he wrote to Dr. Harry Shapiro at the American Museum and asked him to take them (Boas 1942). They remained at the AMNH untouched for over 40 years.

The Rediscovery of Boas' data

This lack of analysis was mentioned by T. Dale Stewart in *The People of America* (1973), which is how Richard Jantz learned of its existence. He sent a letter to D.H. Thomas, the chairman of the anthropology department at the American Museum of Natural History in New York, inquiring about the Boas anthropometric records. Not only were the Jesup records there, but nearly all other anthropometric data collected under Boas and others between 1890 and 1911. These records were loaned to the University of Tennessee in 1984. Data entry began in 1987 and required about 4000 hours of labor. Data corrections and revisions continue today. Also stored with the data

was an unpublished manuscript by Dina Jochelson summarizing the Siberian anthropometric data that was apparently sent to Boas after 1911. She conducted the only published summary of the Siberian data, based on Siberian female data from her doctoral dissertation (Brodsky-Jochelson 1906; Chard 1951).

The Siberian and Amur researchers reported collecting data from over 1900 subjects (Boas, 1903). UT recovered 1414 records, and there are excellent sample sizes for most groups. About 300 records are missing from Siberia based on reports to Boas from Jochelson and Bogoras. Specifically, many Kamchadal and Yukaghir are missing, based on the unpublished manuscript by Dina Jochelson. Additionally, all of Laufer's data from 150 or so Amur peoples are missing.

JNPE Data Collection

Data collection began in the Summer of 1897 in southern British Columbia, and Boas personally measured over 450 out of a total of 579 subjects measured. Collection continued on the Northwest Coast through 1898.

The movements of the various teams are chronicled on the data sheets which include the observer, observation place, and date. The demographic information about measured individuals includes tribe, age, sex, occupation, birthplace, tribe of the mother and father, and number of children, many of which were also measured. Admixture in a subject can be finely quantified thanks to the meticulous recording of the tribe and

admixture of each parent, sometimes recorded as 3/4 of one tribe, 1/4 of another. Anthroposcopics include hair color, form, and distribution, including beard and mustache, form of eyes, nose, lips, and ears, and skin color based on color charts.

On the western side of the Pacific, Berthold Laufer began work in 1898 on Sakhalin Island and along the Amur river, and continued through 1899. The northern collecting began in late Summer, 1900, with Waldemar Bogoras and his wife leading one team, and Waldemar Jochelson and his wife leading the other. Alexander Axelrod was the unsung hero of Jesup anthropometric data collection. He travelled mainly with the Jochelsons and measured over 1,150 Siberians.

Trans-Pacific Data

Table 2 shows the North American groups for comparison, of which the JNPE made a contribution of about 450 individuals. Boas was well aware of which groups had not been measured before the JNPE, since he was in charge of the data collection for the 1892 World's Columbian Exposition, for the British Association for the Advancement of Science, and for other research expeditions. The 1892 exposition provided data from all of North America including data from many Northwest Coast tribes, and some researchers went to Baffin Island and Labrador to collect data on the Eskimo. Additionally, the Huntington California Expedition ran concurrently with the Jesup Expedition. Boas did not need redundancy. He realized that he had to record the information before the disappearance of many of these tribes. As testimony to his

Table 2. Groups available for analysis

Tribe	Number	Language	Area
Aleut	30	Aleut	**Aleutians**
Bella Coola	19	Salish	**Southern Northwest Coast (NWC)**
Carrier	26	Athapascan	Northern Plateau/Southern Subarctic
Chilcotin	42	Athapascan	Northern Plateau
Chuvantsy	33	Paleoasiatic (Yukaghir)*	Eastern Siberia
Coastal Chukchi	55	Paleoasiatic (Chukchi)	**Chukchi Peninsula**
Reindeer Chukchi	107	Paleoasiatic (Chukchi)	Eastern Siberia
Labrador Eskimo	30	Inuit	**Labrador**
MacKenzie Eskimo	26	Inuit	**Ft. McPherson, Herschel Island**
Siberian Eskimo	106	Yupik	**Chukchi Peninsula**
Even	31	Tungus	Gizhiga Bay area
Evenk	105	Tungus	Gizhiga Bay area
Haida	45	Na-Dene*	**Mid-NWC**
Koryak	241	Paleoasiatic (Koryak)	**Penzhina Bay, Upper Kolyma**
Reindeer Koryak	26	Paleoasiatic (Koryak)	Upper Kolyma
Kwakiutl	75	Wakashan	**Southern NWC**
Lillooet	150	Salish	Northern Plateau
Makah	56	Wakashan	**Southern NWC**
Navajo	61	Athapascan	Southwest US
Nivkhi #	17	Paleoasiatic (Gilyak)*	**Lower Amur region, Sakhalin**
Okanagan	54	Salish	Northern Plateau
Quillayute	30	Chimakuan	Southern NWC
Tahltan	23	Athapascan	Northern NWC
Tenino	37	Penutian	Southern Plateau (WA, OR)
Thompson	174	Salish	Northern Plateau
Tsimshian	60	Penutian	**Mid-NWC**
Yukaghir	38	Paleoasiatic*	Eastern Siberia
Total	1708		

* language isolate
\# Males only

Island/Coastal groups are shown in bold

foresight, several of the tribes measured from 1890 to 1902 are now extinct.

Siberian Group Descriptions

Since many of the Siberian groups may be unfamiliar to the reader, a brief description of each is provided.

Maritime Chukchi, measured on the coast of the Chukchi peninsula. **Reindeer Chukchi**, measured at several locations on the Chukchi peninsula.

The Reindeer Chukchi breed the most reindeer in Siberia for slaughter, both in total number and in size of individual herds. The Maritime Chukchi subsist on sea mammal hunting. There is considerable interaction between the two, and group membership can change. The Reindeer Chukchi share and barter their meat with the Maritime groups during times of need, and trade with each other very often. The Russian Empire never subdued the Chukchi. The only way the Russians could get many Chukchi to pay tribute was to exchange gifts of much greater value. There was no Russianization of the Chukchi, who refused to speak another language, change their way of life, or religion. The few Russian influences up to the turn of the century had been the use of tobacco, tea, a chimney in houses, and the transliteration of several Russian riddles and proverbs (Bogoras 1901,1909; Antropova and Kuznetsova 1964).

Chuvantsy, measured in east central Siberia.

The Chuvantsy are a Yukaghir tribe that lived in an area bounded roughly by Markovo, Yeropol, and the Penzhina river at the time of the Jesup expedition (Bogoras, 1904-9). Jochelson remarked that at the time of the JNPE, the Chuvantsy were either Russianized or influenced by the Koryak or Chukchi (Jochelson 1926b). The Chuvantsy were bounded by Reindeer Chukchi to the north and Reindeer Koryak to the south. Some Chuvantsy practice reindeer breeding and speak Chukchi, while others fish and hunt (Stepanova *et al.* 1964).

Eskimo, measured at Indian Point (*Mys Chaplino*)

The Siberian Eskimo inhabit the Eastern coast of the Chukchi peninsula, often in close contact with the Chukchi. They share many cultural practices and beliefs with the Chukchi but speak dialects of Yupik Eskimo. Their subsistence is primarily from hunting sea mammals, walruses, whales, and seals (Bogoras, 1909; Menovshchikov 1964; Fitzhugh 1988b).

Evenk and **Even**, measured throughout southern central Siberia.

The Evenk and Even are close in origin, language (Tungus), and culture. The Evenk were the most widespread group in Siberia, ranging from the sea of Okhotsk to the Yenisey river in the 17th century. The Evens are bounded by the Chukchi, Koryak, Yakut, and Evenk. Both groups are reindeer breeders and hunters, while some Evenk

are farmers and pastoralists, and some Even migrate to the coast and fish in the spring. Compared to the Chukchi reindeer, Evenk reindeer are larger and healthier due to controlled breeding, since the Evenki ride the reindeer on their shoulders. Few Evenki breed reindeer for slaughter. (Arutiunov 1988a; Levin and Vasilyev 1964; Vasilevich and Smolyak 1964)

Kamchadal, measured on the Kamchatka peninsula, most on the west coast.

The aboriginal group of the Kamchatka peninsula, the Itelmen, had been almost totally assimilated by the turn of the century. Most were assimilated by emigrant Russians and became known as the Kamchadal. Fishing for salmon was especially important, using nets and hooks. Some groups hunted seals as well. Gathering plant foods was more important for them than for other Siberian groups (Antropova 1964b).

Maritime Koryak and **Reindeer Koryak**, measured in the northern part of the Kamchatka peninsula, the Penzhina Bay area, and the upper Kolyma river area.

The Koryak groups, unlike the Chukchi, have several divergent dialects. The Reindeer Koryak are very close culturally to the Reindeer Chukchi, their neighbors to the north, and their languages are mutually intelligible. The coastal Koryak hunt seals and small whales, and both groups also rely on fishing. (Arutiunov 1988; Antropova 1964b)

Nivkhi, (Gilyak) measured in the Amur river area and Sakhalin.

The Nivkhi speak a unique paleo-asiatic language and are thought to be the direct descendants of the neolithic population of the Amur region. Their language is quite distinct from the Tunguso-Manchurian groups around them, whose speakers also moved into northeastern Siberia. The mainland Nivkhi are primarily fishermen, secondarily land hunters, while the Sakhalin Gilyak hunt mainly sea mammals. The Nivkhi are among the most tabu oriented peoples in the North Pacific. Marriage practices up to 1917 were unusual in that, according to one source, the Nivkhi were made up of exogamous patrilineal clans, and a male would marry his mother's brother's daughter, establishing clan alliances, while according to another, the clans were merely exogamous in giving and receiving female mates. In any event, there was an agnatic kinship system (Ivanov, Levin, and Smolyak 1964; Black 1973, 1988).

Yukaghir, measured in northeastern Siberia.

The Yukaghir are the northwestern neighbors of the Evens. There are not many left today due to 19th century plagues and famines, and many have been assimilated by Even, Evenk, Chukchi, and Yakut populations. According to Jochelson, the Yukaghir were in serious decline at the time of the Jesup expedition due to poor health, low fecundity, and assimilation and admixture with neighboring tribes. Dina Jochelson supposedly recorded tribe as "Yukaghir" for the Even and Evenk living near the Yukaghir, due to reported intermarriage (Jochelson 1926b:20). The Yukaghir speak a paleo-asiatic language, but with several divergent, mutually unintelligible dialects. Most

Yukaghirs were bilingual at the time of the JNPE. The upper Kolyma Yukaghir spoke Yakut and the Tundra Yukaghir spoke Even, and often Chukchi and Yakut as well as Russian. Some Yukaghirs assimilated by the Evens called themselves Evens. Some Yukaghir bred reindeer with knowledge gained from the Evenk. Many converted to primarily hunting and fishing after catastrophic reindeer epidemics (Stepanova *et al.* 1964).

Chapter 5

Statistical Methods and Results

Anthropometric variables

Boas' philosophy was that it was better to collect fewer measurements on more people than vice-versa (Boas, unpublished manuscript). Anthropometric information common to all data sheets include the six body and six face measurements in table 3. These were recorded to the nearest millimeter.

Table 3. Anthropometric measurements in the Boas data base.

Standing Height
Shoulder Height (acromial height)
Sitting Height
Finger Reach (span of arms)
Finger Height (height of point of second finger)
Shoulder breadth (biacromial breadth)
Head Length (maximum)
Head Breadth (maximum)
Face Breadth (bizygomatic breadth)
Nose Height (nasion-base of nose)
Nose Breadth (maximum)
Face Height (nasion-menton)

The back of the Siberian sheets had space for more anthropometrics than the North American sheets. Boas apparently made it clear that the Siberian researchers should record at minimum the measurements used by the North American researchers, for there are very few that lack all 12 measurements.

Data Preparation

For the purposes of this study, several synthetic variables were generated. Arm length was derived by subtracting finger height from shoulder height, as Boas had intended, since both measures could be taken in rapid succession without the movement of the subject (Boas 1894b). Leg length was calculated by subtracting sitting height from standing height. Finger height and sitting height were then dropped due to linear dependency.

Data from individuals of 3/4 or greater Indian purity were used. The data set was also limited to individuals between 21 and 59. These age ranges were chosen due to a suggestion of delayed maturity (Boas 1894b) and loss of height with age. Also, many individuals with an age of 20 and 60 had estimated ages.

Canonical Discrimination and Dendrograms

The measurements from each sex were standardized and pooled to increase sample sizes and analyzed using SAS PROC CANDISC for canonical discrimination (SAS Institute, Inc., 1985). This type of analysis acts to separate the groups as much as possible along multiple variance maximizing axes using a linear combination of group means and the pooled variance-covariance matrix. Canonical discrimination converts the information expressed by many quantitative variables into fewer uncorrelated variables, the canonical axis scores. It also produces a distance matrix consisting of pairwise differences expressed in one number between each set of groups using all axes (Tatsuoka

1988). The significance of the distances were tested based on the F distribution of Hotelling's T^2 statistic (Davies 1971), where:

$$T^2 = \frac{N_1 N_2}{N_1+N_2} D^2$$

and

$$F = \frac{N_1+N_2-m-1}{(N_1+N_2-2)m} T^2$$

The top formula calculates Hotelling's T^2 statistic, where N_1 and N_2 are the sample sizes of each group and D^2 is the distance between them. The T^2 value is then plugged into the bottom equation, where **m** is the number of variables, and an F statistic is generated.

Dendrograms were formed using the distance matrix and NT-SYS pc version 1.80 (Rohlf 1993). There are various clustering algorithms available but using both UPGMA (unweighted pair-group method, arithmetic average) and COMPLETE yielded similar results. Cophenetic values were computed and compared to the original distance matrix. UPGMA showed the highest cophenetic correlation, indicating that the UPGMA tree represents the best fit to the data (Rohlf 1993). UPGMA first joins the two most alike groups in a sample, treats them as one group, calculates the mean distance to other groups for this couple, and then finds the closest pair of groups once again. This procedure is repeated until all groups are connected.

Canonical analysis of Siberians

Figure 2 shows the results of a canonical discriminant analysis of the Siberian data. The first six canonical axes were significant at $p < .01$. The horizontal (x) axis is the first canonical axis, and the vertical (y) axis is the second canonical axis. Examination of the between-group canonical structures (Table 4) shows that groups that score high on the first canonical axis have relatively longer legs and shorter arms, larger faces, taller and wider noses, and are more brachycephalic than those on the left in Figure 2 with the opposite general pattern. The second canonical axis separates groups in the upper half who have relatively shorter statures, with larger heads, narrower shoulders, and taller noses from those below. Since only two axes are displayed out of 10 total axes, some information is lost. In this case, however, the first two axes represent 75% of all information in the measurements. The first axis separates speakers of paleoasiatic languages from the Tungus speakers, except for the groups from the Kamchatka peninsula. The second axis separates the Chukchi and Kamchatka peninsula groups from groups that live for the most part between these areas.

On the whole, Geography reflects group relationships better than language. Four groups well separated anthropometrically, geographically, and linguistically are the Chukchi, Kamchadal, and Penzhina Koryak, speakers of different paleoasiatic languages, and the Tungusic speaking Evenks. The groups that plot in each of these clusters, though, speak various languages and are close geographically.

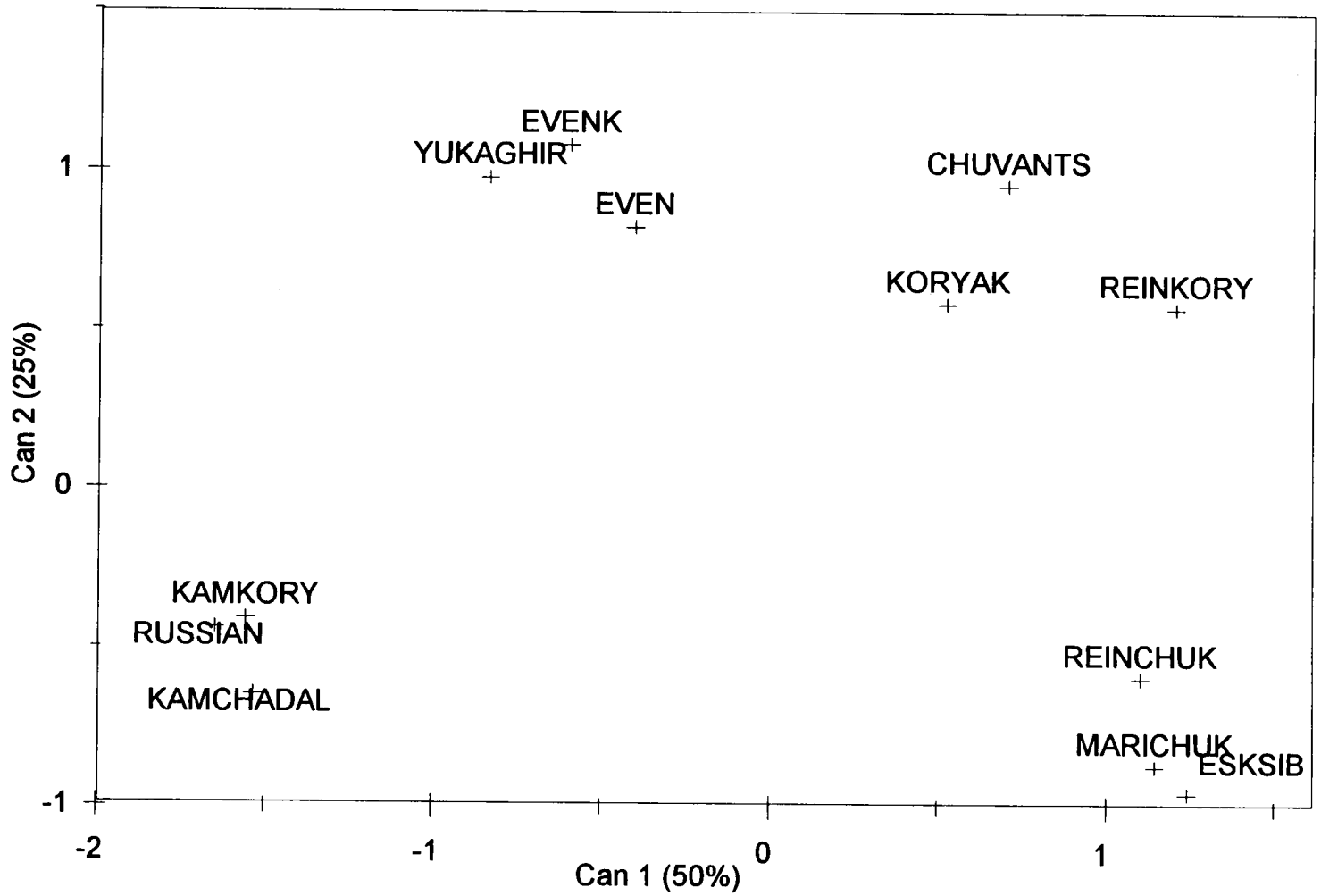

Figure 2. Canonical Plot of Siberian Groups.

Table 4. Between-canonical structure for Siberians

Measurement	Can 1	Can 2
STANDHT	0.329	-0.840
SHLDRHT	0.273	-0.847
FINGERR	-0.767	-0.549
SHOULDWT	0.026	-0.803
HLENGTH	-0.291	0.559
HEADBRTH	0.699	0.337
FACEHT2	0.831	-0.061
FACEBRTH	0.816	0.156
NOSEHT	0.842	0.356
NOSEBRTH	0.803	-0.367
ARML	-0.867	0.064
LEGL	0.783	-0.290

The most isolated cluster is from the Kamchatka Peninsula. The Kamchatka cluster includes the Kamchatka (Palantsy and Karagintsy) Koryak, the Kamchadal, and the Kamchatka Russians. This cluster reflects gene flow between all three, as Jochelson did not visit the isolated villages in far southern Kamchatka where the aboriginal inhabitants (Itelman) lived. At the time of the JNPE the Kamchadal and Koryak of the Kamchatka peninsula had been intermarrying with the Russians for nearly 200 years (Jochelson 1908). In the 18th century, the Kamchadal were distributed more northward, overlapping with the Koryak (Antropova 1964a). While language is not necessarily a barrier to gene flow, dialects can reflect social interactions. The Koryak on Kamchatka speak Aliutor, a distinctive dialect of Koryak, if not a separate language (Krauss 1988). The Kamchadal samples are from the western linguistic branch, which include dialects greatly influenced by Koryak and Russian (Antropova 1964a; Arutiunov 1988b). Nearly

all Kamchatkans measured had Russian names.

The Chukchi groups and Siberian Eskimo make up the Chukchi peninsula cluster. All three have mutually understandable languages and trade with each other, and Maritime Chukchi and Siberian Eskimo groups often live adjacently. According to historical accounts, the Maritime Chukchi have been slowly assimilating the Siberian Eskimo (Menovshchikov 1964), a fact well illustrated by the anthropometrics. Table 5, the distance matrix, which takes all variation into account, verifies that the Siberian Eskimo are closest to the Maritime Chukchi. Outside of the Even-Evenk-Yukaghir distances and the Koryak-Reindeer Koryak distance, all were significant at $p < .001$.

The Evenk cluster represents much of southern Siberia. The relatively recent formation of the Even, believed to be from the assimilation of Yukaghir, Koryak, and other elements by northeastern Evenk (Arutiunov 1988a; Levin and Vasilyev 1964), is reflected by the anthropometrics. The Even group centroid lies between these three groups, and is closer to the Evenk and Yukaghir than to the Koryak, implying a greater contribution of these peoples to their ethnic makeup.

The loose cluster of (Penzhina Bay) Koryak, Reindeer Koryak, and the Chuvants is distorted in two dimensions, because the distance matrix (Table 5) shows that the Chuvantsy are roughly equidistant from the Koryak, Reindeer Koryak, and Yukaghir. There has evidently been significant gene flow between the Reindeer Koryak and the

	ALEUT	BELLA	CARRI	CHIL	CHUV	ESKLA	ESKMA	ESKSIB	EVEN	EVENK	HAIDA	YUK	KORYA	KWAK	LILL	MAKAH	MCHUK	NAVAJ	NIVKHI	OKAN	QUILL	RDKOR	RCHUK	TAHL	TENIN	THOM	TSIM	
ALEUT	-	5.23	13.53	8.95	12.66	10.02	13.73	10.40	7.77	9.16	12.23	8.92	11.60	4.37	10.72	6.01	11.80	15.39	8.65	12.62	8.54	14.67	12.45	8.04	11.52	10.40	9.84	ALEUT
BELLA	5.23	-	13.53	8.96	13.40	12.39	13.24	15.31	11.72	12.68	11.02	9.88	13.84	4.14	9.53	6.03	16.03	16.16	8.43	11.71	8.75	16.95	14.47	6.44	12.66	11.81	8.82	BELLA
CARRIER	13.53	13.53	-	3.40	9.93	8.24	8.87	6.41	10.62	10.00	10.22	10.66	6.67	9.92	6.15	10.09	4.77	9.26	9.29	7.67	15.69	6.12	4.04	6.82	7.41	6.36	11.70	CARRIER
CHILCOTI	8.95	8.96	3.40	-	14.09	7.31	13.26	9.55	10.47	11.01	6.67	10.55	8.62	6.35	2.22	4.25	6.33	4.27	4.80	4.87	6.22	9.18	5.98	6.63	2.67	2.54	5.72	CHILCOTI
CHUVANT	12.66	13.40	9.93	14.09	-	6.97	7.95	4.89	4.22	4.10	15.42	4.21	3.54	8.43	14.85	16.41	5.68	25.63	11.20	15.11	23.46	3.38	4.78	11.46	19.31	15.32	16.80	CHUVANTSY
ESKLAB	10.02	12.39	8.24	7.31	6.97	-	6.91	5.48	2.47	2.73	6.05	3.71	1.48	4.75	6.00	10.16	4.77	11.09	5.96	5.53	14.10	3.33	4.29	9.08	11.89	4.58	6.77	ESKLAB
ESKMAK	13.73	13.24	8.87	13.26	7.95	6.91	-	4.32	9.90	8.77	12.56	10.49	5.04	7.16	14.64	13.63	7.48	16.16	12.91	11.52	23.88	7.51	7.12	8.17	18.14	12.30	13.23	ESKMAK
ESKSIB	10.40	15.31	6.41	9.55	4.89	5.48	4.32	-	6.12	6.03	11.44	8.36	3.52	6.07	11.98	12.42	1.21	15.91	11.29	11.07	20.18	3.87	2.32	8.62	13.59	9.81	12.02	ESKSIB
EVEN	7.77	11.72	10.62	10.47	4.22	2.47	9.90	6.12	-	0.88	8.77	1.27	2.95	5.76	8.81	11.38	6.09	17.89	7.39	10.44	14.69	4.64	5.10	10.17	14.49	8.39	9.70	EVEN
EVENK	9.16	12.68	10.00	11.01	4.10	2.73	8.77	6.03	0.88	-	10.04	0.83	2.80	7.08	9.76	12.43	6.32	17.62	6.03	9.67	17.60	5.06	5.79	9.83	15.81	7.49	11.50	EVENK
HAIDA	12.23	11.02	10.22	6.67	15.42	6.05	12.56	11.44	8.77	10.04	-	11.00	9.08	6.00	4.95	6.10	9.90	10.66	8.06	2.62	8.62	11.15	8.90	6.70	7.43	5.36	1.00	HAIDA
YUKAGHI	8.92	9.88	10.66	10.55	4.21	3.71	10.49	8.36	1.27	0.83	11.00	-	4.20	6.44	9.32	12.27	7.98	18.03	5.47	10.78	16.27	6.43	6.80	10.23	16.42	8.06	11.75	YUKAGHIR
KORYAK	11.60	13.84	6.67	8.62	3.54	1.46	5.04	3.52	2.95	2.80	9.08	4.20	-	6.68	8.18	11.45	3.40	14.09	7.35	8.32	17.21	0.85	2.50	9.04	12.28	7.57	10.36	KORYAK
KWAKIUT	4.37	4.14	9.92	6.35	8.43	4.75	7.16	6.07	5.76	7.08	6.00	6.44	6.68	-	7.26	5.59	6.48	12.37	6.31	6.80	9.57	8.96	6.63	6.04	10.76	6.89	4.19	KWAKIUTL
LILLOOET	10.72	9.53	6.15	2.22	14.85	6.00	14.64	11.98	8.81	9.76	4.95	9.32	8.18	7.26	-	4.44	9.10	7.07	5.46	5.81	4.69	9.12	6.59	9.61	3.25	2.82	4.54	LILLOOET
MAKAH	6.01	6.03	10.09	4.25	16.41	10.16	13.63	12.42	11.38	12.43	6.10	12.27	11.45	5.59	4.44	-	11.37	8.81	4.75	7.53	2.41	13.90	9.81	7.84	2.72	5.88	3.60	MAKAH
MARICHU	11.80	16.03	4.77	6.33	5.68	4.77	7.48	1.21	6.09	6.32	9.90	7.98	3.40	6.48	9.10	11.37	-	12.86	8.90	8.93	17.36	2.88	1.05	9.22	10.41	7.17	10.34	MARICHUK
NAVAJO	15.39	16.16	9.26	4.27	25.63	11.09	16.16	15.91	17.89	17.62	10.66	18.03	14.09	12.37	7.07	8.81	12.86	-	9.55	7.78	11.18	17.00	13.43	9.89	7.17	3.75	9.46	NAVAJO
NIVKHI	8.65	8.43	9.29	4.80	11.20	5.96	12.91	11.29	7.39	6.03	8.06	5.47	7.35	6.31	5.46	4.75	8.90	9.55	-	5.26	8.74	10.02	8.43	9.14	7.69	3.11	6.77	NIVKHI
OKANAGA	12.62	11.71	7.67	4.87	15.11	5.53	11.52	11.07	10.44	9.67	2.62	10.78	8.32	6.80	5.81	7.53	8.93	7.78	5.26	-	12.04	10.50	9.62	5.94	8.31	3.29	3.69	OKANAGAN
QUILLAYU	8.54	8.75	15.69	6.22	23.46	14.10	23.88	20.18	14.69	17.60	8.62	16.27	17.21	9.57	4.69	2.41	17.36	11.18	8.74	12.04	-	19.25	14.89	13.34	3.63	8.77	5.46	QUILLAYU
RDKORY	14.67	16.95	6.12	9.18	3.38	3.33	7.51	3.87	4.64	5.06	11.15	6.43	0.85	8.96	9.12	13.90	2.88	17.00	10.02	10.50	19.25	-	1.75	11.61	12.66	10.03	12.76	RDKORY
REINCHU	12.45	14.47	4.04	5.98	4.78	4.29	7.12	2.32	5.10	5.79	8.90	6.80	2.50	6.63	6.59	9.81	1.05	13.43	8.43	9.62	14.89	1.75	-	9.93	8.75	7.25	9.42	REINCHUK
TAHLTAN	8.04	6.44	6.82	6.63	11.46	9.08	8.17	8.62	10.17	9.83	6.70	10.23	9.04	6.04	9.61	7.84	9.22	9.89	9.14	5.94	13.34	11.61	9.93	-	10.08	8.07	7.95	TAHLTAN
TENINO	11.52	12.66	7.41	2.67	19.31	11.89	18.14	13.59	14.49	15.81	7.43	16.42	12.28	10.76	3.25	2.72	10.41	7.17	7.69	8.31	3.63	12.66	8.75	10.08	-	5.93	6.16	TENINO
THOMPS	10.40	11.81	6.36	2.54	15.32	4.58	12.30	9.81	8.39	7.49	5.36	8.06	7.57	6.89	2.82	5.88	7.17	3.75	3.11	3.29	8.77	10.03	7.25	8.07	5.93	-	5.08	THOMPSON
TSIMSHIA	9.84	8.82	11.70	5.72	16.80	6.77	13.23	12.02	9.70	11.50	1.00	11.75	10.36	4.19	4.54	3.60	10.34	9.46	6.77	3.69	5.46	12.76	9.42	7.95	6.16	5.08	-	TSIMSHIA
	ALEUT	BELLA	CARRI	CHIL	CHUV	ESKLA	ESKMA	ESKSIB	EVEN	EVENK	HAIDA	YUK	KORYA	KWAK	LILL	MAKAH	MCHUK	NAVAJ	NIVKHI	OKAN	QUILL	RDKOR	RCHUK	TAHL	TENIN	THOM	TSIM	

Table 5. North Pacific Distance Matrix

Chuvants, whom they border. The distance matrix, which indicates that the Koryak are closer than the Reindeer Koryak to the Chuvantsy, may be somewhat deceiving because the Reindeer Koryak are much further from the Evenk cluster than the Koryak, and are most likely "pulling" the Chuvantsy closer to them through admixture by way of the Koryak.

Figure 3 is the dendrogram for the Siberian populations. This confirms the clusters observed in the canonical plot. The Siberian Eskimo are close to the Maritime and Reindeer Chukchi, which are more distantly related to the Koryak groups. The Chuvantsy group loosely with the Evenk cluster. The admixed populations of Kamchatka, as might be expected, are the outliers. This dendrogram showed a cophenetic correlation of .72 using the NT-SYS COPH program for the generation of cophenetic values and the MXCOMP program to compare the cophentic matrix to the original distance matrix. According the standards of cophenetic correlation in Rohlf (1993), this represents a "poor" fit to the distance matrix, yet the dendrogram seems to represent most of what was examined in the distance matrix and canonical plot. Some loss of information may be illustrated by observing that the Russian sample is closer to the Kamchadal Koryak in the distance matrix, while this relationship is impossible to determine from the dendrogram.

The Siberian relationships reflect a recurrent pattern in biological studies in other parts of the world, that groups in close proximity exchange genes with each other,

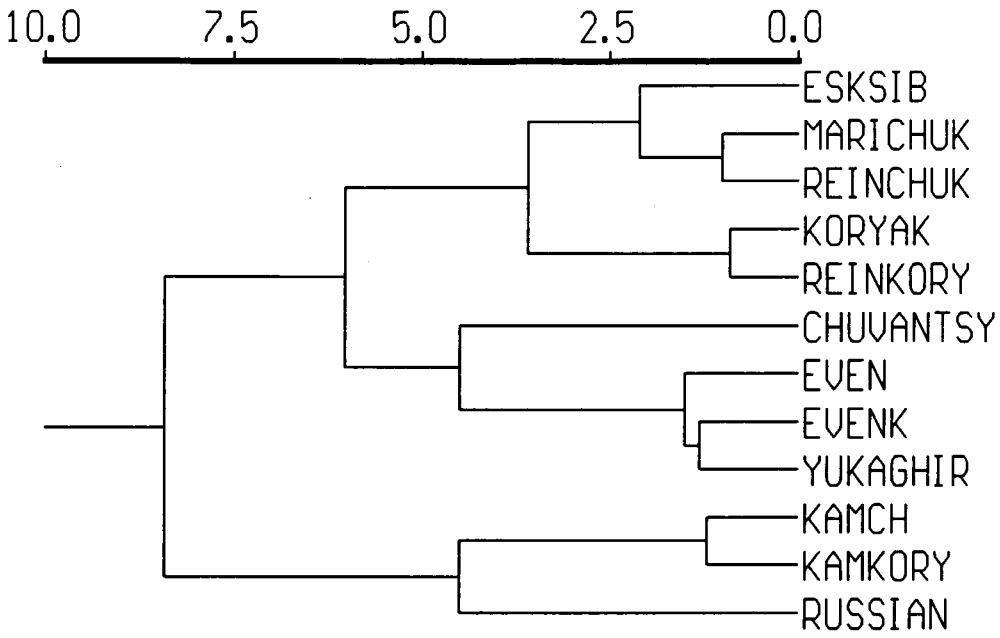

Figure 3. Siberian dendrogram.

whether concomitant with trade, warfare, or migration (Harding and Sokal 1988). Linguistic "barriers" are often not genetic barriers, but geographic barriers are more formidable than many cultural ones.

Trans-Pacific Canonical Analysis

Figure 4 shows what Boas had in mind when he directed the various expeditions around the turn of the century: A direct comparison of peoples on both sides of the North Pacific. The groups show excellent East-West separation along the first canonical (x) axis with several significant exceptions. The Mackenzie and Labrador Eskimo are the most "westwardly" displaced groups compared to geography and the Nivkhi are the most "eastwardly" displaced. The first axis thus divides Eskimo and Siberian groups from all

New World groups and the Nivkhi. The second axis divides the Old World between Siberian Paleoasiatics and Tungus speakers, and separates the New World fairly well into Athapascan and Salish speakers at the top, mid-Northwest Coast groups in the middle, and the Aleut, Bella Coola, and Kwakiutl at the bottom. The Kamchadal groups were not included due to the demonstrated extensive Russian admixture.

The first 11 canonical axes were significant at $p < .01$, and the between-canonical weights for the first two axes are shown in table 6. Groups that have higher scores on the first (x) canonical axis are taller and have longer arms, are more brachycephalic, have shorter and wider faces, and wider noses than groups on the left. The second (y) axis differentiates groups nearer the top that have relatively longer legs and smaller heads and faces. The axes in figure 4 represent only 56% of the variation, less than in the Siberian canonical plot.

Table 6. Between-canonical Structure for North Pacific Groups.

Measurement	Can 1	Can 2
STANDHT	0.634	0.192
SHLDRHT	0.677	0.255
FINGERR	0.887	-0.144
SHOULDWT	0.423	-0.174
HEADL	-0.361	-0.442
HEADB	0.819	-0.337
FACEHT	-0.691	-0.299
FACEBR	0.501	-0.530
NOSEHT	-0.604	-0.308
NOSEBR	0.799	0.184
ARML	0.840	-0.099
LEGL	0.444	0.575

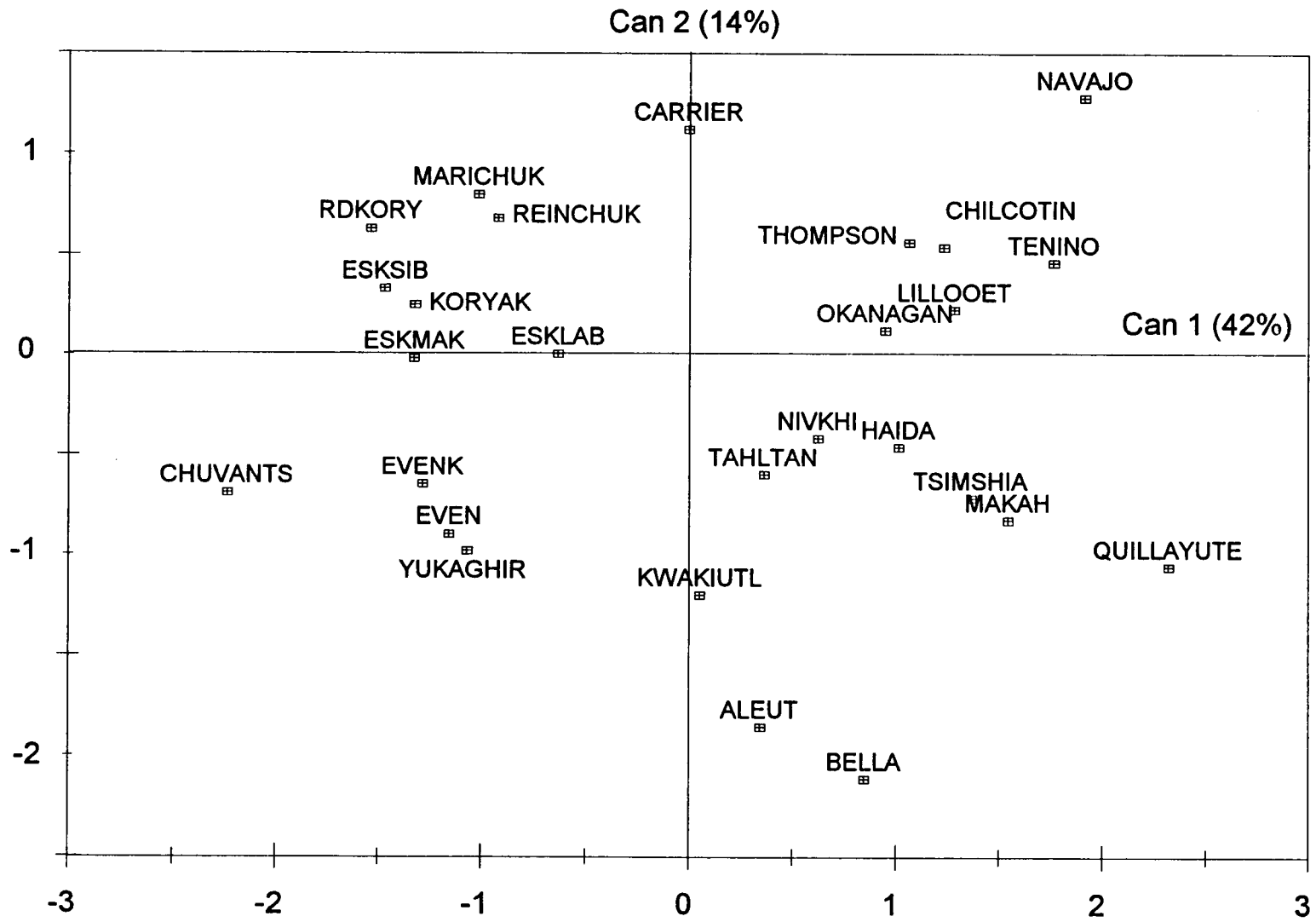

Figure 4. Canonical Plot of North Pacific Groups.

Figure 5 illustrates the sections of the graph dominated by various language or geographical groupings. These patterns reflect geography better than language, as Boas (1899) noted. The very loose Athapascan area at the top right is missing the Tahltan and Haida, who cluster with the middle Northwest cluster, which contains Wakashan and Penutian speakers as well. The Salish/Northern Plateau cluster includes the Athapascan Chilcotin, but the neighboring Salish speaking Bella Coola cluster with the Aleut. The Salish that cluster together are geographically contiguous, and the Chilcotin are situated just north of the Lillooet. This cluster could even be extended to include the Tenino, who reside in the southwest plateau region. The middle part of the New World side has the mid-Northwest Coast groups that speak a variety of languages and the Nivkhi. The Haida, who speak a NaDene isolate, live on Queen Charlotte Island and are closest overall to their neighbors across the Hecate Strait, the Penutian speaking Tsimshian. The Athapascan Tahltan reside just north of the Tsimshian. Interestingly enough, the Aleut cluster, mid-Northwest Coast, and Salish/Northern Plateau clusters produced by canonical discrimination correspond to the Kwakiutl, Northern, and Thompson River types that Boas (1899b) derived based on his observations and limited metric data. Hall and Macnair (1972) were able to confirm Boas' Thompson type in a Thompson-Lillooet-Chilcotin-Shuswap cluster. The New World clusters in two dimensions and in the distance matrix reflect geography better than language, as Spuhler (1979) observed in his sample. Still, the isolation of the Kwakiutl and Bella Coola with the Aleut does not fit geography. It does fit an assessment of Bella Coola culture by Boas, who found that the Bella Coola had adopted the social organization and culture of the other Northwest Coast

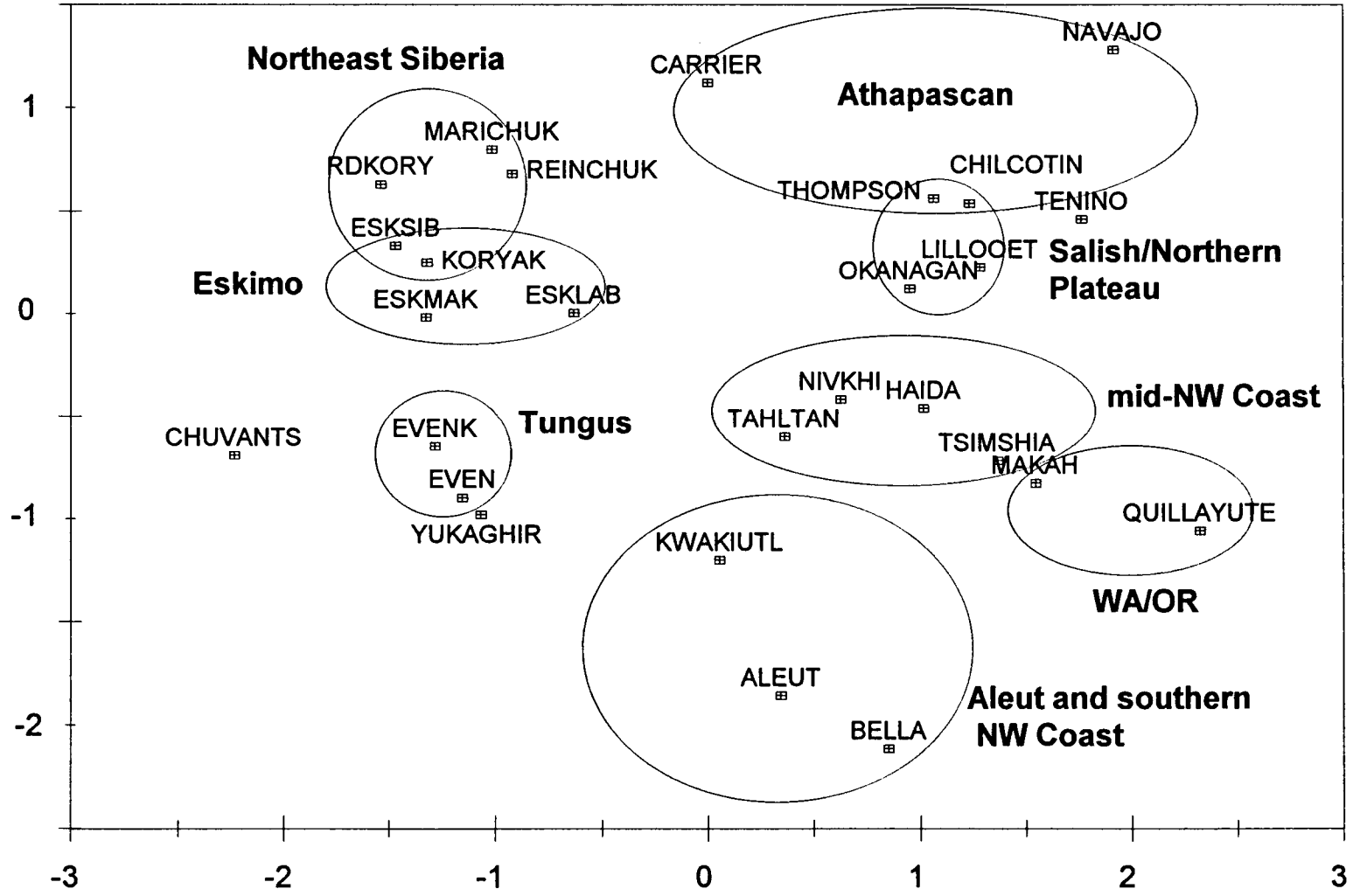

Figure 5. Canonical Plot with linguistic/geographical groupings.

tribes to a much higher degree than other Salish speaking tribes (Boas 1900).

The Old World clusters are linguistically somewhat tighter, at least in a separation of the Tungus from the northeastern paleoasiatics, but the Yukaghir are more similar, a not unexpected result given the closely intertwined histories of all three groups. There is considerable overlap between the Paleoasiatic and Eskimo cluster. The Koryak are near the middle of the Eskimo cluster, and show the smallest distance to the Labrador Eskimo. The Chuvantsy are relative outliers and roughly equidistant from the Koryak groups and Yukaghir in the distance matrix (Table 5).

The distance matrix brings out important details concerning Trans-Pacific relationships. The Mackenzie Eskimo (ESKMAK) are closest to the Koryak on two axes in figure 4, but the distance matrix shows that the Labrador Eskimo (ESKLAB) sample is closest to the Koryak. Like the Koryak, they are not very different from any Siberian groups. The ESKLAB are closer to all Siberian groups and many Northwest Coast groups than they are to the ESKMAK. Given the great distance from Penzhina Bay to Labrador, it would seem that a common origin or very close association at one time and (Thule) migration explains their biological proximity rather than recent gene flow between them. This pattern is the same as expressed in dermatoglyphic data in that the Eskimo groups furthest away (Greenland, Labrador) are closer to most Siberian groups than are Alaskan Eskimos (Ousley 1992). In fact, the Thule migration Eskimos are dermatoglyphically closer to southern Siberian groups such as the Ainu and Nivkhi than

they are to most Alaskan Eskimos. The closest New World groups to the ESKLAB anthropometrically are the Thompson and Kwakiutl.

The ESKMAK, in turn, are relatively more differentiated from their nearest group, the Siberian Eskimo (ESKSIB), followed by the Koryak, ESKLAB, and Chukchi groups. The ESKMAK are not close to any of these groups, but they certainly have been in contact, if indirectly, through other north Alaskan Eskimo. There have been documented contacts and group migrations across the Bering Strait of Chukchi and Siberian Eskimo up to the very recent past (Bogoras 1904-9; Jenness 1934). At times, one can even travel across the iced-over Bering Strait. Since the Chukchi have assimilated the ESKSIB, sporadic and recent gene flow between ESKSIB, Chukchi, and ESKMAK would best explain the closeness of the ESKMAK to them. The looser ESKMAK affinities to the Koryak and LABESK are probably due to their common origin.

Another anthropometric reflection of migration is illustrated by the Athapaskan speaking Navajo, who reside in the American Southwest but migrated from British Columbia, near other Athapaskan tribes (Haskell 1987). In the canonical plot and the distance matrix, they are near the Thompson (Salish) and Chilcotin (Athapascan).

The Aleut, Bella Coola, and Stalo show distances closer to both the Evens and Evenks than to the Koryak, which is very near the East Siberian mean. The Haida,

Kwakiutl, Makah, Nivkhi, Tsimshian, and (barely) Thompson show distances to either the Even or Evenk that are less than their distance to the Koryak.

It is important to stress again that linguistic relationships do not reflect anthropometric ones: The distances between the Thompson, a Salishan speaking plateau tribe, and the Chilcotin (2.54), Labrador Eskimo (4.58), Carrier (6.36), Koryak (7.57), and Quillayute (8.77) are much less than the distance to the Bella Coola (11.81), a Salish speaking tribe a few hundred miles away. In fact, the Chilcotin, the closest group to the Thompson anthropometrically, speak an Athapascan language. Located between them are the Salish speaking Lillooet, who are closer anthropometrically to the Chilcotin than to the Thompson. The linguistic designation of a tribe does not reflect biological relationships on the Northwest Coast or Plateau, or in Siberia, as we have seen.

The Nivkhi, the southernmost group measured in Asia, are closer to several Northwest Coast groups than they are to any Siberian groups. In fact, they are much closer to the Thompson, Makah, and Chilcotin than they are to the Yukaghir, the closest Siberian group to them. The Nivkhi are also closer to the ESKLAB than they are to every other Siberian group besides the Yukaghir. The small Nivkhi sample is comprised of males only, but male means for the Nivkhi are very close to the Thompson male means (Appendix A). The Nivkhi may represent a southern Asian "wave" different from the one that Turner (1985,1986a) contends. The missing data from Laufer are more disappointing due to the possibility of Nivkhi-New World connections, echoed by

dermatoglyphic data (Ousley 1992).

"Centrality", the distance from the overall mean, and the relative within group variance can also provide valuable information. Harpending and Ward (1982) provided a model for estimating the expected genetic heterozygosity of groups based on the total heterozygosity of other groups in an analysis and their distance from the mean centroid. Relethford and Blangero (1990) expanded this model for use with quantitative traits. The expected anthropometric variance is based on distance from the overall center. Groups near the center of the distribution are expected to show greater variance due to their assumed gene flow with other groups, which keep them near the center. Groups farther from the overall center are expected to show the effects of greater isolation, such as reduced within group variation due to isolation and drift. A group showing much greater than expected variance would indicate significant gene flow from other groups. John Blangero has written RMET, a computer program that performs all the necessary calculations. Figure 6 is a plot of group distance from the overall center (r_{ii}) against the observed and expected variance, from the output of RMET version 4.1.

It is remarkable that the Labrador Eskimo, the most northeastern and isolated of all groups surveyed, are nearest the overall center for all groups, and the Chilcotin and Kwakiutl follow. Not much further behind are the Nivkhi, the southwesternmost group. The Siberian groups are fairly close to the overall centroid and show less than expected variance, which may be due to the devastating epidemics that swept through Siberia in

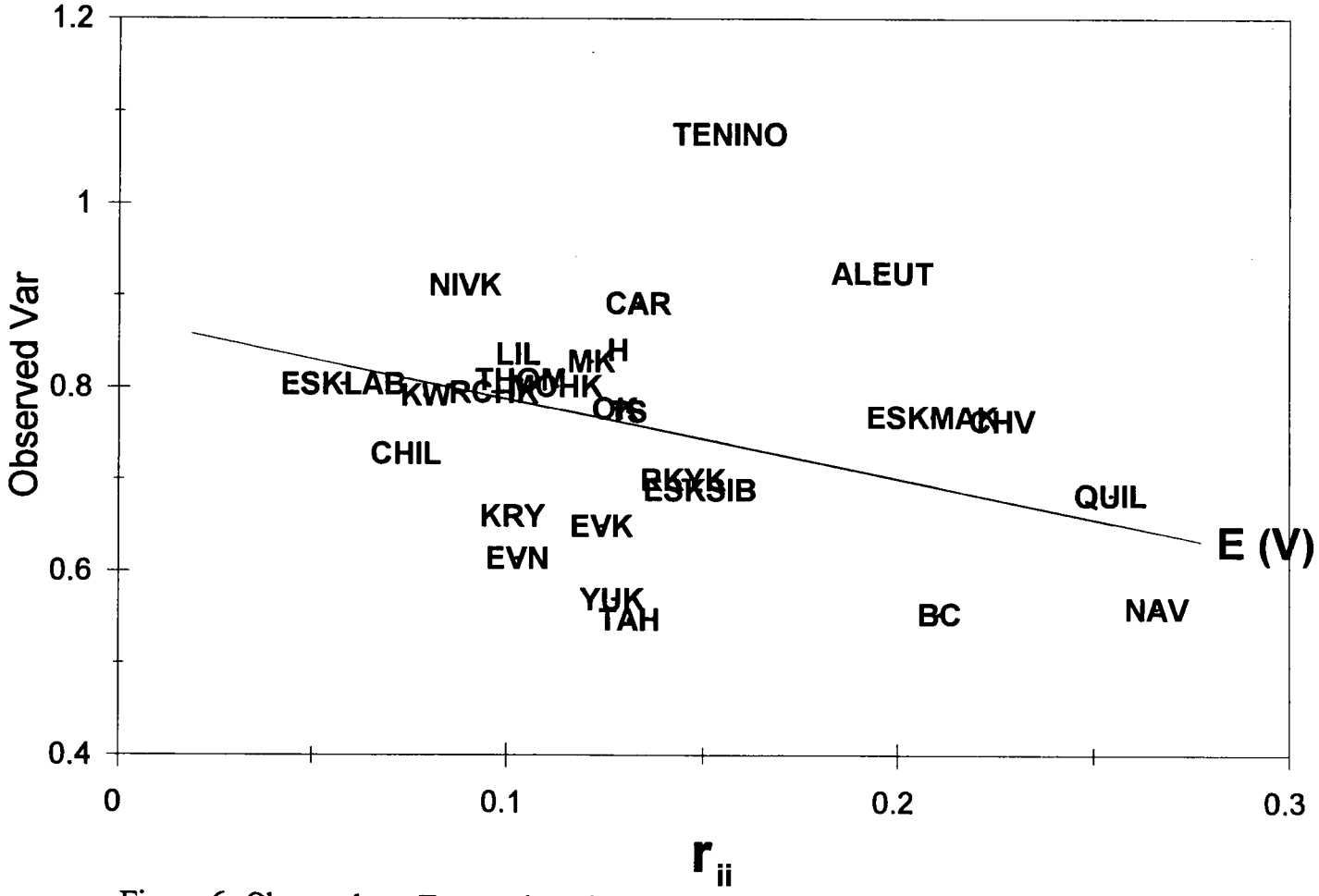

Figure 6. Observed vs. Expected Variance.

the years preceding the JNPE. The Tenino show the greatest heterogeneity of all groups, which might be because of gene flow from the surrounding tribes into their circumscribed habitat in Oregon. The ESKMAK may show their above average variance because the sample is pooled from Herschel Island and Ft. MacPherson, some 200 miles inland. There were also migrations of north Alaskan Eskimos onto Herschel Island around the turn of the century to trade with whaling crews (Smith 19). Also, the Likewise, the small Gilyak is pooled from Sakhalin and mainland Asian samples. The pooled Aleut sample shows greater heterogeneity than expected, especially if one maintains that they were isolated and homogeneous. Part of this is probably due to the pooling of data from three Aleutian islands. They are also relatively far from the overall center, about the same distance as the Bella Coola.

The Aleuts

In figure 4 the Aleut are found at the bottom of the graph in the middle with the Kwakiutl and Bella Coola. The mean value for Aleuts shows a closer affinity to New World groups than to Siberians. This is partially due, perhaps, to a larger sample from Umnak, near the eastern end of the Aleutians. The distance matrix also reflects the Aleut displacement from all groups, but they are closest to the Kwakiutl, Bella Coola, and Makah. What is remarkable is the separation of the Aleut and Eskimo groups. The Aleut are closer to the Tungus speakers and Nivkhi than any of their linguistic cousins. Figure 7 is a plot of the Aleut pooled mean and by island with the same canonical

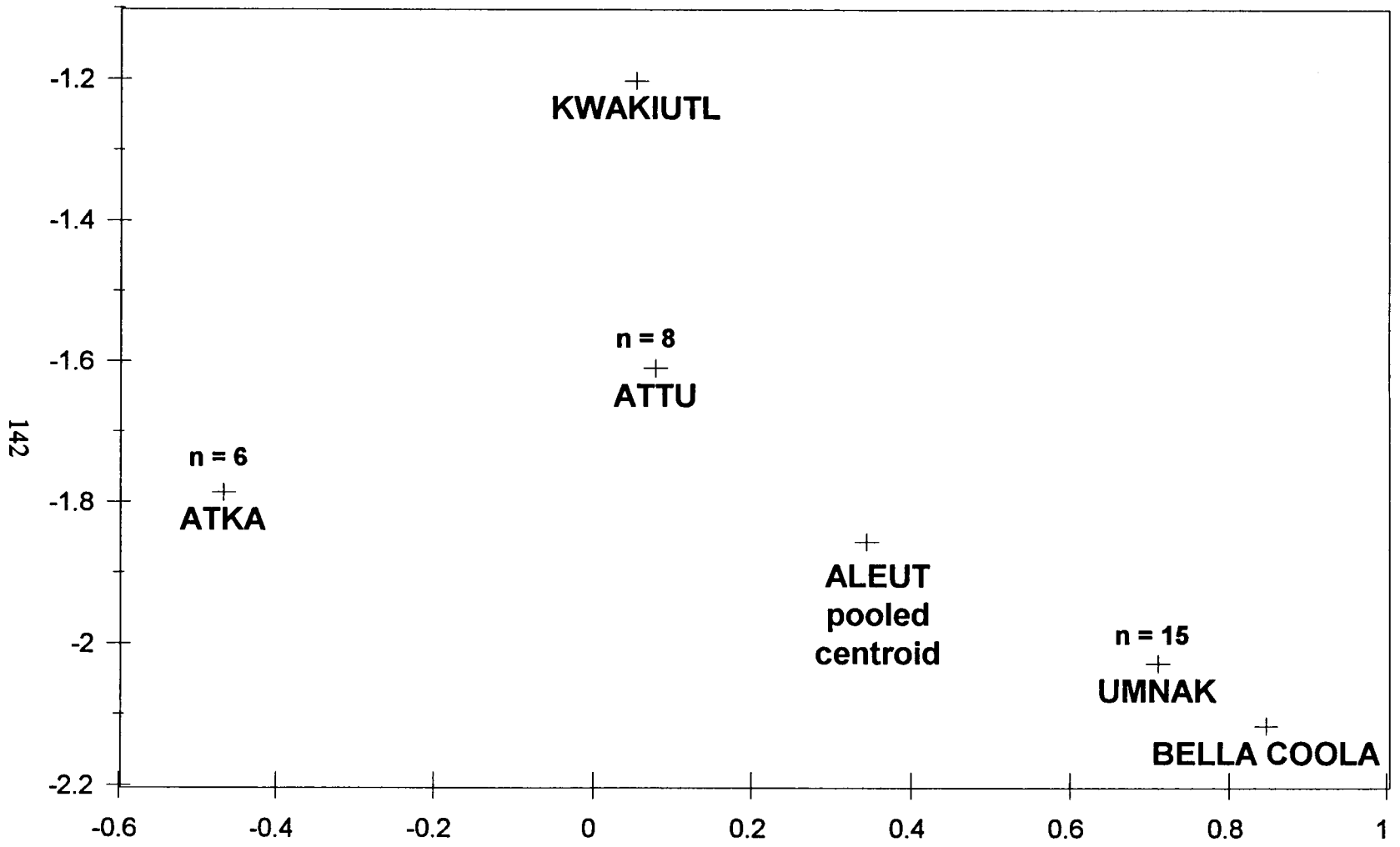

Figure 7. Canonical Plot of Pooled Aleuts and by island.

weights as in Figure 4. As seen in figure 1, Attu is in the western Aleutians, Atka is near the middle, and Umnak is in the eastern Aleutians.

Table 7 shows the distances for each island when analyzed separately using canonical discrimination. Umnak and Attu are fairly close to each other, but otherwise each island is relatively distant from all other groups. Atka, in the middle of the Aleutians, is more distant from the Aleutian samples at either end. On the whole, all island samples are far from the Eskimo-Koryak cluster as well as the Nivkhi-Northwest Coast cluster. The Kwakiutl, Even, Bella Coola, and Makah have the lowest average distances to all three islands. All three islands show geographic clines in their distances to all non-Eskimo groups but the Nivkhi, which classifies with the American side and shows the opposite cline. For example, going east from Attu, the distances to the Bella Coola, Kwakiutl, Makah, (and Nivkhi) decline. Proceeding west from Umnak, the distances decrease to the Even and Koryak. Nearly all these distances are significantly different from zero.

Table 7. Aleutian Island Mahalanobis Distances

	ATTU	ATKA	UMN	ESK LAB	ESK MAK	ESK SIB	BELLA	EVEN	KORY	KWAK	MAK	NIVK
ATKA	5.16	0.00	5.86	7.31	15.36	11.44	11.76	**5.12**	10.11	6.69	12.42	11.25
ATTU	0.00	5.16	2.28	12.35	13.54	9.04	7.79	9.04	12.73	6.31	6.89	9.87
UMNAK	**2.28**	**5.86**	0.00	12.47	15.59	12.47	**4.14**	10.48	13.95	**5.00**	**5.67**	9.90
Avg. D^2	3.72	5.51	4.07	10.71	14.83	11.21	7.89	8.22	12.26	**6.00**	8.33	10.34

The inter-island distances are not significant from zero, however, and small sample sizes are a factor. While some could interpret this as a sign of homogeneity, the distances between Attu and Umnak and the Bella Coola are also not significantly different from zero, and the distances between Atka, the westernmost island, and the Even and Nivkhi are not either.

To get around the problems of small sample sizes, a nearest neighbor analysis was also performed on the Aleuts (Table 8). This non-parametric analysis is based on the closest individuals (neighbors) from all other tribes to each Aleut using all twelve measurements. In this case, classification is based on the seven nearest neighbors. Their heterogeneity and differentiation from the Eskimo is indicated first by the fact that only three Aleuts are closest to Eskimos (Siberian). None of the 29 Aleuts show any affinity to non-Siberian Eskimos. Second, about half of the Aleut are closer to Northwest Coast Indians from 5 different tribes, the rest to Siberians from 6 groups. The groups that the Aleuts more often showed affinities to are the Bella Coola, Kwakiutl, Kamchadal, Tsimshian, Even, and Siberian Eskimo. On an island by island basis, going from west to east, there is a greater proportion of Aleuts closest to Northwest Coast groups. Five of six Aleuts closest to Evens are from Attu and Atka, in the western and middle Aleutian islands, while the 4 Aleuts closest to Kwakiutl are from Umnak, on the eastern side of the Aleutian Islands.

These results parallel the findings of Ossenberg (Ossenberg 1992, Szathmary and Ossenberg 1978), indicating a closer relationship of Aleuts to Amerindians than to Eskimos. On the whole, it appears that either or both sides of the Aleutians experienced gene flow with mainland groups from their respective side.

Table 8. Nearest Neighbor Classification of Aleuts by Island.

	EVEN	EVENK	ESK SIB	NIV	BELLA	CHIL	KWAK
Attu	1	1	1	1	2		
Atka	4				2		
Umnak	1	1	2		6	1	4

Siberian - Amerindian relationships

Boas never published an analysis of JNPE data. One statistic he could have used would have been the cephalic index, or to plot head length by head breadth (figure 8). If he had, however, he would have seen that the Siberian and Eskimo groups have medium head lengths and rather small head breadths, like the Siberians. The Northwest Coast groups were segregated from the Siberians. Where were his Americanoids? Where was the Eskimo wedge? On the other hand, he believed that the cephalic index and other indices for "types" were useless, or at best, that there were too many other factors that determined head shape besides race (Boas 1899a, 1902). Even if he had used statistics he mistrusted but others would have believed, he could not have shown the affinities he wanted to show. Boas even had to deal with a critic who checked his published group means and wrote that Boas had calculated them incorrectly. The author

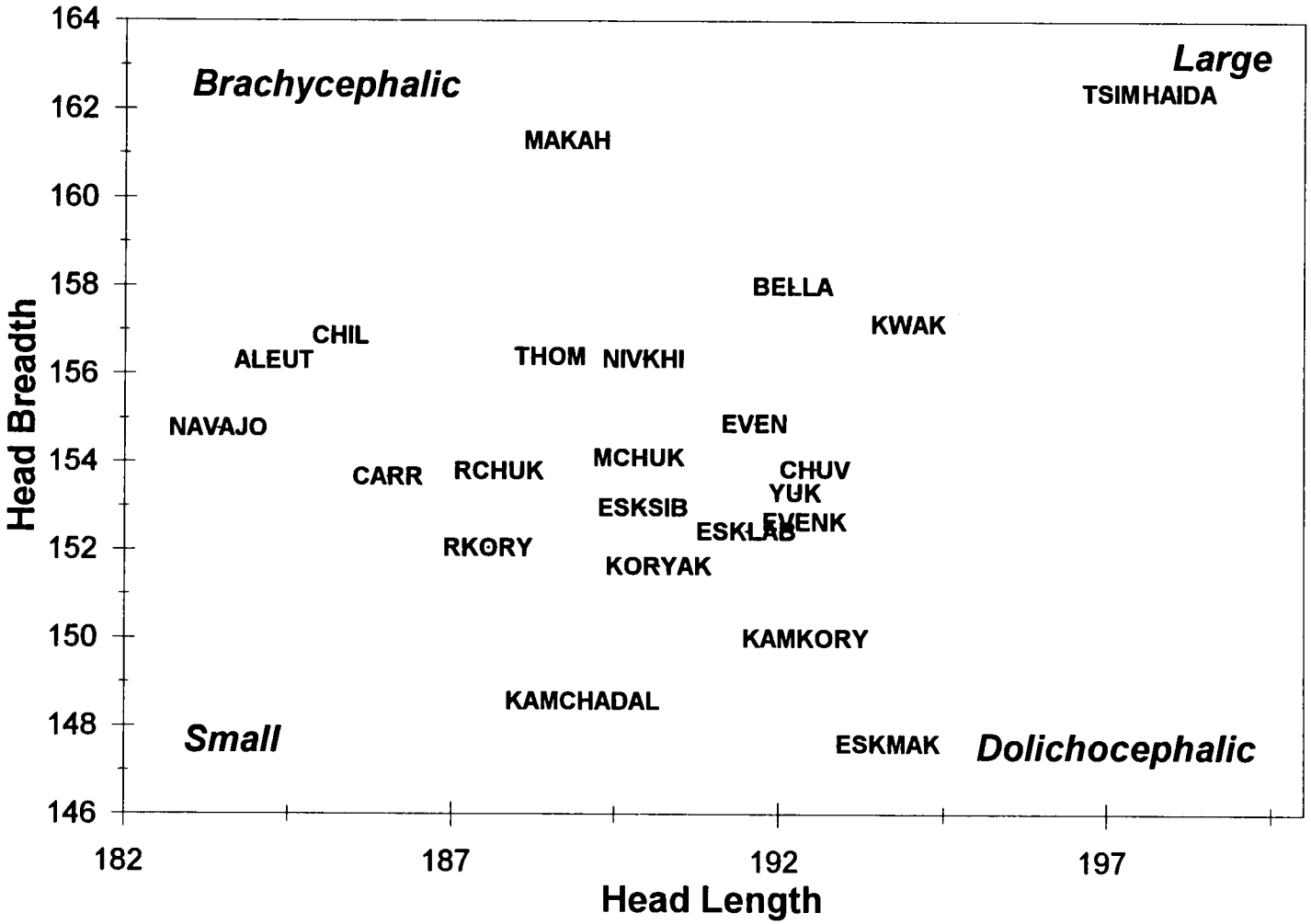

Figure 8. North Pacific Head Length and Breadth.

did not use something "taught in elementary arithmetic", the weighted mean (Boas 1912a:533). These complicating factors may be why he turned more and more to growth studies.

Some Northwest Coast groups, as we have seen, are closer to Siberian groups than they are to other tribes a few hundred miles away. But are they generally closer than Amerindians from the rest of North America? Siberians and 35 Amerindian groups were analyzed using canonical discrimination. Table 9 shows the distances of various tribes to the nine group Siberian centroid. Northwest Coast Groups are in bold. The Koryak are closest to the overall Siberian mean, followed closely by four nomadic groups, the Reindeer Koryak, Reindeer Chukchi, Evens, Evenks, and the ethnically mixed Chuvantsy. The Labrador Eskimo are the closest North American group to the Siberian mean, and are closer than the Siberian Eskimo, adjacent Maritime Chukchi, and the Yukaghir. Northwest Coast/Northern Plateau groups, in bold, are the closest groups overall to the Siberians. Of the Northwest Coast groups that are more distant, the Makah and Bella Coola are among the closest groups to the Aleut (Table 5). The relatively great distance between the Siberian centroid and the Sioux contrasts with the clustering of Sioux and Asian groups in Brennan and Howells (n.d.).

Individual Mahalanobis distances from five groups are arranged from smallest to largest in Table 10. The affinities of the Labrador Eskimo (ESKLAB) are obviously in Siberia, where the six closest groups are from. Several Northwest Coast groups follow.

Table 9. Distance to Unweighted Mean Siberian Centroid.

KORYAK	2.69	SHOSHONI	11.55
REINCHUK	3.34	ZUNI	11.59
REINKORY	3.35	OTTAWA	11.59
EVEN	3.54	MENOMINI	12.04
EVENK	3.67	**MAKAH**	12.34
ESKLAB	3.82	**BELLA**	13.34
CHUVANTSY	3.82	ONEIDA	13.34
MARICHUK	4.03	MUNSEE	13.46
ESKSIB	4.29	KIOWA	13.47
YUKAGHIR	4.60	CADDO	13.51
ESKMAK	7.61	SENECA	13.66
KWAKIUTL	7.18	ARAPAHO	13.66
CARRIER	7.64	CHEROK	14.02
NIVKHI	8.50	SIOUX	14.28
THOMPSON	9.30	YUKI	14.28
CHILCOTIN	9.60	UTE	15.11
TAHLTAN	9.88	NAVAJO	16.56
HAIDA	10.18	STALO	17.34
ALEUT	11.17	POMO	17.85
PAWNEE	11.25	YOKUTS	18.19
CHERNC	11.32	CROW	19.50
TSIMSHIAN	11.47	KUTENAI	20.52

The MacKenzie Delta Eskimo (ESKMAK) are about halfway down the ESKLAB list while the Aleuts are near the bottom. The ESKMAK likewise have an affinity to Siberian groups, though the ESKMAK are not as close to them as the ESKLAB: While the ESKLAB are the third closest group to the ESKMAK, the ESKLAB has 18 other groups closer to them than the ESKMAK. Their overall greater distance may also reflect some northern Athapascan admixture. The Aleuts are near the bottom of the list. The Aleuts, meanwhile, show affinities to Northwest Coast and Plateau groups, two from the Wakashan language family, two Athapascan, and one Salish. The Even and Nivkhi sample are also relatively near the Aleuts, while the closest Eskimo group is 13th closest. Next, the Koryak are closest to all Siberian groups and ESKLAB, followed by Northwest

Table 10. Mahalanobis Distances from Selected Groups.

ESKLAB		ESKMAK		ALEUT		KORYAK		NIVKHI	
KORYAK	1.42	*ESKSIB*	4.21	**KWAKIUTL**	4.26	RDKORY	0.94	**THOMPSON**	3.28
EVEN	2.23	KORYAK	5.04	**BELLA**	4.64	**ESKLAB**	1.42	**MAKAH**	4.66
EVENK	2.50	*ESKLAB*	6.62	**MAKAH**	5.63	REINCHUK	2.55	**YUKAGHIR**	4.93
YUKAGHIR	3.36	REINCHUK	7.01	**TAHLTAN**	7.53	EVENK	2.84	**CHILCOTIN**	4.95
RDKORY	3.56	**KWAKIUTL**	7.17	EVEN	7.60	EVEN	2.92	**STALO**	5.30
REINCHUK	4.28	MARICHUK	7.22	NIVKHI	8.22	CHUVANTS	3.26	EVENK	5.60
KWAKIUTL	4.72	RDKORY	7.69	**CHILCOTIN**	8.26	MARICHUK	3.67	ESKLAB	5.73
THOMPSON	4.87	CHUVANTS	8.11	YUKAGHIR	8.61	ESKSIB	3.84	MENOMINI	5.82
MARICHUK	4.92	ARAPAHO	8.11	EVENK	9.01	YUKAGHIR	4.21	**TSIMSHIAN**	6.55
SHOSHONI	5.37	CHERNC	8.24	**TSIMSHIAN**	9.07	ESKMAK	5.04	EVEN	6.62
ESKSIB	5.56	PAWNEE	8.31	**STALO**	9.09	**CARRIER**	6.67	**KWAKIUTL**	6.69
NIVKHI	5.73	TAHLTAN	8.36	THOMPSON	9.50	**KWAKIUTL**	6.95	ZUNI	7.07
HAIDA	5.84	**CARRIER**	8.79	*ESKLAB*	9.55	NIVKHI	7.45	MUNSEE	7.10
YUKI	6.07	EVENK	8.92	*ESKSIB*	10.76	CHERNC	7.77	KORYAK	7.45
CHERNC	6.26	SHOSHONI	9.60	HAIDA	11.27	THOMPSON	8.10	SHOSHONI	7.75
CHUVANTS	6.51	EVEN	9.70	**KORYAK**	11.72	SHOSHONI	8.23	**HAIDA**	7.75
PAWNEE	6.53	KIOWA	9.74	MARICHUK	11.79	**HAIDA**	8.80	ONEIDA	8.16
ZUNI	6.59	SIOUX	9.80	KIOWA	12.07	CHILCOTI	8.83	**ALEUT**	8.22
ESKMAK	6.62	SENECA	10.32	ZUNI	12.19	TAHLTAN	8.99	BELLA	8.33
TSIMSHIAN	6.67	YUKAGHIR	10.54	PAWNEE	12.43	PAWNEE	9.05	OTTAWA	8.42
CHILCOTIN	7.29	ONEIDA	10.67	MENOMINI	12.56	ZUNI	9.57	REINCHUK	8.78
MENOMINI	7.31	OTTAWA	10.77	ONEIDA	12.62	TSIMSHIAN	10.36	SENECA	8.95
UTE	7.81	MENOMINI	11.90	REINCHUK	12.64	ARAPAHO	10.60	KIOWA	9.02
CARRIER	8.08	HAIDA	12.30	CHUVANTS	13.20	YUKI	10.64	PAWNEE	9.25
SENECA	8.17	THOMPSON	12.43	CARRIER	13.35	MENOMINI	10.86	ARAPAHO	9.26
TAHLTAN	8.60	MUNSEE	12.43	CADDO	13.40	OTTAWA	11.01	MARICHUK	9.37
ARAPAHO	8.60	ZUNI	12.78	NAVAJO	13.94	KIOWA	11.02	POMO	9.46
OTTAWA	8.64	TSIMSHIAN	12.94	SENECA	14.09	MAKAH	11.53	TAHLTAN	9.67
MUNSEE	8.80	YUKI	13.11	*ESKMAK*	14.23	**ALEUT**	11.72	NAVAJO	9.68
KIOWA	9.11	CHILCOTIN	13.23	OTTAWA	14.27	CHEROK	11.82	CARRIER	9.71
ONEIDA	9.18	BELLA	13.40	SIOUX	14.59	SENECA	11.98	CHERNC	10.30
ALEUT	9.55	CHEROK	13.45	SHOSHONI	15.14	CADDO	12.09	RDKORY	10.41
CHEROK	9.58	UTE	13.58	RDKORY	15.19	MUNSEE	12.17	YUKI	10.72
MAKAH	9.77	CADDO	13.64	ARAPAHO	15.63	UTE	12.20	UTE	11.28
POMO	10.04	NIVKHI	13.93	MUNSEE	15.86	SIOUX	12.46	CHUVANTS	11.34
CADDO	10.10	**ALEUT**	14.23	CROW	17.23	ONEIDA	12.72	CADDO	11.36
SIOUX	10.65	MAKAH	14.34	KUTENAI	18.05	BELLA	13.33	SIOUX	11.41
NAVAJO	10.85	NAVAJO	15.99	UTE	18.52	NAVAJO	14.15	ESKSIB	11.97
BELLA	11.32	CROW	16.85	CHERNC	19.70	POMO	14.66	CHEROK	13.03
STALO	13.18	POMO	17.22	CHEROK	19.89	YOKUTS	15.79	ESKMAK	13.93

Coast and Plateau tribes. The Aleut are near the middle of the list. The last column shows that the Nivkhi sample is closer to several Northwest Coast and Siberian groups and relatively far from the Koryak. In looking at all values, the Kwakiutl seem to have a special role: They are the closest Amerindian group to New World Eskimos and Aleuts, who are quite differentiated. They also appear roughly midway between the Aleuts and ESKLAB in figure 4.

The dendrogram constructed using UPGMA with these 46 total groups is shown in figure 9. In this case, the Siberian separation from North America, except for the Nivkhi, is quite evident. One could reasonably discern between 2 and 5 "waves", but it must be emphasized that these waves would be largely independent of language. The dendrogram shows the ESKLAB relatively distant from both Koryak groups and ESKMAK as an outlier in the Siberian branch.

The Amerindian branch shows a deep separation between Aleuts, Nivkhi, and all Northwest Coast groups that live on the coast from all other Amerindians including groups that live inland in the Northwest Coast area. The coastal branch, thus, includes all non-Eskimo and non-Siberian coastal peoples. All of these coastal groups, as pointed out before, show a closer relationship to either or both the Even and Evenki than to the Koryak. The Kwakiutl, Aleut, Haida, and Nivkhi (partially) live on islands. Within the coastal branch, the Aleut, Bella Coola, and Haida form a separate cluster.

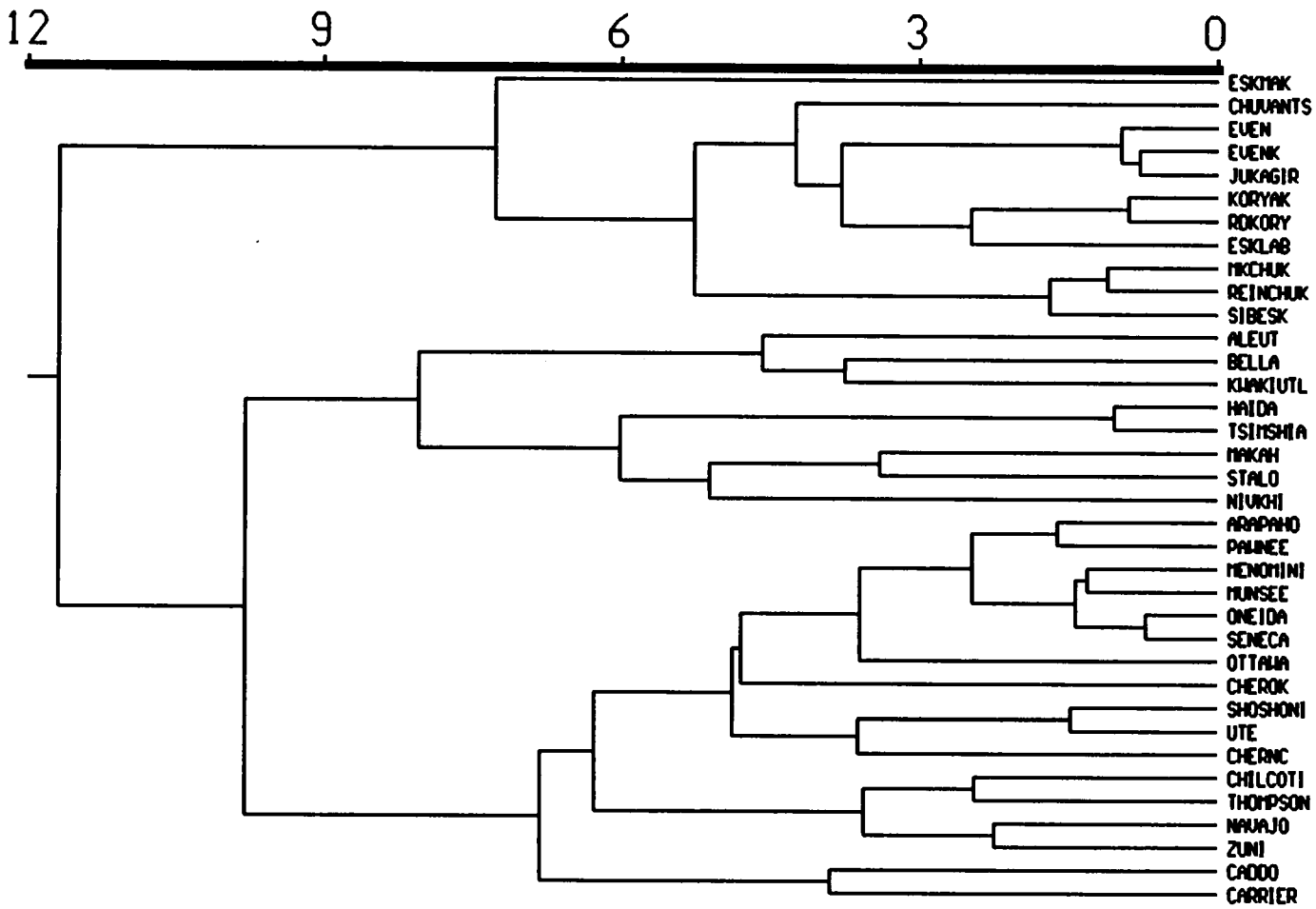

Figure 9. North Pacific Dendrogram

The non-coastal branch has several deep divisions including a Carrier-Caddo cluster. The Carrier, however, do show smaller distances to the Chukchi groups than to many other Amerindian groups. The Chilcotin-Thompson-Navajo-Zuni cluster may trace the migration of the Navajo from their Northwest Coast Athapascan beginnings to their homeland in the Southwest. The other main branch consists of Plains, Northeast, and Southeast tribes.

Based on anthropometrics, it appears that the home of the Thule migration, represented by the Labrador Eskimo, is in Siberia, for that is where their nearest relatives are. There is also an implied "wave" of Northwest Coast inhabitants. Within this cluster, Aleuts are closest to the Kwakiutl and Bella Coola. This is consistent with ethnographic data linking the southern Wakashan whaling practices to southwest Alaskan Eskimo and Aleut practices, and early "Eskimoid" archaeological finds in the southern Northwest Coast. The distance matrix shows that the Makah are next closest to the Aleut. The Aleuts are essentially Northwest Coast Amerindians that speak an Eskimo language and have an Eskimo lifestyle that was quite common on the northern Northwest Coast.

The Nivkhi position is unusual, given that the closest 3 tribes to them based on the distance matrix, the Thompson, Makah, and Yukaghir, are from three different "waves" in this figure. While we may recognize three waves in the dendrogram, we must also recognize possible distortions and inconsistencies when compared to the

distance matrix.

The coastal cluster echoes recent archaeological finds (Ackerman 1992; Borden 1979) suggesting an early coastal occupation of the Northwest Coast separate from radiations in the interior. The coastal cluster may also reflect more recent interaction between coastal groups. If so, this would have been independent of language and to some extent geography, and related more to subsistence. Given the great mobility of coastal groups that travelled hundreds of miles on raids or to hunt or trade, this would not be unexpected.

Chapter 6

Discussion

North Pacific Natives

Based on the Boas anthropometric data, several recurrent patterns of north Pacific relationships and prehistory emerge:

Groups in close proximity have exchanged genes independent of language, as shown by the Kamchatka Koryak, Russians, and Kamchadal (forming the Itelmen); the Evenk, Yukaghir, and Reindeer Koryak (forming the Evens); the Yukaghir, Koryak, and Chukchi (forming the Chuvantsy); the Maritime Chukchi and Siberian Eskimo; the maritime Northwest Coast groups; several inland Northwest Coast groups (Thompson, Lillooet, Chilcotin; Navajo and Zuni).

Conversely, groups that speak the same language or in the same language family have been shown to differ greatly, seen in Aleut and Eskimo physical differences and Kamchadal Koryak-Penzhina Koryak differences. The Athapascan Carrier are closer to some Salish and Chukchi tribes than they are to the Athapascan Tahltan; the Athapascan Chilcotin are closer to Salish and Sahaptian tribes than to other Athapaskans.

There has been significant gene flow across Beringia **and** across Bering Strait. This is illustrated by the ESKLAB affinity to Siberians, especially the Koryak, and the ESKMAK affinity to the ESKSIB.

The Northwest Coast tribes are generally biologically closer to Siberians and Eskimos than other Amerindians and cluster separately from inland tribes, suggesting more recent contact/origin with Siberians/Eskimos.

There is no biological "Eskimo wedge". All Eskimo groups cluster with Siberian groups.

Non-coastal Amerindians are closer to northeast Siberians than to the southern Tungus speaking groups.

The Aleuts are closest overall to maritime Northwest Coast groups, especially the Bella Coola and Kwakiutl, and show no affinity to the Eskimo groups, who are more distant biologically than southern Siberian groups.

The Aleuts (especially the Western islands) and all other coastal Northwest Coast groups show closer affinities to southern Siberians than to the northeast Siberians.

The Nivkhi are the only Old World group that are very close to many Amerindian groups, most of which are concentrated in the Northwest Coast.

The results support archaeological evidence for an Eskimo (or proto-Eskimo) influence on/origin with the Koryak, at least for the Thule (Labrador) Eskimo.

On the whole, the closeness of the Koryak to Labrador Eskimo, ESKSIB to ESKMAK, and Aleut and Nivkhi to Northwest Coast groups implies a more complicated pattern to the settlement of Beringia and arctic North America than traditional ideas based on linguistics. The severity of a geographic barrier like the Bering Strait can be assessed by the closeness of peoples on either side of that barrier. After all, the main goal of the Jesup Expedition was to illuminate the role of Beringia as a crossroads and the Bering Strait as a barrier. The formation and regression of Beringia has greatly influenced the similarities and differences between North American and Siberian peoples and cultures.

Eskimo-Indian relationships based on anthropometrics may support Szathmary's blood results indicating that some NaDene groups are closer to the Eskimo than other Amerinds (Szathmary and Ossenberg 1978; Szathmary 1979,1981). Unfortunately there are no Alaskan Athapaskans in the Boas data base. The small Tlingit sample was improperly measured, as shown by aberrant values and recordings in inches. If the Alaskan natives followed the "Siberian Tradition" of local gene flow

independent of language, there is every reason to expect Eskimo-Athapascan affinity in those areas of contact. The fact must be emphasized that the Northwest Coast groups (beside the Bella Coola and Kwakiutl) are generally closer to the Siberians and Eskimos independent of language: The four closest Northwest Coast tribes to the Labrador Eskimo include a Wakashan (Kwakiutl), Salishan (Thompson), NaDene isolate (Haida), and Penutian group (Tsimshian). The Northwest Coast groups are apparently closer because of the Siberian connection rather than the Eskimo affinity: The Labrador Eskimo represent a wave that occurred long after the first Americans arrived in the New World. The Eskimos in South Alaska may be a link between northeast Siberians, Aleuts, and Northwest Coast groups.

As noted by Alekseev and Fitzhugh (1988), the Bering Sea culture which gave rise to the Eskimo is intimately linked to the Koryak. The fact that all Eskimo classify with the east Siberian groups tends to point to that area as their homeland. The home of the Thule Eskimo seems to be in Siberia.

The dendrogram could be interpreted to show three "waves", but does not have to: Clearly, there is a separation of Eskimo and Siberians from all others. As we have seen, both the Nivkhi and Aleuts share many cultural traits with many Northwest Coast peoples. The third "wave" could be a "Paleoindian" wave, as long as it has a substantial Athapascan component. But a label such as "Paleoindian" may imply that it was significantly earlier than the Aleut-Northwest Coast wave. This is

not certain due to submergence of the Northwest Coast shoreline. The earliest coastal finds so far are over 9000 years B.P., and if Meadowcroft and Monte Verde are as old as maintained, then they would seem to require at least some early migrations. However, the time between Paleoindian and coastal migrations may not be as great as has been proposed.

Ossenberg's (1992) results showing close Aleut-Northwest Coast affinities is supported by the anthropometric data. Since there is anthropometric data from three Aleutian islands, additional insight has been gained to the biological affinities of each. If the Aleuts evolved *in situ*, as Laughlin claims, the closeness of eastern Aleuts to maritime Northwest Coast means that the Aleuts were **already** more like Amerindians when they initially occupied the Aleutian islands. Based on biological, ethnographic, linguistic, and archaeological data, the Aleuts were clearly not isolated. In fact, they appear to be part of an early coastal migration.

Testing Hypotheses

> "There has been little gene exchange between Eskimos and Indians since diverging" (Laughlin and Harper 1988:32)

This is apparently true for the groups that were sampled. However, Alaskan Amerindian groups are absent. Based on the "Siberian Tradition" of admixture, Aleut affinities, the northern Northwest Coast language and culture area, and remarks by Hrdlicka and archaeologists, it is expected that the south Alaskan Eskimos will show

affinities to Aleuts and Amerindians. Once again, the key will be Eskimo heterogeneity, who like the Aleut, should not be expected to be biologically uniform.

> "We have inferred the split between Aleut and Eskimo occurred 9000 B.P." - (Harper 1980:550

Linguistically, the Eskimo-Aleut split probably occurred between 3000-6000 years B.P. (Dumond 1987; Krauss 1988). There is no reason, however, why a biological divergence could not occur sooner or later than a linguistic split. Archaeology holds the best hope for certain chronologies, but associating certain artifacts, especially very old ones, with languages or tribes is uncertain.

> "in no other part of the New World is there as profound a dichotomy in physical characteristics between groups as that between Aleuts and Eskimos on the one hand, and Indians on the other hand" (Laughlin *et al.* 1979:98

The Aleuts show far greater affinities to Northwest Coast Amerindians than they do to the Eskimo groups in the Boas data base. Once again, the Eskimo of southern Alaska should be compared to Aleuts and Amerindians.

> "On a worldwide scale, the North American Indians, Eskimos and Aleuts are a genetically distinct race or breeding population, related most closely to the Mongoloid peoples of eastern Asia." (Spuhler 1979:171)

The Eskimo in the Boas data base are much closer to northeast Siberians, and the Aleuts are closer to certain Amerindian groups. Northeast Siberians are distinct from "Mongoloid peoples" to the south and west.

> "the Aleut-Eskimo stock" (Laughlin and Harper 1988:32)
>
> "Eskaleuts" (Schanfield 1992)

These should be laid to rest because of heterogeneity within and between Eskimos and Aleuts.

> "The Asiatic Eskimo are intermediate between American Indians and Siberian Mongoloids... Americanoid features are characteristic only for the Eskimo... As for the Eskimo type, its specific peculiarities find no analogies among the peoples of Siberia - at least the modern ones... the Eskimo might represent a return migration from America " (Chard 1951:30-31, summarizing Debets 1947)

Anthropometric data have brought about important results in helping to understand north Pacific variation. Instead of relying on typologically oriented research by the Russians, we have more reliable and objective data for comparison. Thanks to Boas, we know that the Eskimo "type" is very close to the Koryak. In one sense, the Eskimo *are* between some Amerindians and Siberian Mongoloids, in that the non-Northwest Coast Amerindians are closer to Eskimos and northeastern Siberians (but also often Nivkhi) than the southern Siberians represented by the Evens and Evenks.

> "the search for "ultimate origins" of *any* mobile, flexible, opportunistic, biological population of *H. sapiens* is bound to result in

> no indisputable conclusions. Perhaps heretofore we have asked the wrong questions, as we sought *the* origin or *the* affinity of any one human population" (R. Hall, comment in Szathmary and Ossenberg 1978)

The flexibility and opportunism of these populations has been underestimated. As shown by ethnographic data, many tribes on the Northwest Coast show traits of Aleut, Eskimo, and northeastern and southeastern Siberian cultures. Biological data indicates no significant barriers to local admixture.

> "the interpretation of a single gene can be edifying or misleading, depending on our knowledge of the population structure and its time depth, which differs in different parts of its present domain. Equally to the point is the advantage of using several genes; the single genes become more informative when employed in a larger multivariate analysis" (Laughlin and Harper 1988:32)

Using one gene frequency, like one or two anthropometrics, in the case of the cranial index, can be very misleading. Laughlin still relies on the cranial index to illustrate a cline in supposed biological affinity. These assertions have been tested using more anthropometric variables and disproved. Also, adding more genetic information does not necessarily improve the assessment of population relationships (Sukernik *et al.* 1981).

> "one polygenetic character contains exactly as much information as one single-locus marker. If environmental effects are considered, quantitative characters are probably less informative about populations than single loci." (Rogers and Harpending 1973:992)

In a sense it is true that anthropometrics do not reflect the underlying genetic diversity within populations, if all genetic materials are considered (blood genetics, nuclear DNA, and mtDNA, all with differing rates of mutation). Within populations, anthropometrics are conservative in their variance when compared to discrete blood genetics. However, due to this, if one wishes to examine population relationships and get reliable results, anthropometrics are more suitable, as shown by a lower Wilks' Lambda and higher F_{st}, and a greater proportion of significant distances.

> "human tribes are the evolutionary equivalents of much larger populations - presumably because they are an integral part of a larger network of interacting populations." (Ward et al. 1991:8724)

This may be a crucial insight in understanding why populations are poorly genetically differentiated.

> "the anthropometric method is a most important means of elucidating the early history of mankind and the effect of social and geographical environment upon man" (Boas 1912a:562)
>
> "We have, therefore, a means of discovering in our extensive anthropometrical series a mixture of divergent types. This investigation is an important one and should be taken up at an early date." (Boas 1902:77)
>
> "the opinion ... has been expressed ... that our observations destroy the whole value of anthropometry, in particular the study of the cephalic index has been shown to have no importance." Boas 1912a:562
>
> "Comparisons of [physical] type, language and culture make it at once evident that the Northeast Siberian people are much more closely akin to the Americans than to other Asiatics" (Boas 1905:99)

The first two quotes by Boas have been confirmed, in that anthropometrics have proven valuable in assessing population relationships around the world. They have also helped discover "types", that is, clusters of closely related peoples distinct from others, independent of language. The third quote reflects the frustration of Boas, who had to work with indices that he had shown were genetically unreliable, because deriving relationships from more variables was nearly impossible or extremely time-consuming. His results also threatened the validity of other analyses of the day. It is hard to reconcile the last quote with the first two. Boas did not analyze the Jesup data, so he couldn't say for certain that they were similar. If he had tried to plot the cranial measurements, he would have found no Americanoids. Still, he did maintain the unsupported physical similarity for the rest of his career (Boas 1903,1905,1912b,1928).

A New Hypothesis

First a few facts and caveats:

> As mentioned before, groups have tended to exchange genes locally independent of language. Linguistic phyla do not necessarily represent population waves. For example, based on archaeological data, there were at least two waves of Eskimos. There is also the possibility of failed waves and language loss. Estimating the number of waves using linguistic data is tenuous.

Any post-contact observations are the products of both ancient and more recent history, such as the decimation by epidemics and the increased warfare on the Northwest Coast after 1500 years B.P.

Some groups had to have reached Monte Verde, which shows unmistakable human dwellings and activity by 10,500-11,500 years B.P. (Fiedel 1987).

Evidence for human occupation or activities must be restricted to sites of definite human activity, not merely "human" induced bone fractures and "hearths" without tightly associated artifacts.

Based on anthropometric, archaeological, ethnographic, and few linguistic data, the peopling of the New World proceeded as follows:

1. There were movements of peoples through interior Beringia around 13,000-11,000 years B.P. who eventually found their way to the American Continent unimpeded though probably circumscribed by the Laurentian and Cordilleran ice sheets. These people were the ancestors of Athapaskans and most of Greenberg's "Amerind" linguistic classification.

2. There were movements of coastally adapted peoples across the ice-free Beringian/southern Siberian and Alaskan coasts and down the Northwest Coast.

These groups included the ancestors of Aleuts and other Northwest Coast peoples. If earlier than 9000 years B.P., this evidence is under water. At any rate, by the time these groups reached the southern Northwest Coast (Namu - 9000 years B.P.) there were apparently already peoples from the earlier wave present in Washington state with a different subsistence pattern (11,000-13,000 years B.P.). Some coastal migrants could have gone on to California and South America.

3. Eskimos initially occupied the Bering Strait area around 4000-5000 years B.P. Successive waves of people and technology swept across the Canadian Arctic to Labrador and Greenland and into southern Alaska. In Southern Alaska, there were Eskimo cultural intrusions and differential genetic admixture, with some areas integrating populations, while other Eskimo groups nearly replaced the residents. More data are needed from southern Alaska, which may also indicate whether there was gene flow between Aleuts and the Yupik speakers, or that some groups retained their original affinity to Aleuts.

North Pacific Researchers

They say a good lawyer can prove an innocent man is innocent, but a **great** lawyer can prove a *guilty* man innocent. Something similar may have been involved in the debate over the settling of the New World. As Szathmary pointed out, however, very little *evidence* was presented by Greenberg *et al.* They did present the outcome of clumsily manipulated data, especially in the case of Turner's groupings

and dendrograms. When the synthesis was published in *Current Anthropology*, none of the comments mentioned reliable biological data to disprove the authors' claims. Szathmary did point out that differences in blood frequencies can change results, and her analysis of the Williams *et al.* (1985) data showed that Eskimos are closer to Amerindians. But few of the distances were significant anyway, so all analyses are equally invalid. No one mentioned or utilized the Aleut data from Spuhler (1979) showing that the mixed island Aleuts had at best a tenuous association with the Eskimo groups. No one cited craniometric or any other biological analyses that countered the three wave hypothesis. Up to quite recently, the strongest arguments against Greenberg *et al.* have been based on linguistics (Morell 1990).

Ossenberg (1992) used biological data only very recently to seriously challenge the validity of the three wave assertion as outlined by Greenberg *et al.* This tells us something about the state of our knowledge of North Pacific biology. All three analyses are assertions that have persisted because they were made to mesh together well superficially, if somewhat uncomfortably in depth (Greenberg's early Amerind wave vs. Turner's early Eskimo-Aleut wave). As we have seen, each one, standing on its own or integrated with the other analyses, does not prove or even provide good support for a three wave scenario. Greenberg *et al.* were not even good lawyers. They succeeded because the opposition did not bring any reliable evidence to court. The same lack of data has also made any biological test of Boas' "Eskimo wedge" theory impossible (Szathmary 1979).

Reliable evidence is available now, in the form of anthropometric data. The Anthropometric data do not support the three wave hypothesis as outlined by Greenberg *et al.* While the biological data in this thesis stands on its own, and should be taken into account by new theorists, it also fits recent archaeological, biological (craniometric, non-metric, and dermatoglyphic), ethnographic, and linguistic reassessments remarkably well. That is, other biological, linguistic, cultural, and archaeological data support the anthropometric data ***and vice versa.***

Many researchers have been riding the wave theory since Greenberg *et al.*, publishing unreliable results because they seem to confirm "waves" to the New World. Of course, their research design has been built on assumed waves. Dendrograms have come into vogue, and naturally, one can decipher waves from dendrograms. What is necessary, however, is not to forget the statistical bases that form the dendrogram and keep it stable (or unstable): The distance matrix and the standard errors of the distances. Unfortunately, the consideration and publication of these are negatively correlated with dendrogram production, and conclusions are based on sample sizes that are smaller and smaller, especially in mtDNA research. We do not get closer to an understanding of north Pacific history by producing reasonable trees based on questionable data.

The popular misconception that Aleuts and Eskimos are close relatives (Rouse 1986; Turner 1985,1986a) is contradicted by craniometric, anthropometric, and

linguistic data which separate them. The Eskimo-Aleut linguistic affinity, along with general similarities in subsistence and culture, contributed to the misconceptions propagated by biological researchers (Ossenberg 1992). More recent linguistic data shows a common origin but also more recent intense contacts with Athapaskan groups. The only linguistic barriers were those in the minds of researchers who put linguistic criteria above all else. "Eskaleut" makes as much sense biologically, if not linguistically as Grecoenglish or Salutian (Salish and Penutian).

It has been customary to justify biological data as "relevant" by showing that it fits linguistic or archaeological facts. However, craniometric and anthropometric data, by their very nature, should stand by themselves: the cultural data should be checked for goodness of fit to the biological data, not vice-versa. These various spheres of data are not one-way streets: As we have seen in Siberia, each can help explain phenomena in the other. The idea that cultural data can "prove" biological relationships is wrong, and has led to "reasonable assertions" ever since Hrdlicka, with a corresponding lack of new insights. It is unrealistic to expect objective biological data to fit to subjective, artificial, and at times arbitrary linguistic classifications that have little statistical justification. If we accept that tribes admix with neighboring groups independent of language, as has been shown, we should not expect language to agree with biology too often, and should not judge biological results by their agreement with assumed linguistic relationships. Blood data can fit just about any scenario, as we have seen. If there is a problem with the very high

quality Boas data it is a sampling problem. Biological data must be held to the same high standards as North American archaeology in dealing with possible evidence of early sites. (Grayson 1988)

Diversity, whether cultural, linguistic, typological, blood marker, or mtDNA, has caused many problems for researchers, as it did for Boas. Recognition of great diversity in these areas has led many researchers to try to "date" the arrival of the first Americans or the foundation of a major Amerindian group. Harper (1980) attempted to date the origin of all North American aborigines based on blood frequency diversity and reported a figure of 18,000 years B.P. Turner (1985,1986b) tried to date the arrival of immigrants in North America by using "dentochronology", converting the dental MMDs into years of divergence between Amerindians and Asians, and arrived at a figure of 13,000 years BP. Nichols (1990) tried to date the arrival of the first Americans using neoglottochronology, and concluded that a minimum occupation of 20,000 years was required to explain the diversity. Torroni *et al.* (1992, n.d.a.,n.d.b.) have tried to date the split of major linguistic agglomerations based on mtDNA sequence divergences, and concluded that Amerindians diverged from Asians 20,000 years BP. In all of these studies there is an underappreciation of the great diversity within each group, making reliable comparisons impossible. The anthropometric results, however, have been shown to be highly informative and more reliable for north Pacific population relationships.

The anthropometric results repeat a common finding in genetic research, that quantitative traits bring out significant population differences more often than blood genetics (Lewontin 1984). This is probably due not only to statistical methods, but also greater individual genetic diversity within groups. What are the biological relationships between several groups of humans? Are groups and individuals really more alike (blood genetics) or more different (anthropometrics)? The answers depend on what one looks at. There are no objective biological distances, and each method has drawbacks.

Quantitative Traits and Population Relationships

As in numerous other studies, anthropometric within-group variation was proportionally smaller than among group variation when compared to blood genetics, resulting in more statistically valid assessments of group relationships (Black 1982; Friedlaender 1975; Lewontin 1982; Relethford and Lees 1982; Rogers and Harpending 1983; Spielman and Smouse 1976; Neel and Ward 1970).

Spuhler (1979), utilizing discriminant function and canonical correlation analysis, apparently could not get many distances between groups significant from zero. This implies several factors, not mutually exclusive: The linguistic designations and implied relationships are incorrect; language is not highly correlated with biology; culture area is not highly correlated with biology; tribal designations mask underlying heterogeneity or more relevant groupings, making all comparisons

based on tribes invalid; tribes are in fact correct groupings but are on the whole too genetically homogeneous for reliable comparisons, whether due to admixture, differing modes of selection, or drift.

Black (1982) believed that anthropometrics perform better at group discrimination because: 1). Metric traits show greater overall variation than blood data, making discrimination between groups easier, 2). metrics are a result of many loci and represent more of the genome, 3). in small village populations, gene drift may obscure gene frequency differences, and polygenic traits are more resistant to drift, and 4). since different villages constitute different environments, differences in metric traits, which represent environmental and genetic variation, will be accentuated. Black concluded that when estimating population relationships, it seems best to work with polygenic traits that show low environmental influence. Dermatoglyphics meet these criteria, but show greater relative within-group variation than anthropometrics or craniometrics (Friedlaender 1975; Rogers and Harpending 1983; R.L. Jantz, personal communication). Apparently, the type of selection acting on the polygenetic trait determines whether or not drift has a greater effect.

A reanalysis of data from Ousley (1992) confirms this pattern, and examination of the F_{st} values avoids the statistical pitfalls of comparing different significance tests (Lewontin 1984,1986). Ousley utilized 20 ridge counts in an analysis of 25 groups from the north Pacific. The Wilks' lambda was .47 and the F_{st}

generated from RMET was .023, compared to the 12 variable anthropometric Wilks' lambda of .05 and an F_{st} of .139 for 27 groups. The F_{st} for dermatoglyphics is slightly less than Relethford and Blangero's (1990) F_{st} of .027 for 5 minimally admixed rural Irish villages using 10 anthropometrics. The dermatoglyphic F_{st} is also not much greater than the observed F_{st} of .0174 for 20 ridge counts from 7 Jirel villages in Nepal (Relethford and Blangero 1990). A 10 variable anthropometric F_{st} of 6 Siberian groups, the Evens, Evenks, and Chukchi and Koryak groups in the present analysis, was .109, much greater than the F_{st} of .047 for 18 Siberian tribes (Crawford and Enciso 1982). These estimates are more dramatic when one remembers that anthropometric traits are not 100% heritable, so the anthropometric F_{st}s are minimum estimates. If average heritability is 50%, the anthropometric F_{st} values should be doubled to compare to genetic F_{st}s. Crawford and Enciso (1982) analyzed blood data from 52 circumpolar groups ranging from the Urals to Greenland and from as far south as 40° north latitude (Kazakhstan). Their highest F_{st} was .122 for all groups including the quite different Touvininas and Topholars, whose values may be skewed due to lab errors (R.L. Jantz, personal communication). This pales in comparison to the doubled anthropometric F_{st} (.278), which well exceeds the F_{st} of .125 for six major human races of the world calculated by Wright (1978) using 7 loci and 21 alleles. These race values were averages for populations, which undoubtedly homogenized the local variation. If dermatoglyphics are selectively neutral (Blangero 1988) with minimum environmental effects, and anthropometrics show less relative within-group variation, there must be factors decreasing the relative within-group

anthropometric variation, increasing the relative among-group anthropometric variation, or both. Blood F_{st}s seem to roughly agree with dermatoglyphics, but as we have seen, blood markers do not separate populations well, dermatoglyphics do better, and anthropometrics perform the best. Anthropometrics must be under a different selective regime (Lewontin 1986), not merely the products of different statistical tests (Lewontin 1984).

Relethford and Lees (1982) explored the use of anthropometrics in estimating population relationships. Based on results from many researchers, they reported that anthropometrics apparently reflected gene flow and historic relationships better, through polygenic "averaging", while blood data was apparently more sensitive to gene drift.

This phenomenon was reluctantly echoed by Rogers and Harpending (1983), though they stressed the fact that anthropometrics have no inherent advantage because they are polygenic: One completely heritable anthropometric trait has as much information as one single locus marker, because the variance of the variance among groups is not lower for polygenic characters than for single loci. However, using Friedlaender's data, they found that anthropometrics distinguish groups much better than dermatoglyphic variables due to less within group variation relative to among group variation. There have since been improvements in dermatoglyphic data analysis which help distinguish groups better. But why is this so, and how does it affect

group comparisons? Rogers and Harpending wrote

> "geographically varying selection, environmental heterogeneity affecting growth and developmental or a nonadditive genetic basis for morphological characters, has contributed to variation of anthropometric characters on Bougainville" (pg.996).

The environmental factors would seem to be dramatic but hidden: Bougainville Island is roughly 140 long and 40 miles wide. The island of Hvar, in the Adriatic, is even smaller - 41 miles long and on average, less than 3 miles wide on average, with a total area of about 180 square miles. Anthropometrics were collected and analyzed from 9 villages by Rudan *et al.* (1986). Significant differences between villages were detected using 24 body and 14 head anthropometrics that were highly correlated with geography. Differences were greater for the eastern villages as a group vs. the western villages, reflecting a later migration into the western part of the island and extreme geographical barriers between them. Clearly, migration and gene flow will change population relationships faster and more dramatically than environmental similarities.

All of these authors have acknowledged that the environment plays a significant role in influencing the anthropometric expression of genetic traits, and that generalizations to wider areas of study may not be valid. These studies in the field were conducted in well circumscribed areas without a great deal of climatic variation. But the "environment" is a complicated concept, involving geophysical, nutritional, demographic, developmental, ecological, pathological, and other considerations. It changes throughout the lifetime of an individual. How many measures, and what

events in a life history would be necessary to record all necessary information? How many environments are there? How can it be integrated with other data? There can be no environmental typologies. Further complicating these environmental factors are the various cultural ameliorations for environmental stresses. These, in effect, reduce the potential influence of "**the** environment" by being a part of it. Due to the difficulties of measuring the "environment", most authors have assumed an overall neutral environmental effect.

Black (1982) also conducted explicit tests of the environmental effects on anthropometrics from several of the Solomon islands. He found a high correlation between the genetic and phenotypic correlation matrices, implying that anthropometric/phenotypic information essentially represents genotypic information, at least for group relationships. Cheverud (1988) gathered genetic and phenotypic variance-covariance matrices from studies of mice, rats, snakes, sheep, cattle, and humans. His results indicated that the genetic and phenotypic variance-covariance matrices were highly correlated, especially when using traits with higher heritabilities, sample sizes, and effective sample sizes (heritability * total number). Black's study was conducted on a small island, and much of Cheverud's data came from laboratory experiments, so environmental variability was limited if not controlled.

A recent study of Boas anthropometrics utilized four groups from very different environments, however, ranging from the hills of Tennessee to the shores of

Lake Huron (Konigsberg and Ousley 1993). Anthropometric measurements and pedigree data revealed that the phenotypic and genetic variance-covariance matrices are proportional, meaning that the anthropometric relationships between groups are very close to the genetic relationships, as Black (1982) and Cheverud (1988) found. The environmental effects are about 50% of the total variation, but are random in effect, barely changing the relative group relationships.

Cheverud (1984) and others have pointed to a possible cause for anthropometric lower within-group variance: developmental constraint. This line of reasoning sees "internal" environmental effects as highly significant. For example, leg length is determined by the growth of the bones, but the leg is made up of many elements, and interacts with the muscle, circulatory, and nervous systems as well as other bones. Pleiotropic and linkage disequilibrium effects are significant factors determining the integration of body parts. Cheverud (1981) also demonstrated higher phenotypic correlations within functional groups in the skull, i.e. parts that work together, such as the optical or masticatory systems. This suggests important pleiotropic effects in anthropometrics.

In this study, The number of anthropometric measurements that are correlated to each other is remarkable. In fact, a great many body measurements are very weakly correlated with face measurements, but of all 66 correlations, nearly all are significant at $p < .01$. Only 4 are not significant for males, and for females, eleven

are insignificant at $p < .05$, mostly from low correlations between leg length - facial measures, and nose height - body measures. What is more, all significant correlations were positive except for very weakly correlated (-.085) female measurements of arm length with nose and face height. In both sexes, the highest facial set correlations are head breadth and face breadth (.58), and all body set measurements but shoulder breadth show correlations of at least .58. Males generally show higher correlations.

Table 11 shows the average correlation of each measurement to other body and face measurements using the standardized data from groups in the trans-Pacific canonical analysis. In all cases the correlation of a measurement with itself (1.0) was eliminated and the mean correlations to the remaining variables calculated. All of the body measurement correlations were very high (in bold) except for shoulder width which has the lowest correlations with the other body measurements. The body measurements still show much greater correlations among themselves than the face measurements. Face breadth showed the highest correlation to other face measurements (in bold), but is relatively low in comparison. Head Breadth, face breadth, and nose breadth showed average body correlations close to their average head and face correlations.

The high intercorrelations of anthropometric measurements seem to conform to Cheverud's (1981) morphological integration and Moss and Young's (1960) functional matrix. The internal environment is relatively conservative: There are clearly limits

imposed on anthropometric measurements, which appear to be due primarily to normalizing selection and developmental constraint beginning in the womb. The process of growth and development necessitates integration. In other words, shape seems to be under normalizing selection. Additionally, adult anthropometrics may be

Table 11. Correlations of Measurements by Type.

	Average Body Correlation	Average Head/Face Correlation
STANDHT	**.728**	.211
SHLDRHT	**.713**	.182
FINGERR	**.673**	.145
SHOULDW	.385	.203
ARML	**.616**	.110
LEGL	**.602**	.141
HLENGTH	.158	.210
HEADBRTH	.244	.253
FACEHT	.089	.256
FACEBRTH	.278	**.323**
NOSEHT	.032	.216
NOSEBRTH	.189	.186

under size selection: They are measurements of persons who made it to adulthood, and children that grew too fast or too slow and died are not measured. Nutrition plays a significant role in the expression of many anthropometrics, especially stature. Catch-up growth and delayed maturation can be seen as greater opportunities for the phenotype to achieve the fullest genetic potential.

If Konigsberg and Ousley (1993) are correct that the phenotypic and genetic variance-covariance matrices are proportional, normalizing selection and developmental constraint would seem to be the major factors that would preserve the genetic relationships between groups yet diminish the within-group variance. There may be more significant environmental effects in this data set, though, and genotype-environmental interaction could play a role. As was noted before, however, all environmental factors would be impossible to measure. Anthropometric changes due to environmental effects, however, would probably involve changes to other related measurements, reflecting linkage disequilibrium and pleiotropic effects (Cheverud 1981). Changes through "environmental" selection would seem to be inherently conservative. It is important to remember that groups were able to move into the higher latitudes because of *cultural* evolution and availability of non-food resources, not *biological* evolution.

The high intercorrelations between the Boas anthropometrics may ironically help in group discrimination. While adult anthropometrics are certainly the products of normalizing selection and developmental constraint, and perhaps weak directional selection, blood genetics have been shown to be under directional, normalizing, and diversifying selection. There are definite cultural modifications to some anthropometrics, (cradleboarding) but there are also cultural modifications to blood genetics, as shown by the lower prevalence of sickle cell anemia in groups that eat raw fava beans in malarial areas. The question remains where the variation between

groups comes from. The differences probably originate in a combination of selective mating, founder effects, admixture, drift, genetic-environmental interactions, and environmental effects.

Anthropometrics are not without problems, however. Secular changes, such as the acknowledged secular increase in stature in the United States, can muddle relationships. A secular trend may affect racial or ethnic groups differentially, changing group relationships based on anthropometrics (Meredith 1976). The secular differences in adult height, however, are not as great as for children, apparently due to delayed maturation in the earlier populations (Meredith 1976). However, Ousley and Jantz (1993) demonstrated an apparently much greater secular increase in the femur and tibia of 19th century American white males compared to black males. Eveleth (1978) cited studies indicating a secular increase in stature for Japanese immigrants to the United States. The Japanese in Japan are now catching up, however, though more of the increase is accruing in the legs.

Interobserver error can also significantly affect analyses of population relationships (Jamison and Zegura 1974). As Szathmary (1979a) noted, combining data from different times and different measurers can produce confusing results, as in Neves *et al.* (1985).

The Paradox of Boas

Boas warned anthropologists not to expect to find agreement between biology, language, and culture. Boas recognized not only the independence of the three hierarchies for comparisons, but also the subjective nature of classifications. Yet he claimed to have found all three in agreement between Northwest Coast and Siberian tribes based on JNPE data.

He also recognized that the modern data showed how the populations related to each other in the present, making necessary a consideration of history in order to project into the past:

> "We recognize thus that every classification of mankind must be more or less artificial, according to the point of view selected, and here [in Anthropology], even more than in the domain of biology, we find that classification can only be a substitute for the genesis and history of the now existing types." (Boas 1911:10)

But Boas read history into the JNPE data. About other subjects Boas was cautious:

> "I repeat that I have no solution to offer, that I have only stated the results of my observations and considered the plausibilities of various explanations that suggest themselves, none of which were found satisfactory. Let us await further evidence before committing ourselves to theories that cannot be proven" (Boas 1912a:562)

This thesis has shown that many researchers, including Boas himself, have succumbed to an assumption of a high correlation between language, culture, and biology. The confusion was firmly established in the Aleutians: Laughlin, like Boas, let cultural considerations sway his interpretations. Many Physical anthropologists

accepted Laughlin's proposals, if not entirely, then at least Eskimo-Aleut unity. The persistence of "Eskaleuts" has been perpetuated to this day by researchers such as Schanfield. Turner pooled dental samples by assumed language and geography, and concludes the Eskaleut wave had to be early because of biological differences. Boas saw a much greater age in North America than Siberia because of greater cultural and linguistic diversity. Hrdlicka defended the homogeneity of the Amerindians and therefore a short history. Nichols sees great age in great linguistic diversity. Torroni *et al.* pool mtDNA samples according to language phylum and age them by sequence divergences. The later theories, however, do not have a firmer foundation than the Americanoid theory. Modern biological researchers produce more numbers, charts, plots, and trees, but are statistically unreliable.

The paradox of Boas is the paradox of anthropology, and science in general, namely, that humans will theorize whether or not there is sufficient evidence. Phlogiston, phrenology, and racial superiority based on head shape are testimony to changes in the biological sciences.

Boas resorted to indices and typologies simply because there was little else to help understand and illustrate the patterns of variation. He did recognize three types on the Northwest Coast that were seen in the canonical plots, but did not make a career of the Americanoid theory or of population relationships. As was stated before, it is no wonder he devoted more and more time to growth studies,

ethnography, and linguistics. Another paradox of Boas must be that he saw to it that valuable data was collected and preserved that he had no hope of analyzing in depth.

The only reason we can discuss group relations in the North Pacific with any confidence is due to Boas' foresight in seeing that metric data were collected. If Boas was born too early, and had he lived in the age of radiometric dating, quantitative genetics, and the personal computer, he would have analyzed the data and gotten better answers to the pressing questions of anthropology that are still important. But there would be no anthropometric data to analyze. Unfortunately, the technology to analyze large amounts of data came after the technology that eradicated or assimilated many peoples.

Technology cannot answer all our questions, and has even become a handicap in arguments for which mtDNA or DNA preparations are better for what purposes. Computers have made analysis faster and easier, but are no substitute for high quality useful and reliable data. The reliability of the data must be assessed statistically, because statistics are our only independent way of judging biological phenomena. The cranial index was abandoned as a way to classify races (leading to such labels as "peusdo-Negroid") because it was inconsistent and unreliable. There was simply too much overlap in groups. The same is true for blood genetics, mtDNA and apparently nuclear DNA.

If we want to answer important questions, it makes sense to use the best tools that produce the most reliable results. We must also have a consideration for history and human behavior in forming and testing hypotheses for the peopling of the New World.

Summary

This thesis has revealed significant patterns in north Pacific biological, ethnological, linguistic, and archaeological relationships which contradict most earlier theories based on less useful biological data. It has also uncovered behavior patterns of north Pacific researchers who theorize about the peopling of the New World. Too much emphasis has been placed on linguistic compliance, resulting in assertions of believable though unreliable biological relationships. A comparison of reliable biological data (craniometrics, dermatoglyphics, anthropometrics) confirms that Eskimos and Aleuts are biologically quite different, the Aleuts showing greater affinity to certain Northwest Coast Amerindian groups.

The Eskimo, in turn, shared an intimate beginning with the Koryak, producing the odd pattern in dermatoglyphic and anthropometric data that two groups very far apart geographically are very close biologically. The Nivkhi and Northwest Coast groups show a similar relationship. The Thule migrations are better documented than any southern Siberian migration to America. This thesis has presented the first biological data suggesting a connection between the Amur and Northwest Coast tribes. The Thule migration Eskimos show greater affinities to southern Siberian groups than earlier migrations. The Northwest Coast coastal groups, independent of language, show greater affinities to Aleuts and Siberian groups than other Amerindian groups. This indicates the possibility of a coastal migration of groups who were better adapted to exploit marine resources.

Anthropometrics have been shown to be quite effective, once again, at discriminating groups and deriving reliable relationships between them. For whatever reasons, practical if not theoretical, anthropometrics are the preferred method for comparing populations.

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APPENDIX

Means of measurements by sex and tribe

Females

TRIBE	STHT	SHHT	FGRCH	SHWT	ARML	LEGL	HEADL	HEADB	FACEH	FACEB	NOSEH	NOSEB
ALEUT	1496.5	1237.7	1557.2	330.1	657.6	658.0	181.0	155.6	124.4	145.5	52.2	34.3
ARAPAHO	1600.0	1332.0	1674.7	362.0	721.3	759.0	189.0	146.0	118.7	140.7	51.3	39.3
BELLA	1571.4	1279.8	1661.2	351.6	714.6	716.6	176.2	156.2	122.4	146.8	54.6	34.4
CADDO	1525.3	1274.3	1594.3	347.3	678.5	711.5	177.8	150.9	114.9	135.5	50.0	36.9
CARRIER	1569.6	1300.3	1593.6	343.8	684.9	761.8	178.4	151.0	120.6	137.0	52.6	35.8
CHER-NC	1551.3	1290.0	1590.9	345.7	699.8	747.9	181.3	142.7	111.8	135.1	46.9	36.4
CHER-OK	1575.4	1295.7	1620.1	349.2	692.0	770.4	179.6	150.3	111.8	137.1	49.4	34.6
CHILCOTIN	1569.3	1297.2	1606.9	343.2	694.9	742.6	178.1	155.4	115.7	140.6	48.0	36.3
CHUVANTS	1506.0	1202.8	1519.7	336.0	644.0	736.0	184.0	144.5	123.8	137.8	53.0	30.5
CROW	1590.2	1341.5	1670.3	367.0	740.7	761.2	187.8	155.5	118.9	138.1	52.9	37.9
ESKLAB	1507.1	1238.4	1528.8	334.7	660.8	694.1	187.8	147.7	111.6	138.0	47.4	34.1
ESKMAK	1533.1	1254.5	1531.4	340.0	653.6	719.3	184.7	142.0	120.4	141.9	52.9	33.3
ESKSIB	1522.3	1253.3	1514.4	333.7	626.1	701.7	185.2	147.0	122.5	140.8	51.4	34.4
EVEN	1469.0	1195.6	1498.7	333.2	642.1	678.7	186.5	150.4	117.1	139.9	47.8	31.7
EVENK	1461.3	1201.9	1509.4	315.9	654.2	691.7	187.1	148.9	116.6	138.1	48.8	31.8
GOAJIRA	1495.8	1247.7	1522.5	331.4	657.4	736.3	175.6	149.1	115.1	135.7	50.4	36.4
HAIDA	1578.2	1285.8	1601.6	356.4	678.4	745.0	191.2	157.4	116.0	147.6	46.8	35.8
JUKAGIR	1475.3	1201.8	1530.3	321.5	665.7	692.1	183.9	147.1	116.2	135.8	47.3	31.7
KIOWA	1577.5	1324.7	1651.6	342.7	733.6	756.3	181.9	147.6	116.2	137.9	49.7	36.3
KORYAK	1493.8	1219.4	1485.9	325.1	650.9	700.9	183.8	146.6	118.1	139.5	50.7	34.5
KUTENAI	1464.3	1249.3	1552.3	306.3	717.3	691.0	185.7	151.3	108.3	135.3	52.7	38.3
KWAKIUTL	1536.3	1249.8	1573.0	345.5	655.2	693.1	185.8	150.2	121.1	143.8	51.3	35.6
MAKAH	1539.8	1269.7	1601.8	335.3	683.5	715.3	177.2	157.5	116.9	147.0	48.5	35.7
MENOMINI	1578.1	1301.9	1641.8	345.0	708.5	752.9	185.0	148.7	112.5	137.7	46.9	35.7
MARICHUK	1526.9	1256.4	1520.7	329.7	640.0	711.1	183.0	148.7	122.0	138.6	49.3	34.6
MUNSEE	1583.6	1307.0	1673.8	343.6	723.5	771.8	187.4	152.1	112.2	139.9	48.6	36.8
NAVAJO	1582.7	1318.7	1633.4	336.4	719.3	749.1	177.4	149.1	107.9	135.9	47.0	37.4
NOOTKA	1456.0	1191.0	1563.0	335.0	662.5	654.5	182.0	147.0	116.0	145.5	52.5	34.0
ONEIDA	1607.7	1331.1	1680.6	347.1	725.6	760.9	187.6	149.2	116.5	137.5	48.6	35.6
OTTAWA	1592.1	1291.3	1666.8	361.3	699.3	759.8	190.4	150.2	121.1	140.9	50.4	36.4
PAWNEE	1537.8	1265.0	1585.2	341.0	674.4	733.0	184.0	147.0	115.6	137.0	52.0	37.2
POMO	1533.5	1279.3	1577.4	341.8	688.3	723.0	180.6	146.1	108.4	137.8	43.4	38.4
RDKORY	1492.8	1222.8	1515.8	334.0	664.2	704.2	188.6	149.8	117.4	142.2	48.0	35.0
REINCHUK	1520.2	1248.8	1521.4	338.0	663.4	721.7	181.4	149.4	120.0	139.4	49.1	35.0
SENECA	1588.0	1315.8	1650.3	346.4	713.8	754.8	189.0	149.3	113.8	138.4	48.0	36.2
SHOSHONI	1563.0	1275.0	1592.7	346.0	680.3	749.7	184.7	146.0	111.3	138.3	51.7	40.7
SIOUX	1599.7	1322.7	1689.8	360.5	715.8	782.6	187.2	151.6	118.7	143.7	56.0	37.4
STALO	1531.5	1279.3	1591.0	314.5	687.5	721.0	183.9	159.7	111.6	145.7	44.3	36.5
TAHLTAN	1623.0	1342.4	1636.0	350.0	701.8	764.2	188.0	153.6	120.0	144.8	53.2	34.0
THOMPSON	1534.9	1274.9	1585.0	323.5	678.8	725.4	182.2	149.9	110.6	138.1	45.3	35.7
TSIMSHIAN	1548.2	1271.1	1592.2	350.8	684.2	704.7	187.0	156.3	114.7	145.4	45.4	37.3
UTE	1511.9	1253.3	1572.9	344.6	670.8	707.3	184.9	146.3	107.1	136.0	45.2	39.5
YOKUTS	1545.9	1289.1	1547.6	360.1	685.7	754.8	181.2	159.3	112.1	141.5	44.7	38.7
YUKI	1485.7	1234.6	1519.9	331.1	651.6	696.9	185.9	142.7	104.6	136.5	42.9	37.8
ZUNI	1511.7	1238.8	1579.0	340.5	682.8	690.5	172.9	145.1	108.1	134.3	43.6	33.6

Means of measurements by sex and tribe

Males

TRIBE	STHT	SHHT	FGRCH	SHWT	ARML	LEGL	HEADL	HEADB	FACEH	FACEB	NOSEH	NOSEB
ALEUT	1579.2	1297.5	1666.1	356.1	710.0	700.4	188.9	159.1	124.7	148.1	54.5	36.9
ARAPAHO	1733.9	1447.7	1796.7	381.4	783.6	834.6	194.4	154.2	123.4	150.7	55.0	41.3
BELLA	1642.6	1334.1	1764.7	379.6	744.4	754.2	192.2	158.0	128.6	151.1	57.7	37.6
CADDO	1676.8	1387.9	1767.1	389.6	766.6	810.9	185.0	152.5	126.1	140.5	57.1	40.1
CARRIER	1664.1	1386.8	1715.1	376.1	740.4	818.2	186.1	153.7	129.2	144.9	55.4	37.8
CHEROKEE	1682.8	1403.3	1739.1	380.0	769.5	820.9	190.5	148.4	120.7	143.0	52.2	39.3
CHEROKEE-	1714.5	1412.9	1774.2	393.1	749.4	841.8	191.3	155.4	117.2	145.4	53.7	39.2
CHILCOTIN	1638.7	1350.5	1709.9	363.9	728.2	778.8	185.3	156.9	124.4	145.2	53.7	39.9
CHUVANTS	1587.9	1287.7	1616.9	362.8	696.8	755.1	192.6	153.3	135.1	147.1	58.2	36.5
CROW	1731.6	1460.5	1813.9	394.4	806.5	832.9	197.0	159.5	131.1	148.5	61.0	40.9
ESKLAB	1579.0	1291.1	1617.5	364.9	702.9	743.0	191.5	152.5	122.5	145.8	52.7	38.5
ESKMAK	1683.1	1398.6	1728.6	385.5	744.5	790.8	193.7	147.6	131.1	150.8	57.1	38.1
ESKSIB	1623.0	1331.3	1628.0	366.9	688.6	772.3	190.0	153.0	131.3	147.9	54.8	36.9
EVEN	1557.6	1275.3	1614.5	362.2	701.6	727.5	191.6	154.9	126.0	145.6	52.2	36.1
EVENK	1568.8	1284.6	1625.8	356.0	700.6	741.8	192.4	152.6	125.3	146.3	52.3	35.7
GOAJIRA	1590.7	1327.5	1654.7	354.4	721.1	758.8	181.9	156.7	120.2	144.8	51.8	40.2
HAIDA	1678.1	1386.7	1746.2	393.9	756.4	799.3	198.1	162.4	123.2	153.5	52.0	39.9
JUKAGIR	1563.4	1271.6	1648.0	358.5	705.6	739.9	192.3	153.3	126.1	145.6	53.3	35.4
KIOWA	1699.5	1426.4	1785.0	380.9	786.9	806.6	189.7	153.5	125.6	146.1	56.2	39.5
KORYAK	1595.9	1308.0	1613.9	365.8	704.9	761.4	190.2	151.6	124.9	146.5	54.2	37.1
KUTENAI	1686.2	1424.2	1749.9	353.2	778.9	799.2	195.9	156.5	123.8	142.0	57.9	41.9
KWAKIUTL	1629.0	1325.7	1710.6	377.6	720.6	742.5	194.0	157.2	127.5	149.2	54.4	39.0
MAKAH	1651.0	1362.0	1739.3	378.4	754.2	767.7	188.8	161.3	125.3	156.7	52.5	40.6
MENOMINI	1694.6	1392.9	1788.8	376.7	760.9	810.2	190.7	154.3	121.5	145.1	52.2	40.0
MARICHUK	1628.8	1329.5	1629.4	365.4	686.1	780.6	189.9	154.1	129.0	145.9	53.4	38.4
MUNSEE	1721.8	1418.0	1826.0	393.6	783.6	838.0	195.4	155.7	123.9	148.7	52.2	40.2
NAVAJO	1689.4	1409.0	1740.7	365.7	755.3	789.3	183.4	154.8	115.9	145.7	49.0	38.7
NIVKHI	1614.5	1324.1	1706.7	347.6	742.6	771.1	189.9	156.4	123.6	149.1	51.8	39.6
NOOTKA	1583.7	1281.0	1728.0	380.7	744.7	733.0	194.0	151.3	129.7	151.3	56.0	39.0
ONEIDA	1721.0	1421.6	1828.9	388.8	780.8	820.5	194.3	154.4	125.8	146.9	52.9	39.0
OTTAWA	1731.6	1414.6	1786.5	380.9	764.4	827.2	199.4	159.4	127.4	151.1	55.0	41.3
PAWNEE	1713.1	1421.8	1778.6	384.9	765.7	813.2	192.1	154.1	122.8	145.6	55.2	39.8
POMO	1658.3	1373.4	1758.3	378.1	756.1	804.6	190.0	154.0	113.4	148.6	48.5	45.3
RDKORY	1593.7	1296.6	1580.6	366.9	689.3	769.9	187.6	152.0	128.3	144.5	56.3	37.9
REINCHUK	1617.9	1317.6	1637.0	376.4	690.3	781.2	187.7	153.8	128.5	147.1	53.2	37.9
SENECA	1726.4	1437.2	1824.7	391.5	793.6	818.4	197.4	154.2	126.6	147.2	53.8	40.4
SHOSHONI	1676.4	1390.9	1735.9	379.8	751.3	802.5	192.9	154.5	119.1	148.9	53.0	42.0
SIOUX	1723.5	1427.0	1809.9	386.0	767.8	832.4	194.8	155.8	125.2	149.7	58.6	40.0
STALO	1642.3	1365.7	1748.6	364.0	757.8	770.3	189.3	165.9	121.7	152.7	49.5	40.5
TAHLTAN	1705.8	1413.8	1767.4	374.5	763.8	802.7	192.8	159.2	128.9	150.3	57.0	35.7
THOMPSON	1621.7	1340.7	1704.4	362.1	729.1	773.9	188.5	156.4	118.8	147.0	49.8	39.1
TSIMSHIAN	1679.9	1380.0	1758.8	393.7	752.3	793.5	197.1	162.4	123.7	155.3	52.2	40.8
UTE	1656.2	1378.0	1728.7	388.4	739.6	793.2	191.4	152.9	118.3	146.4	51.9	43.7
YOKUTS	1701.6	1425.3	1736.9	396.2	756.0	843.8	191.6	160.8	119.6	149.2	48.6	42.6
YUKI	1605.7	1336.3	1687.3	369.2	731.7	767.1	195.3	149.2	115.2	146.4	49.7	42.5
ZUNI	1629.2	1345.2	1685.2	361.3	720.6	764.9	182.3	151.0	115.3	143.7	48.3	38.7

VITA

Stephen David Ousley was born on March 10, 1961, and eventually escaped from Seabrook, Maryland, where he grew up. He attended the University of Maryland and was the physical anthropologist and hack zooarchaeologist for the Caesarea Maritima Summer 1982 Excavations. He received a B.A. in Anthropology and nearly one in History in 1985. He then spent a year in Germany as an exchange student, studying German history, language, and beer. On his return, he worked at the Smithsonian Institution as a Museum Technician, then worked at the Armed Forces Institute of Pathology where he catalogued, curated, and computerized the Blackburn-Neumann Neuropathology Collection over a span of two years.

Steve arrived at the University of Tennessee in 1989. Since then he has been the manager of the Forensic Data Bank and research assistant to Dr. Richard Jantz, with whom he co-authored FORDISC 1.0, a computer program that estimates the sex and race of an unknown skull using information from the Forensic Data Bank. His interests are in Zoology in general and all applications of Physical Anthropology, especially skeletal biology, human and primate variation and evolution, quantitative genetics, and forensics.