Children in helicopter at Hooper Bay, Alaska, 1981. © R. Drozda.

PHYSICAL ANTHROPOLOGY IN ALASKA: 1973-2003

G. Richard Scott
Department of Anthropology, University of Nevada, Reno NV 89557. grscott@unr.edu

Abstract: During the 1960s and early 1970s, the International Biological Program sponsored a major 'human adaptability' project among Alaskan native populations. After 1972, there were no comparable initiatives, but there remained a high level of interest in Aleut, Inuit, and Athapaskan biological variation. Some workers focused on physiological and morphological adaptations to the stresses of the far north, from nutritional considerations to craniofacial characteristics. Others concentrated on the cranial and dental variation of past populations and genetic variation among extant groups to enhance our understanding of the differentiation and internal and external relationships of Alaska's indigenous groups. Finally, with the passage of NAGPRA, the past decade has seen a flurry of 'salvage physical anthropology' where human skeletal remains from Alaska, collected earlier in the century, were fully documented prior to reburial.

Keywords: Affinity Assessment, Human Adaptability

As a subdiscipline, physical anthropology has focused traditionally on primate anatomy and behavior, the primate and hominid fossil record, human skeletal biology, and human variation and adaptability of extant populations. Given the latitude and biogeographic history of Alaska, contributions in the areas of primate studies and paleoanthropology have been nil (assuming, of course, that Alaskan muck does not hold *Homo erectus* or Neanderthal fossils). With that said, we can proceed to studies of prehistoric/protohistoric and contemporary Alaskan populations that fall within the purview of physical anthropology.

Alaska contains a diverse and unique set of human populations that fall within the Arctic (Aleuts, Yupik and Inupiaq Eskimos), Western Sub-Arctic (Kutchin, Koyukon, Kolchan, Ingalik, Tanaina, Ahtna, and Tanana Athapaskans), and Northwest Coast (Eyak, Tlingit, Haida) culture areas. The basic questions posed by physical anthropologists regarding Alaska's array of native populations is: (1) where did they come from? (2) how are they related to one another? (3) what can we infer about the health and lifeways of earlier populations from the study of skeletal remains? and (4) how have these groups adapted to the stresses of a northern environment? In other words, Alaskan physical anthropology has centered on four primary areas: population origins, affinity assessment, bioarchaeology, and human adaptability. The first area of focus, the origins of Alaskan native populations, is taken up by C.G. Turner II (this volume). The second and fourth areas, affinity assessment and adaptability among prehistoric and living Alaskan populations, are reviewed in the following sections.

In 1974, I taught a course entitled "The Biology of Arctic Peoples" at the University of Alaska Fairbanks. My graduate training in the American Southwest did not 'pre-adapt' me for this role, but it did provide an opportunity to learn Arctic physical anthropology 'under fire.' As this paper centers on the period from 1973 to 2003, all the information I compiled for the Arctic peoples course dealt with data available before 1973. To set the stage for recent work, I provide a synopsis on the foundation laid before 1973 for studies of human variation and adaptability. Without providing some details on this foundation, it is difficult to appreciate how far physical anthropology in Alaska has progressed over the past 30 years.

HUMAN VARIATION: FOUNDATIONS

Skeletal biology

During the first half of the 20th century, the Smithsonian Institution carried out many expeditions to Alaska for the purpose of recovering human skeletal remains from village sites. This effort was led by Aleš Hrdlička, aided at various times by other Smithsonian anthropologists, including Henry B. Collins, Jr. and T. Dale Stewart. During this period, several thousand skeletons were collected from many parts of the state and taken to the Smithsonian Institution for curation. By far the majority of these remains came from Eskimo and Aleut populations, especially those along the coasts of Alaska. Only a small number of Athapaskan remains were involved in this massive collection effort. Although Hrdlička covered most of Alaska's coasts, two of his major efforts were directed at the Aleutians and Kodiak Island. Monographs that included discussions of the archaeology and skeletal remains from these areas were published in two major books (Hrdlička 1944a; 1945). While focusing on the coasts, Hrdlička had earlier traveled up some of Alaska's major rivers to collect remains. These efforts are summarized in *Anthropological Survey of Alaska* (Hrdlička 1930). Given the times, it is not surprising that his work in obtaining collections far surpassed his work in analysis where he utilized only the most basic of descriptive statistics. This is well illustrated in his many 'catalogs of human crania' that are specimen by specimen listings of nine basic cranial measurements and associated indices, including the presumably all-important cranial index. Three of these catalogs dealt with skeletal collections from Alaska: (1) The Eskimo, Alaska and Related Indians, (2) Eskimos in General and (3) Non-Eskimo Peoples of the Northwest Coast, Alaska, and Siberia (Hrdlička, 1924, 1942, 1944b).

While the Smithsonian dominated the 'collecting' scene in Alaska, the American Museum of Natural History (AMNH) also made a big splash when Helge Larsen and Froelich Rainey (1948) excavated a large number of skeletons from Point Hope, Alaska in the 1940s, representing early and late time periods (Ipiutak and Tigara). Several hundred skeletons were shipped to AMNH in New York for curation and analysis but, given the situation at the museum, it turned out to be mostly curation with very little analysis. Before 1973, the only paper that included data on the Tigara and Ipiutak series was written by the Russian anthropologist Debetz (1959). This brief but tantalizing analysis of cranial and post-cranial measurements suggested a major population break between Ipiutak and Tigara. Unfortunately, the series was never subjected to the detailed analysis it deserved. When Arctic physical anthropologists asked AMNH curator Harry Shapiro if they could examine the materials from Point Hope, he held that the collections were his to analyze and publish. While Shapiro found time to publish a book on Peking man's missing bones and Pitcairn Islanders, he never found the time to analyze the intriguing Ipiutak series. Some papers have since been published on various aspects of the Ipiutak collection (cf. Costa 1980, 1982; Utermohle 1984, 1988), but the sample has still not been subjected to a thorough analysis.

While Smithsonian scientists did obtain skeletal remains on St. Lawrence Island, this rich resource was also tapped by Alaskan collector par excellence Otto Geist. In the 1930s, Geist 'mined' human skeletal remains out of the sites of Kukulik and Gambell and took many of them back to the University of Alaska Museum. Given his strategy of excavating with high pressure water hoses, provenance of the remains was never well established.

Professor Hans-Georg Bandi of the University of Bern spent the summers of 1971, 1972, and 1973 excavating sites on St. Lawrence Island. He focused on Gambell and Kitnepaluk, where he unearthed extensive archaeological remains and over 150 human skeletons. He took the remains back to Bern, Switzerland where they were subjected to a variety of analyses, including one by this author (Scott and Gillispie 2003).

In the pre-1973 era, Smithsonian scientists utilized Alaskan skeletal remains for a handful of descriptive and analytical studies. For example, T. D. Stewart (1953) published an analysis of neural arch defects in Alaskan natives while Collins (1932) and Goldstein (1931, 1932a, 1932b) published a series of papers on dental pathology, attrition and third molar agenesis in Eskimos. However, over the past thirty years, the Alaskan collections at the Smithsonian have been subjected to dozens of studies on craniometrics, nonmetric cranial traits, dentition, and paleopathologies. Many of the papers cited later were based on the observations and analyses of skeletal remains curated at the Smithsonian.

Dental studies

The foundation of Alaskan dental anthropology was laid by C.F.A. Moorrees (1957) in his seminal work on the Aleut dentition. Before this monograph was released, there were limited efforts to describe the dentition of Native Alaskans, from size and morphology to descriptions of dental wear and pathologies (Collins 1932; Goldstein 1931, 1932a, 1932b;). Stimulated by the pioneering work of Moorrees on Aleuts, P.O. Pedersen (1949) on East Greenland Eskimos, and Albert A. Dahlberg (1951, 1963) on American Indians, C.G. Turner II (1967a) pursued this avenue of research in his dissertation *The Dentition of Arctic Peoples* (republished in 1991 by Garland). Turner was interested in assessing the pattern of dental morphological variation on the Aleutian Islands, which he attributed largely to genetic drift, a process still considered controversial in the 1960s by British evolutionary biologists. In follow up studies, Turner (1967b, 1969) used dental morphological data to estimate the amount of admixture in modern Koniag and Aleut populations, who tended to show frequencies intermediate between those of Europeans and prehistoric Kodiak Island and Aleut skeletal collections. Finally, Matis and Zwemer (1971) made metric and morphologic dental observations on 47 Eskimos from Nome, along with samples of four Southwest Indian groups (Pima, Papago, Apache, Navajo). Using a discriminant function approach, they found that no Eskimo was ever classified as an American Indian although six Indians were classified as Eskimos. Interestingly, five of these six were Athapaskans, the significance of which was not fully appreciated at the time.

Genetic markers

Between 1900 and 1950, the study of blood group markers was in its infancy. When W. C. Boyd (1950) published his landmark volume *Genetics and the Races of Man*, he focused on gene frequencies at the ABO, MN, and Rh loci. Before 1950, only a handful of Alaskan groups had been sampled for these red cell antigens. The works of Levine (1947, 1949, 1951) on Eskimos from Nome and Barrow and the Tlingit, Matson and Roberts (1949) on Kuskokwim delta Eskimos, and Laughlin (1951a, 1951b) on Aleuts represented what was then known about Native Alaskan genetic markers at the ABO, Rh, and MN loci.

With the modern synthesis of evolution in the 1940s, there was a major shift in physical anthropology from the study of bones to the study of genes. During the 1950s and 1960s, blood samples were collected from Eskimos at Anaktuvuk Pass (Laughlin 1956) and Chignik (Chown and Lewis 1961). Small surveys were also conducted among interior Athapaskans (McKennan 1964), the Kutchin (Lewis et al. 1961) and the Haida (Thomas et al. 1964). As part of the larger Aleutian-Kodiak Island project (Laughlin and Reeder 1966), Denniston (1966) analyzed genetic variation among three Koniag isolates. In 1959, Corcoran et al. provided the most extensive genetic profile of Eskimo (Wainwright, Barrow, Anaktuvuk Pass), Athapaskan (Arctic Village, Fort Yukon, Beaver), and Tlingit samples to date. This study went beyond the three classic loci (ABO, MN, Rh) and included data on the Duffy, Kidd, Kell, P, and Diego blood group systems.

The earliest study of variation in a serum protein was conducted by Blumberg et al. (1959) on haptoglobin variants in Alaskan Eskimos and Indians. Also going beyond standard genetic markers, Allison and Blumberg (1959) collected data on PTC (ability to taste phenylthiocarbamide) in Alaskan Eskimos while Allison et al. (1959) evaluated the genetic-metabolic marker βAIB (β-isobutyric amino acid secretion). In sum, prior to 1973, genetic studies on Alaskan Native populations remained in their infancy.

Human variation: 1973 to 2003

During the first half of the 20th century, the general approach to evaluating human variation involved the comparison of two or more groups for a single variable (measurement, gene frequency, trait frequency). A longstanding alternative was to take two measurements, derive an index, and then compare groups for that index. The cephalic or cranial index (head breadth/head length X 100), the 'king' of indexes, was used to great effect in the Arctic. For example, many workers observed the contrast in general head form between north Alaskan Eskimos, southwest Alaskan Eskimos, and Aleuts. Northern Inupiaq Eskimos tended to be dolichocephalic (long and narrow headed), Yupik Eskimos were brachycephalic (short and broad headed), and Aleuts were hyperbrachycephalic (Laughlin et al. 1979a). While indexes do have some utility, they also have their limitations. On the bright side, however, indexes were far superior to the other comparative strategy of the early 20th century typology. Inferring population history on the basis of cranial types, popular for over 100 years, was used by Hrdlička (1944b) to deduce the actual numbers of Indian, Eskimo and Aleut types in the Uyak collection from Kodiak Island. Georg Neumann's (1952) paper on the different types of Native American skulls, tied as they were to various migration scenarios, represented the climax and portended the downfall of the typological approach. Among Neumann's eight primary types, he did include 'Inuid' and 'Deneid' (i.e., Eskimo and Na-Dene), adding that these represented the latest Native Americans to enter the New World.

Technological and methodological advances in the 1960s significantly impacted the way in which physical anthropologists assessed human variation. No longer did we have to rely on trait by trait, index by index, or type by type comparisons. Multivariate statistics, whose principles had been developed much earlier (e.g., Mahalanobis D^2, Penrose size and shape, principal components and factor analysis, discriminant functions, etc.), could finally reach their potential when revolutionary advances in computational hardware (computers, calculators) made their use practical and feasible on a large scale. Anthropologists enthusiastically embraced the general approach of multiple character comparisons across many samples that was being popularized in biology by the numerical taxonomists (Sokal and Sneath 1963).

To assess population affinity using the new tools of multivariate analysis and biological distance, physical anthropologists used several different kinds of data. Skeletal biologists utilized craniometric measurements, nonmetric cranial trait frequencies, and tooth crown and root trait frequencies to evaluate similarities and differences among groups. Human biologists who work with living populations utilized both quantitative traits, such as anthropometric and dermatoglyphic variables, and qualitative traits, including genetic polymorphisms for blood groups and serum proteins, and haplogroups for mitochondrial DNA and the Y-chromosome.

The three types of skeletal data used to evaluate between group relationships differ in methods of analysis and in assumptions about their inheritance. Craniometric traits, for example, are classic quantitative traits that can be measured with some precision (based on a well-defined set of landmarks) and are assumed to reflect a combination of underlying genetic factors and environmental influences. These interval scale traits are summarized by means, variances, and other parametric statistics. Cranial measurements co-vary to some extent so this fact has to be taken into account when population distances are estimated through methods like the Penrose size and shape or Mahalanobis' D^2 statistic.

Nonmetric cranial characters, along with tooth crown and root traits, are not inherited as simple Mendelian traits even though expression is manifested in terms of presence or absence. For both nonmetric cranial and dental traits, presence expressions can be scored on a graded scale from slight to pronounced. After evaluating population, family and twin data, most workers have concluded these traits are threshold dichotomies, or quasicontinuous variants, with complex modes of inheritance (Scott and Turner 1997). In contrast to craniometric traits where samples are compared for means, variances, and the like, nonmetric traits are summarized and analyzed by trait frequencies.

The past 30 years have witnessed many efforts to evaluate population relationships among earlier Alaskan groups using skeletal and dental data. These efforts, in part, have been directed at making inferences on prehistoric population movements. Secondly, workers have also addressed any concurrent changes in the culture, language and biology of Arctic groups. The problems and results of the three data sets are reviewed below.

Craniometrics

In the late 1960s, Brennan and Howells (n.d.) prepared a paper for volume 3 of the Handbook of North American Indians. Unfortunately, that volume is still 'in press' after 35 years but the paper does serve as a harbinger of things to come in Arctic craniometric analyses. Utilizing several of Hrdlička's 'catalogs of human crania,' these authors analyzed nine craniometric variables across 68 samples from Siberia and North America, 21 of which were from various parts of Alaska. Based on this analysis, they found a fundamental split between American Indians and Eskimos. Interestingly, the American Indian side of the dendrogram includes Aleut and Koniag samples that cluster specifically with Na-Dene samples (Apache, Tlingit). The Eskimo branch shows a basic dichotomy between Yupik-speaking groups from southwest Alaska (along with Siberian Eskimos and Chukchi) and Inupiaq groups distributed from northwest Alaska to Greenland.

The work by Brennan and Howells ushered in a very active period of craniometric analysis of Alaskan groups. As part of the IBP project in northwest Alaska, Zegura (1971) devoted his dissertation to the analysis of craniometric variation in 609 crania from 12 recent Eskimo series (11 Alaskan, 1 Greenlandic). Using the Hrdlička data set once again, Utermohle and Merbs (1979) analyzed 25 Aleut, Eskimo and Chukchi samples, using the Penrose shape statistic and cluster analysis. This analysis led to a massive effort by Utermohle (1984, 1988) that involved the analysis of 1384 crania in 26 Arctic samples, including 16 from Alaska. Although using different samples and statistical methods, Zegura and Utermohle were both trying to determine the extent to which linguistic divisions in the Arctic paralleled divisions indicated by craniometric variation. For the most part, they both found that cranial measurements dichotomized Inupiaq and Yupik Eskimos with a high level of consistency. They also found Aleuts and Koniags to be outliers compared to both Yupik and Inupiaq Eskimos. (Zegura 1975, 1978; Utermohle 1984, 1988).

In a later study on 'exploratory human craniometry' in the Arctic, Heathcote (1986, 1994) evaluated the differences among Yupik and Inupiaq Eskimos, Aleuts, Athapaskans, and Iroquoians. In many ways, his findings paralleled those of Zegura and Utermohle in finding the Aleut to be closer to the Koniag than to any other Eskimo group. He also found his Athapaskan sample was far more similar to Eskimos (especially Yupik Eskimos) than to his American Indian sample.

While the craniometric analyses of Zegura and Heathcote were mostly synchronic, with an emphasis on sampling recent Alaskan populations, Utermohle also took on the task of evaluating ancestral-descendant sequences in different parts of Alaska. While there is evidence for biological continuity in the Barrow region from Birnirk to recent times, the same cannot be said for Point Hope where there appears to be a distinct dichotomy between the early population from Ipiutak and later Thule aged populations. For Kodiak Island, Utermohle (1984) found that the early series from Uyak (Blue, or Pre-Koniag) was most similar to Yupik speaking Eskimos from southwest Alaska while the more recent Uyak sample (Black, or Koniag) clustered with Aleuts. Zegura and Heathcote do not weigh in on this issue as they did not study the early Uyak samples. However, Brennan and Howells (n.d.) found a similar pattern linking Koniags and Aleuts on the one hand and Pre-Koniags and Yupik samples on the other.

Nonmetric cranial traits

While several physical anthropologists pursued Native Alaskan affinity assessment through craniometry, comparable research on nonmetric cranial traits was dominated by one scholar – Nancy Ossenberg. From the early 1970s to the late 1990s, Ossenberg traveled to numerous museums, collecting data on 25 nonmetric cranial traits in dozens of skeletal samples. For Alaska alone, she amassed data on over 20 Eskimo, Aleut and Indian samples. She made observations on at least seven different Aleut samples, seven Yupik samples, and three Inupiaq samples. Moreover, she observed Na-Dene samples that the craniometricians did not consider, including Tlingit, Haida, Northern Athapaskan, Apache and Navajo. For broader comparisons, she includes Algonquin, Siouan, Siberian, and Asian samples. Her data set for Alaskan and Arctic populations rivals that of C. G. Turner II on the dentition of northern groups.

Ossenberg (1977, 1992, 1994) found a broad pattern in her data that suggests (1) Aleuts are more similar to American Indians than they are to Eskimos; and (2) Kodiak Islanders from the three Uyak levels (Blue, Red, Black) are not only closely related to one another but are also closely related to Yupik speaking groups from southwest Alaska. These findings, running counter to the long held belief of biological ties between Eskimos and Aleuts and their distinction from American Indians, was not tested by Zegura or Utermohle as they did not include Athapaskan or Indian samples in their analyses. However, the findings are hinted at in the work of Brennan and Howells (n.d.) and Heathcote (1986). Despite linguistic ties to Eskimos, Aleuts are biologically enigmatic.

Dental studies

After 1973, work proceeded apace on the dental anthropology of Native Alaskans. Turner, who was expanding his data base on morphological variation throughout the world, analyzed collections from Kodiak Island, the Aleutians, Barrow, and Kachemak Bay (cf. Turner 1983, 1984, 1985a, 1985b, 1986, 1988). He also made morphological and pathological observations on the teeth of the Medvedev Party, a group of ten Russians massacred by Aleuts on Umnak Island in 1764 (Turner et al. 1985). Data on crown and root trait variation were also collected by G.R. Scott on St. Lawrence Islanders (Scott and Gillispie 2002) and Kodiak Islanders (Scott 1991, 1992, 1994). Based on dental comparisons among the three time periods represented at the Uyak site, Scott concluded that there was continuity from Kachemak to Koniag times, contrary to the findings of the craniometricians although congruent with the findings of Ossenberg (1992) on nonmetric cranial traits. Turner (1988) feels the Kodiak Island samples from Uyak were not strictly Eskimos, a point Hrdlička (1944a) made in his monograph.

Beyond issues of affinity assessment, additional dental studies include those of Bang and Hasund (1971, 1973; Hasund and Bang 1985) on the morphology of small Eskimo samples from Point Lay, Point Hope and Anaktuvuk Pass. The oral health of earlier Alaskan populations was considered by Costa (1980, 1982) in his study of Kodiak Islanders and samples from Point Hope, including, amazingly enough, Ipiutak. Recently, Schwartz et al. (1995) found an example of 'tooth drilling' in an individual from Point Hope, indicating an early example of therapeutic treatment.

In his master's thesis, C. J. Utermohle (1975) analyzed patterns of dental wear in western Alaskan Eskimos. He found that males consistently wore their teeth more than females, an observation that ran counter to many earlier Arctic observers who felt females should wear their teeth more because of their unique behavioral activities (e.g., chewing frozen mukluks). Scott and Gillispie (2002) report a similar pattern of wear in prehistoric St. Lawrence Islanders.

Turner and Cadien (1969) found that dental chipping (small traumatic fractures of tooth enamel) was extremely common in Alaskan Eskimos, much more so than in Aleuts or northern Indians. Later support for this view comes from Scott and Gillispie (2002) who found crown chipping to be extremely common in prehistoric St. Lawrence Islanders.

Genetic studies

Before 1973, anyone interested in assessing the genetic affinities of modern Alaskan populations had to deal with a very limited data set. Some groups were known for a few loci but many populations had never been sampled at all. To some extent, this situation has been remedied over the past 30 years. Pioneering work on serum protein and red cell enzyme variation was conducted by E. M. Scott and his colleagues (Duncan et al. 1974; Scott 1979; Scott and Wright 1978, 1983a, 1983b; Scott et al. 1966, 1970), among others (cf. Schanfield et al. 1990). While their efforts were statewide in scope, one region surveyed that was largely unknown up to this time was the Yupik area of southwest Alaska. Workers now had a larger array of methods for assaying genetic variability, a fact put to good use in population genetic studies of St. Lawrence Islanders (Ferrell et al. 1981), Kodiak Islanders and Pribilof Island Aleuts (Majumder et al. 1988). In the 1990s, data on nuclear markers were supplemented by mtDNA haplogroup frequencies in Alaskan Inuit and Athapaskan populations (Shields et al. 1992, 1993).

While our knowledge of Native Alaskan genetic variation increased significantly over the past 30 years, there are still many areas of the state that have been but little studied. There is no adequate genetic profile for a number of major groups, including the Tlingit, most interior Athapaskan populations, and the Eskimo populations of the Seward Peninsula. The current emphasis on mtDNA and Y-chromosome haplogroups has overshadowed efforts to complete profiles for standard nuclear markers.

Despite the fact that gaps still exist in the genetic record, the situation is far better than it was before 1973. This has led a number of workers to analyze recent data sets through modern methods of affinity assessment. The classic study of Szathmary and Ossenberg (1978) evaluated both genetic data and nonmetric cranial traits on Eskimo, Athapaskan, and Algonquian samples. Their conclusion was set forth in the title: "Are The Biological Differences Between Eskimos and American Indians Truly Profound?" The title might overstate the case given that no American Indians south of the Canadian/U.S. border were included in the study. However, they do find a closer relationship between 'northern' Indians and Eskimos than most earlier authors would admit. Laughlin (1951a, 1962, 1963, 1966, 1967) devoted a great deal of effort to laying out the differences between Eskimos and Indians, so it was probably this position that Szathmary and Ossenberg took issue with. Szathmary (1977, 1979a, 1979b, 1981, 1983, 1984, 1993a, 1993b) has reiterated her finding of close Eskimo-Athapaskan affinity on many occasions. She feels the two most plausible explanations for the similarity between Eskimos and Indians (Athapaskans) is either ancient gene flow or common origins. Her position has received support from the findings of Shields et al. (1993) on mtDNA haplogroups, who found a small distance value between Inuit-Athapaskan. Although genetic 'clocks' are always somewhat suspect, this analysis resulted in an estimated divergence date of 7000 BP for these groups. Whether the 'clock' for mtDNA can be trusted in this instance is unknown, but what most workers would agree on is this: Athapaskan gene frequencies and genetic distances tend to be intermediate between Inuit and American Indian populations (cf. Cavalli-Sforza et al. 1994). The question of whether the Inuit and Athapaskans diverged before or after their arrival in the New World is an open question in the minds of many anthropologists and geneticists.

Adding to the conundrum is a rare genetic variant, Albumin Algonquin, that has a frequency of 3-9% in Athapaskans and Algonquians but is effectively absent in Eskimos (Lampl and Blumberg 1979; Schell and Blumberg 1988). The explanations for the shared occurrence of this rare variant in Athapaskans and Algonquins are again common ancestry or ancient gene flow. More data are needed to resolve the long-standing puzzle of the interrelationships of all native northern populations, Eskimo-Aleuts, Na-Dene and Algonquin groups alike.

Another attempt at analyzing gene frequency data in the broader context of the archaeological and linguistic record was carried out by A. Harper (1980; Harper and Laughlin 1982). While finding close correspondence between divergence dates estimated by linguistic and genetic similarities, Harper bases his 'clock' on the assumption that the site of Anangula represents an early Aleut population. While the pattern of splitting he reports is consistent with the population relationships found by most other workers, his dates appear to be off by a few thousand years because of the 'Anangula assumption' developed and promulgated by W. S. Laughlin.

Although beyond the scope of this review, the past 30 years have seen a tremendous increase in the number of genetic surveys among Siberian populations. Workers who have analyzed the genetic variation of native Alaskan groups in a broader northern context include Crawford and his co-workers (Crawford and Enciso 1982; Crawford et al. 1981), Szathmary (1979a, 1981, 1984) and Erikkson et al. (1980).

Anthropometrics

Taking measurements on living individuals was, at one time, the bread and butter of physical anthropology. However, few workers now collect anthropometric data with the goal of affinity assessment. Despite this caveat, a recent paper by Ousley (1995) resuscitates an anthropometric data set collected under the direction of Franz Boas during the Jesup North Pacific Expedition (1897-1903). Of the northern groups studied during this survey, the only Alaskan group represented was the Aleut. The remaining 26 groups were from Siberia, Arctic Canada and the Northwest Coast. To expand his analysis beyond the JNPE set, Ousley included anthropometric data on Alaskan groups collected by A. Hrdlička and R. Moore between 1929 and 1931 (i.e., four Eskimo samples: lower Yukon, lower Kuskokwim, Bristol Bay, St. Lawrence Island; two Athapaskan samples: Koyukon, Kutchin).

In his conclusion, Ousley (1995:452) says "The anthropometric picture is in agreement with craniometric and nonmetric studies indicating a separation of Aleuts from geographically distant Eskimos…….and Aleut-Amerindian similarity." This conclusion runs somewhat counter to both the raw distance values (pp. 448-449) and the dendrogram for all groups (Fig. 5; 450). The smallest pairwise distance values between Aleuts and other groups in the array are with Bristol Bay Eskimo (1.7), Bella Coola (2.7), Kwakiutl (2.8), Kuskokwim Eskimo (2.9), Yukon Eskimo (4.1), St. Lawrence Island Eskimo (4.6), and Koyukon (4.9). All other Aleut pairwise distances are over 5.0. While the similarity between the two Northwest Coast Indian samples and Aleuts is interesting, their primary similarity is still to Yupik-speaking groups of southwest Alaska. This is also apparent in the dendrogram. In a second article that analyzed anthropometric data from the JNPE, Jantz et al. (1992) evaluated differences between many American Indian populations but only one Eskimo sample.

HUMAN ADAPTABILITY: FOUNDATIONS

Given the latitudinal dispersion and varied maritime influences, Alaskan populations have been subject to a broad range of environmental stressors. At one extreme are the groups along Alaska's northern coast who are subject to cold, dry conditions and pronounced seasonal swings in temperature and light. Populations along the Gulf of Alaska coast are exposed to cold, wet conditions with high precipitation and more moderate seasonality in light and ambient temperature. Groups along the Chukchi and Bering Seas fall between these extremes. Populations of Alaska's interior show similar contrasts in environmental stressors, dependent again on latitude and proximity to major bodies of water.

Before discussing research on human adaptability in Alaska, a few basic definitions are required. Homeostasis refers to the ability of an organism to maintain a steady-state equilibrium in basic life functions such as temperature, pulse, respiratory rate, and blood glucose levels. An external or internal force that deflects an organism off homeostatic levels is referred to as a stress or stressor. The degree to which an organism is thrown off homeostatic levels (e.g., varying levels of lowered body temperature below 37° C) is called strain (Little and Morren 1976). Adaptation is accomplished when an organism relieves stress, reduces strain, and reestablishes homeostasis through a hierarchy of adaptive responses (Slobodkin 1968).

Behavioral (or cultural) adaptation provides an organism with the first line of defense against an environmental stress. For example, when ambient air temperature falls below thermal neutrality (75-80° F), humans can engage in activities that help them generate body heat (e.g., build a fire, eat, exercise, etc.) or reduce heat loss (e.g., add layers of clothing, find shelter, etc.), the goal of which is to maintain a core temperature of around 37° C. When behavioral strategies cannot alleviate a particular stress, neurological, physiological, and chemical mechanisms are brought to bear on the challenge. This tier of the hierarchy, referred to as physiological adaptation, occurs when peripheral receptors in the skin transmit messages to the hypothalamus. With exposure to cold and an inadequate behavioral response to meet the stress, there is vasoconstriction of peripheral arteries, elevated metabolic and heart rates, and nonshivering thermogenesis. The physiological and behavioral goal is the same – maintaining a core temperature that tracks closely to 37° C.

Humans adapt to environmental stress primarily through behavioral and physiological means. In some instances, though, either chronic or acute stressors can call into play the most expensive strategy in the adaptive hierarchy — genetic or evolutionary adaptation. Over the past four decades, workers have tried to determine if any of the anatomical or physiological differences between natives of Alaska and peoples from other regions can be attributed to genetic adaptation. This may sound straightforward in principle but is complicated by the difference between acclimitization and developmental acclimitization. Most humans have the ability to acclimatize to new environmental conditions, usually within a few days or weeks of exposure to these conditions. However, a sojourner may never be able to match the physiological capabilities of an individual raised under the same stressful conditions — such individuals are developmentally acclimatized. It would not be difficult to distinguish between acclimitization and genetic adaptation but the latter is hard to distinguish from developmental acclimitization.

How do humans tolerate and adapt to extremes in climate? Do different 'racial' groups vary in their tolerance to extremes in temperature or altitude? Such questions were rarely addressed in anthropological circles prior to the 1950s. The differential response to cold of white and black American troops fighting in Korea generated both the interest and funding needed to address this problem. After the Korean conflict, the Arctic Aeromedical Laboratory at Ladd Air Force Base in Alaska played a significant role in early studies of cold adaptability (cf. Adams and Rennie 1955; Bollerud et al. 1950; Meehan 1955). At the same time, workers were starting to evaluate the causes behind the significantly elevated metabolic rates observed in Eskimos (Brown et al. 1954; Rodahl 1952). At this time, Brown and Page (1952) also noted the difference between Eskimos and whites in hand temperature responses to extremity cooling. Although most cold research focused on Eskimos (cf. Milan and Evonuk 1966), basic research was also conducted on the responses of Arctic Indians (Athapaskans) to standardized cold tests (Elsner et al. 1960a, 1960b; Irving et al. 1960).

The work at the Arctic Aeromedical Laboratory was the precursor to a more ambitious effort to address human adaptability on a worldwide scale. Between 1962 and 1972, researchers from a multitude of disciplines, including anthropology, conducted systematic studies of the earth's major biomes. Although most of the focus was on plant and animal ecology and adaptations, one project area within IBP addressed questions of human adaptability (HA). One goal of the HA project was to study human populations that had been minimally impacted by modernization and who, over the long course of history, had to adapt to an environment that had one or more major stressors such as heat, cold, or high altitude.

To study cold adaptation, the IBP/HA committee focused on a number of populations residing in the circumpolar zone, including Lapps (Saami), the Ainu, Eskimos from Greenland, Canada and Alaska, and select Siberian populations. As the focus of this paper is on Alaska, only research in this region is addressed here. For broader summaries of circumpolar physical anthropological research, see Milan (1980) and Scott et al. (2000).

For Alaska, a research team led by Frederick A. Milan (1968, 1978) determined that Wainwright village would be a suitable site for studying stresses brought on by: (1) extreme winter temperatures, or cold; (2) highly variable photoperiods, with pronounced seasonal differences; (3) a high protein, high fat, low carbohydrate diet; (4) strenuous physical labor during seasonal movement and subsistence pursuits; (5) local disease vectors; (6) population-resource imbalances; and (7) introduced diseases and foodstuffs, primarily of European origin. To compliment studies in Wainwright, additional study sites in north Alaska included Anaktuvuk Pass, Barrow, and Point Hope.

HUMAN ADAPTABILITY: 1973-2003

Although the IBP program ended in 1972, major publications emanating from that effort appeared after 1973. From an Alaskan standpoint, the most significant synthesis volume is *Eskimos of Northwestern Alaska: A Biological Perspective* (Jamison et al. 1978). Its 22 chapters include coverage of traditional anthropological topics such as anthropometry, dermatoglyphics, and craniofacial variation but by far the greatest number of articles focus on biochemical variation, nutrition, and metabolism.

Two later synthesis volumes emanating from IBP/HA research in the north include *The Human Biology of Circumpolar Populations* (Milan 1980) and *The Health Consequences of "Modernization": Evidence From Circumpolar Peoples* (Shepard and Rode 1997). In the first work, authors summarize research in areas such as genetics, nutrition, physiology, anthropometry, demography, etc., that serves to put northwest Alaskan Eskimos into a larger comparative framework. The second volume places more emphasis on health related concerns and considers at length recent changes in the health and biology of circumpolar groups, including north Alaskan Eskimos.

Some of the basic findings from IBP/HA research teams suggest that Inuit groups show more cultural than biological adaptations to the rigors of high latitude environments. From a physiological standpoint, Eskimos differ from Europeans in showing a quicker warming response to finger immersion in ice-water baths (i.e., Lewis Hunting reflex). Another physiological difference between Eskimos and Europeans is in the notably higher basal metabolic rates of the former. Much of this difference has been attributed to the high protein-high fat diet of northern populations, so this distinction may not be indicative of a physiological adaptation to cold temperatures. Although genetic adaptations to life in the north have been difficult to find, most agree that the body proportions of the Inuit (relatively short limbs compared to torso dimensions) are in line with the ecogeographic rules of Bergmann and Allen. Shorter extremities reduce the surface area to mass ratio and thus helps conserve heat in an environment that places a premium on both heat production and heat conservation.

From the standpoint of nutrition, researchers have found that Eskimos have relatively high frequencies of lactose intolerance, in line with the lack of dairy in the traditional diet. More interesting is the fact that some of the very few cases of sucrose intolerance in the world were found in north Alaskan Eskimos, a testimony to the very low levels of carbohydrates in the diet (Bell et al. 1973, 1978; Draper 1978; Duncan and Scott 1972).

Skeletal adaptations in northern populations

Although human biologists who evaluate growth, physiology, and nutrition dominate studies of human adaptability, skeletal biologists have also contributed in this area. For example, a long-standing debate among Arctic physical anthropologists has focused on the distinctive features of Inuit craniofacial morphology (e.g., broad cheekbones, small brow ridges, gonial eversion, sagittal keeling, large oral tori, narrow nasal index, etc.). Some authors, for example, have argued that extreme cold sculpted the face of Arctic populations (cf. Coon et al. 1950). Others contend that heavy chewing, not cold, is primarily responsible for the distinctiveness of the Eskimo skull.

In 1977, W. L. Hylander wrote an influential article on the adaptive significance of Eskimo cranio-facial morphology. In earlier times, the bite force Eskimos could produce between their upper and lower first molars was 2 to 3 times greater than that produced by Europeans or American whites (Waugh 1937). Hylander tied this great difference to cranio-facial architecture. He felt that some characteristics helped Eskimos generate a large bite force while other traits reflected the dissipation of these forces. For example, the projecting cheekbones, sagittal keeling, a relatively short mandible and broad ramus, along with powerfully developed temporalis, masseter and pterygoid muscles, changed the biomechanics of the bite, greatly increasing its power. To dissipate these enormous forces, Eskimos show a number of other distinctive characteristics, including pinched nasal bones, high and distinct temporal lines, large palatine and mandibular tori, and thickened tympanic plates.

One of the few skeletal characteristics observed in Eskimos that may not reflect heavy chewing is a reduced brow ridge and smaller frontal sinus. Koertvelyessy (1972) studied frontal sinuses in five Alaskan Eskimo series for size and occurrence and found a relationship between reduced sinus size and low wind chill temperatures. Hanson and Owsley (1980) found that Canadian Inuit had even smaller sinuses than Alaskan Eskimos. Finally, Beals (1972: Beals et al. 1984) studied worldwide clines in brain size dimensions and found that brain mass increases in relationship to latitude. Aleuts and Eskimos have some of the biggest brains in the world!

Although most workers have focused on cranial adaptations, Laughlin and his co-workers (1979b) focused on data from long bones. They studied cortical thickness of the femur and bone mineral content (BMC) in Eskimo and Aleut samples. Aleuts showed both thicker bones and higher BMC values than Eskimos. Mazees and Mather (1974) also found rapid bone loss with advancing age in northwest Alaskan populations. To what extent osteoporosis can be attributed to latitude, a high fat-high protein diet or some combination of the two has yet to be resolved.

FINAL THOUGHTS

This review likely differs from others in delving into history beyond the assigned time frame of 1973-2003. However, much of the work accomplished during the past thirty years would not have been possible without the collection efforts of Aleš Hrdlička and other museum personnel. When physical anthropologists wanted to study prehistoric Native Alaskan relationships, their primary destination was the Smithsonian Institution. The work of Turner, Ossenberg, Utermohle, Zegura, Heathcote, and many others was dependent on skeletal series obtained by Smithsonian, AMNH, and other museum researchers during the first half of the 20th century.

Although NAGPRA did not take effect until the early 1990s, very few skeletons were unearthed in Alaska after 1973. This author disinterred skeletons from cemeteries in Kotzebue (Scott et al. 1978), Barrow and Nome in the 1970s and 1980s (at the direction of local authorities) but all remains were reburied immediately. In other words, physical anthropologists and archaeologists were sensitive about the excavation of Native Alaskan remains well before NAGPRA was enacted. The common approach to treating the recovery of human remains is well attested by the discovery, study and disposition of prehistoric frozen mummies found on St. Lawrence Island and Barrow (Scott et al. 1984; Zimmerman and Aufderheide 1984; Zimmerman and Smith 1975). In both cases, scientists worked with native communities to ensure that the interests of both groups would be served. The remains were evaluated scientifically and then returned to the communities for reburial.

Starting in the early 1990s, many Alaskan communities requested the return of skeletal remains removed from their village sites. One of the best publicized cases involved the Uyak site on Kodiak Island. The process of repatriation is documented from the initial requests to reburial by Bray and Killion (1994) in a volume entitled *Reckoning With the Dead: The Larsen Bay*

Repatriation and the Smithsonian Institution. Following the resolution of the Uyak case, many other skeletal collections have been returned to Native Alaskan communities. Prior to reburial, most skeletal series have been or are being subjected to intensive data collection efforts at the Smithsonian and elsewhere, using a standard set of guidelines (cf. Scott et al. 1995, 1996; Street and Scott 1995; Verano and Urcid 1994). Local communities are achieving the goal of reburying their ancestors after physical anthropologists obtain as much information as time allows on the morphology and health of earlier Alaskan populations – an imperfect compromise in an imperfect world.

REFERENCES

Adams, T. and D. W. Rennie
1955 *The Comparative Tolerance of Negroes and Caucasians to a Standardized Cold Stress as Indicated by Body Temperature and Metabolic Rate*. Technical Report No. 57-20, Arctic Aeromedical Laboratory, APO 731, Seattle.

Allison, A. C. and B. S. Blumberg
1959 Ability to Taste Phenylthiocarbamide Among Alaskan Eskimos and Other Populations. *Human Biology* 31:352-359.

Allison, A. C., B. S. Blumberg and S. M. Gartler
1959 Urinary Excretions of β-amino-isobutyric Acid in Eskimo and Indian Populations of Alaska. *Nature* 183:118-119.

Bang, G. and A. Hasund
1971 Morphologic Characteristics of the Alaskan Eskimo Dentition. I. Shovel-Shape of Incisors. *American Journal of Physical Anthropology* 35:43-47.

1973 Morphologic Characteristics of the Alaskan Eskimo Dentition. III. Number of Cusps on the Upper Permanent Molars. *American Journal of Physical Anthropology* 38:721-726.

Beals, K. L.
1972 Head Form and Climate Stress. *American Journal of Physical Anthropology* 37:85-92.

Beals, K. L., C. L. Smith and S. M. Dodd
1984 Brain Size, Cranial Morphology, Climate, and Time Machines. *Current Anthropology* 25:301-330.

Bell, R. R., H. H. Draper and J. G. Bergen
1973 Sucrose, Lactose, and Glucose Tolerance in Northern Alaska Eskimos. *American Journal of Clinical Nutrition* 26:1185-1190.

1978 Metabolic Parameters: Lactose and Sucrose Tolerance. In *Eskimos of Northwestern Alaska: A Biological Perspective*, edited by P. L. Jamison, S. L. Zegura, and F. A. Milan, pp. 184-188. Dowden, Hutchinson and Ross, Stroudsburg, PA.

Blumberg, B. S., A. C. Allison and B. Garry
1959 The Haptoglobins and Hemoglobins of Alaskan Eskimos and Indians. *Annals of Human Genetics* 23:349-356.

Bøllerud, J. J. Edwards and R. A. Blakeley
1950 *Survey of the Basal Metabolism of the Eskimo.* Arctic Aeromedical Laboratory, Project Report 21-01-020, USAF, Point Barrow, Alaska.

Boyd, W. C.
1950 *Genetics and the Races of Man*. Little, Brown, and Company, Boston.

Bray, T. L. and T. W. Killion (Editors)
1994 *Reckoning With the Dead: The Larsen Bay Repatriation and the Smithsonian Institution*. Smithsonian Institution Press, Washington D.C.

Brennan, M. J. and W. W. Howells
n.d. A Craniometric and Linguistic Grouping of Selected North American and Asian Peoples. Unpublished ms., Department of Anthropology, Peabody Museum, Harvard University, Cambridge.

Brown, G. M. and J. Page
1952 The Effect of Chronic Exposure to Cold on Temperature and Blood Flow of the Hand. *Journal of Applied Physiology* 5:221-227.

Brown, G. M., G. S. Bird, L. M. Boag, D. J. Delahaye, J. E. Green, J. D. Hatcher and J. Page
1954 Blood Volume and Basal Metabolic Rate of Eskimos. *Metabolism* 3:247-254.

Cavalli-Sforza, L. L., P. Menozzi and A. Piazza
1994 *The History and Geography of Human Genes.* Princeton University Press, Princeton.

Chown, B. and M. Lewis
1961 The Blood Groups and Secretor Status of Three Small Communities in Alaska. *Oceania* 32:211-218.

Collins, H. B., Jr.
1932 Caries and Crowding in the Teeth of the Living Alaskan Eskimo. *American Journal of Physical Anthropology* 16:451-462.

Coon, C. S., S. M. Garn and J. B. Birdsell
1950 *Races: A Study of the Problems of Race Formation in Man.* C. C. Thomas, Springfield, IL.

Corcoran, P. A., F. H. Allen, A. C. Allison and B. S. Blumberg
1959 Blood Groups of Alaskan Eskimos and Indians. *American Journal of Physical Anthropology* 17:187-193.

Costa, R. L.
1980 Age, Sex, and Antemortem Loss of Teeth in Prehistoric Eskimo Samples From Point Hope and Kodiak Island. *American Journal of Physical Anthropology* 53:579-587.

Costa, R. L.
1982 Periodontal Disease in the Prehistoric Ipiutak and Tigara Skeletal Remains From Point Hope, Alaska. *American Journal of Physical Anthropology* 59:97-110.

Crawford, M. H. and V. B. Enciso
1982 Population Structure of Circumpolar Groups of Siberia, Alaska, Canada, and Greenland. In *Current Developments in Anthropological Genetics, Volume 2,* edited by M. H. Crawford and J. H. Mielke, pp. 51-91. Plenum Press, New York.

Crawford, M. H., J. H. Mielke, E. J. Devor, D. D. Dykes, and H. F. Polesky
1981 Population Structure of Alaskan and Siberian Indigenous Communities. *American Journal of Physical Anthropology* 55:167-186.

Dahlberg, A. A.
1951 The Dentition of the American Indian. In *The Physical Anthropology of the American Indian*, edited by W. S. Laughlin, pp. 138-176. The Viking Fund, Inc., New York.

1963 Analysis of the American Indian Dentition. In *Dental Anthropology*, edited by D. R. Brothwell, pp. 149-178. Pergamon Press, New York.

Debetz, G.
1959 The Skeletal Remains of the Ipiutak cemetery. *Proceedings of the 33rd International Congress of Americanists* 2:57-64.

Denniston, C.
1966 The Blood Groups of Three Konyag Isolates. *Arctic Anthropology* 3:195-205.

Draper, H. H.
1978 Nutrition Studies: The Aboriginal Eskimo Diet — a Modern Perspective. In *Eskimos of Northwestern Alaska: A Biological Perspective*, edited by P. L. Jamison, S. L. Zegura, and F. A. Milan, pp. 139-145. Dowden, Hutchinson and Ross, Stroudsburg, PA.

Duncan, I. W. and E. M. Scott
1972 Lactose Tolerance in Alaskan Indians and Eskimos. *American Journal of Clinical Nutrition* 25:867.

Duncan, I. W., E. M. Scott and R. C. Wright
1974 Gene Frequencies of Erythrocytic Enzymes of Alaskan Eskimos and Athapaskan Indians. *American Journal of Human Genetics* 26:244-246.

Elsner, R. W., K. L. Andersen and L. Hermanssen
1960a Thermal and Metabolic Responses of Arctic Indians to Moderate Cold Exposure at the End of Winter. *Journal of Applied Physiology* 15:659-666.

Elsner, R. W., J. D. Nelms and L. Irving
1960b Circulation of Heat to the Hands of Arctic Indians. *Journal of Applied Physiology* 15:659-661.

Eriksson, A. W., W. Lehmann and N. E. Simpson
1980 Genetic Studies on Circumpolar Populations. In *The Human Biology of Circumpolar Populations*, edited by F. A. Milan, pp. 81-168. Cambridge University Press, Cambridge.

Ferrell, R. D., R. Chakraborty, H. Gershowitz, W. S. Laughlin, and W. J. Schull
1981 The St. Lawrence Island Eskimos: Genetic Variation and Genetic Distance. *American Journal of Physical Anthropology* 55:351-358.

Goldstein, M. S.
1931 The Cusps in the Mandibular Molar Teeth of the Eskimo. *American Journal of Physical Anthropology* 16:215-235.

1932a Congenital Absence and Impaction of the Third Molar in the Eskimo Mandible. *American Journal of Physical Anthropology* 16: 381-388.

1932b Caries and attrition in the molar teeth of the Eskimo mandible. *American Journal of Physical Anthropology* 16:421-430.

Hanson, C. L. and D. W. Owsley
1980 Frontal Sinus Size in Eskimo Populations. *American Journal of Physical Anthropology* 53:251-255.

Harper, A. B.
1980 Origin and Divergence of Aleuts, Eskimos, and American Indians. *Annals of Human Biology* 7:547-554.

Harper, A. B. and W. S. Laughlin
1982 Inquiries Into the Peopling of the New World: Development of Ideas and Recent Advances. In *A History of American Physical Anthropology: 1930-1980*, edited by F. Spencer, pp. 281-304. Academic Press, New York.

Hasund, A. and G. Bang
1985 Morphologic Characteristics of the Alaskan Eskimo Dentition. IV. Cusp Number and Groove Patterns of Mandibular Molars. *American Journal of Physical Anthropology* 67:65-69.

Heathcote, G. M.
1986 *Exploratory Human Craniometry of Recent Eskaleutian Regional Groups From the Western Arctic and Subarctic of North America: A New Approach to Population Historical Reconstruction*. BAR International Series 301, Oxford.

1994 Population History Reconstruction, Based on Craniometry. I. The Backtracking Approach and Initial Results. *Human Evolution* 9:97-119.

Hrdlička, A.
1924 Catalog of Human Crania in the United States National Museum Collections: The Eskimo, Alaska and Related Indians. *Proceedings of the U.S. National Museum* 63:1-51.

1930 *Anthropological Survey in Alaska*. 46th Annual Report of the Bureau of American Ethnology, U.S. Government Printing Office, Washington, D.C.

1942 Catalog of Human Crania in the United States National Museum Collections: Eskimos in General. *Proceedings of the U.S. National Museum* 91:169-429.

1944a *The Anthropology of Kodiak Island*. Wistar Press, Philadelphia.

1944b Catalog of Human Crania in the United States National Museum Collections: Non-Eskimo Peoples of the Northwest Coast, Alaska and Siberia. *Proceedings of the U.S. National Museum* 94:1-172.

1945 *The Aleutian and Commander Islands and Their Inhabitants*. Wistar Press, Philadelphia.

Hylander, W. L.
1977 The Adaptive Significance of Eskimo Cranio-Facial Morphology. In *Oro- Facial Growth and Development,* edited by A. A. Dahlberg and T. Graber, pp. 130-169. Mouton Publishers, The Hague.

Irving, L., K.L. Andersen, A. Bolstad, R. Elsner, J.A. Hildes, Y. Løyning, J. D. Nelms, L. J. Peyton and R. D. Whaley
1960 Metabolism and Temperature of Arctic Indian Men During a Cold Night. *Journal of Applied Physiology* 15:635-644.

Jamison, P. L., S. L. Zegura and F. A. Milan, editors.
1978 *Eskimos of Northwestern Alaska: A Biological Perspective*. Dowden, Hutchinson and Ross, Stroudsburg, PA.

Jantz, R. L., D. R. Hunt, A. B. Falsetti and P. J. Kay
1992 Variation Among North Amerindians: Analysis of Boas's Anthropometric Data. *Human Biology* 64:431-465.

Koertvelyessy, T.
1972 Relationships Between the Frontal Sinus and Climatic Conditions: A Skeletal Approach to Cold Adaptation. *American Journal of Physical Anthropology* 37:162-172.

Lampl, M. and B. S. Blumberg
1979 Blood Polymorphisms and the Origins of New World Populations. In *The First Americans: Origins, Affinities, and Adaptations*, edited by W. S. Laughlin and A. B. Harper, pp. 107-123. Gustav Fischer, New York.

Larsen, H. and F. G. Rainey
1948 *Ipiutak and the Arctic Whale Hunting Culture*. Anthropological Papers No. 42, American Museum of Natural History, New York.

Laughlin, W. S.
1951a The Alaska Gateway Viewed From the Aleutian Islands. In *The Physical Anthropology of the American Indian,* edited by W. S. Laughlin, pp. 98-126, Viking Fund, New York.

1951b Blood Groups, Morphology and Population Size of the Eskimos. *Cold Spring Harbor Symposium on Quantitative Biology* 15:165-173.

1956 Blood Groups of the Anaktuvuk Eskimos. *Anthropological Papers of the University of Alaska* 6:5-15.

1962 Generic Problems and New Evidence in the Anthropology of the Eskimo-Aleut Stock. *Arctic Institute of North America Technical Paper* 11:100-181.

1963 Eskimos and Aleuts: Their Origins and Evolution. *Science* 142:633-645.

1966 Genetical and Anthropological Characteristics of Arctic Populations. In *The Biology of Human Adaptability*, edited by P. T. Baker and J. S. Weiner, pp. 469-492, Clarendon Press, Oxford.

1967 Human Migration and Permanent Occupation in the Bering Sea Area. In *The Bering Land Bridge*, edited by D. M. Hopkins, pp. 409-450. Stanford University Press, Palo Alto.

Laughlin, W. S. and W. G. Reeder (Editors)
1966 Studies in Aleutian-Kodiak Prehistory, Ecology and Anthropology. *Arctic Anthropology* 3(2).

Laughlin, W. S., J. B. Jørgensen and B. Frøhlich
1979a Aleuts and Eskimos: Survivors of the Bering Land Bridge Coast. In *The First Americans: Origins, Affinities, and Adaptations*, edited by W. S. Laughlin and A. B. Harper, pp. 91-104. Gustav Fischer, New York.

Laughlin, W. S., A. B. Harper and D. D. Thompson
1979b New Approaches to the Pre and Post Contact History of Arctic Peoples. *American Journal of Physical Anthropology* 51:579-587.

Levine, V. E.
1947 Blood Groups of the Eskimos at Nome. *Bulletin of the Creighton University School of Medicine* 4:2-9.

1949 Further Studies of the Blood Groups of the Eskimo. *American Journal of Physical Anthropology* 7:284.

1951 The Blood Groups of Alaskan Indians. *American Journal of Physical Anthropology* 9:238.

Lewis, M., J. A. Hildes, H. Kaita and B. Chown
1961 The Blood Groups of the Kutchin at Old Crow, Yukon Territory. *American Journal of Physical Anthropology* 19:383-389.

Little, M. A. and G. E. B. Morren, Jr.
1976 *Ecology, Energetics, and Human Variability*. Wm. C. Brown Company, Dubuque, IA.

Majumder, P. P., W. S. Laughlin and R. E. Ferrell
1988 Genetic Variation in the Aleuts of the Pribilof Islands and the Eskimos of Kodiak Island. *American Journal of Physical Anthropology* 76:481-488.

Matis, J. A. and T. J. Zwemer
1971 Odontognathic Discrimination of United States Indian and Eskimo Groups. *Journal of Dental Research* 50:1245-1248.

Matson, G. A. and H. J. Roberts
1949 Distribution of the Blood Groups, M-N, and Rh Types Among Eskimos of the Kuskokwim Basin in Western Alaska. *American Journal of Physical Anthropology* 7:109-122.

Mazees, R. B. and W. Mather
1974 Bone Mineral Content of North Alaskan Eskimos. *American Journal of Clinical Nutrition* 27:916-925.

McKennan, R. A.
1964 The Physical Anthropology of Two Alaskan Athapaskan Groups. *American Journal of Physical Anthropology* 22:43-52.

Meehan, J. P.
1955 *Individual and Racial Variations in Vascular Response to Cold Stimulus*. Project Number 7-7953, Report No. 1, Arctic Aeromedical Laboratory, APO 731, Seattle.

Milan, F. A.
1968 International Study of Eskimos. *Arctic* 21:123-126.

1978 Multidisciplinary Research on Northwest Alaskan Eskimos. In *Eskimos of Northwestern Alaska: A Biological Perspective*, edited by P. L. Jamison, S. L. Zegura, and F. A. Milan, pp. 1-7. Dowden, Hutchinson and Ross, Stroudsburg, PA.

Milan, F. A. (Editor)
1980 *The Human Biology of Circumpolar Populations*. Cambridge University Press, Cambridge.

Milan, F. A. and E. Evonuk
1966 Oxygen Consumption and Body Temperatures of Eskimos During Sleep. *Journal of Applied Physiology* 22:565-567.

Moorrees, C. F. A.
1957 *The Aleut Dentition: A Correlative Study of Dental Characteristics in an Eskimoid Population*. Harvard University Press, Cambridge.

Neumann, G. K.
1952 Archeology and Race in the American Indian. In *Archeology of Eastern United States*, edited by J. B. Griffin, pp. 13-34. University of Chicago Press, Chicago.

Ossenberg, N. S.
1977 Congruence of Distance Matrices Based on Cranial Discrete Traits, Cranial Measurements, and Linguistic-Geographic Criteria in Five Alaskan Populations. *American Journal of Physical Anthropology* 47:93-98.

1992 Native People of the American Northwest: Population History From the Perspective of Skull Morphology. In *The Evolution and Dispersal of Modern Humans in Asia*, edited by T. Akazawa, K. Aoki and T. Kimura, pp. 493-530. Hokusen-sha, Tokyo.

1994 Origins and Affinities of the Native Peoples of Northwestern North America: The Evidence of Cranial Nonmetric Traits. In *Method and Theory for Investigating the Peopling of the Americas*, edited by R. Bonnichson and D. G. Steele, pp. 79-115. Center for the Study of the First Americans, Corvallis, OR.

Ousley, S. D.
1995 Relationships Between Eskimos, Amerindians, and Aleuts: Old Data, New Perspectives. *Human Biology* 67:427-458.

Pedersen, P. O.
1949 *The East Greenland Eskimo Dentition*. Meddelelser om Grønland, Volume 142. Copenhagen.

Rodahl, K.
1952 Basal Metabolism of Eskimo. *Journal of Nutrition* 48:359-368.

Schanfield, M. S., M. H. Crawford, J. B. Dossetor and H. Gershowitz
1990 Immunoglobulin Allotypes in Several North American Eskimo Populations. *Human Biology* 62:773-789.

Schell, L. M. and B. S. Blumberg
1988 Alloalbuminemia and the Migration of Native Americans. *Yearbook of Physical Anthropology* 31:1-14.

Schwartz, J. H., J. Brauer and P. Gordon-Larsen
1995 Brief Communication: Tigaran (Point Hope, Alaska) Tooth Drilling. *American Journal of Physical Anthropology* 97:77-82.

Scott, E. M.
1979 Genetic Diversity of Athabascan Indians. *Annals of Human Biology* 6:241-247.

Scott, E. M. and R. C. Wright
1978 Polymorphism of Red Cell Enzymes in Alaskan Ethnic Groups. *Annals of Human Genetics* 41:341-346.

1983a Genetic Diversity of Central Yuik Eskimos. *Human Biology* 55:409-415.

1983b Rare and Unusual Alleles in Alaskan Ethnic Groups. *Annals of Human Biology* 10:353-356.

Scott, E. M., I. W. Duncan, V. Ekstrand and R. C. Wright
1966 Frequency of Polymorphic Types of Red Cell Enzymes and Serum Factors in Alaskan Eskimos and Indians. *American Journal of Human Genetics* 18:408-411.

Scott, E. M., D. D. Weaver and R. C. Wright
1970 Discrimination of Phenotypes in Human Serum Cholinesterase Deficiency. *American Journal of Human Genetics* 22:363-369.

Scott, G. R.
1991 Continuity or Replacement at the Uyak Site: A Physical Anthropological Analysis of Population Relationships. *University of Oregon Anthropological Papers* 44:1-56.

1992 Affinities of Prehistoric and Modern Kodiak Islanders and the Question of Kachemak-Koniag Biological Continuity. *Arctic Anthropology* 29:150-166.

1994 Teeth and Prehistory on Kodiak Island. In *Reckoning With the Dead: The Larsen Bay Repatriation and the Smithsonian Institution*, edited by T. L. Bray and T. W. Killion, pp. 67-74 Smithsonian Institution Press, Washington, D.C.

Scott, G. R. and C. G. Turner II
1997 *The Anthropology of Modern Human Teeth*. Cambridge University Press, Cambridge.

Scott, G. R. and T. E. Gillispie
2002 The Dentition of Prehistoric St. Lawrence Island Eskimos: Variation, Health and Behavior. *Anthropological Papers of the University of Alaska,* NS, 2(1): 50-72.

Scott, G. R., B. F. Stocklin and C. J. Utermohle
1978 A Protohistoric Mass Burial at Kotzebue, Alaska. *Anthropological Papers of the University of Alaska* 19(1): 3-10.

Scott, G. R., D. Palmer and T. E. Gillispie
1984 Cranial and Dental Observations on the Utqiagvik Skeletons From Mound 44. *Arctic Anthropology* 21(1): 65-76.

Scott, G. R., S. R. Street, S. Steen and C. R. Colby
1995 *Preliminary Report on the Human Remains From Golovin Bay, Alaska. Part I. Description of Individual Burials.* Submitted to Repatriation Office, Smithsonian Institution, Washington, D.C.

Scott, G. R., S. R. Street, S. Steen, S. Legge, R. Lane and C. R. Colby
1996 *Report on the Human Remains From Nunivak Island, Alaska*. Submitted to Repatriation Office, Smithsonian Institution, Washington, D.C.

Scott, G. R., S. Legge, R. W. Lane, S. Steen and S. R. Street
2000 Physical Anthropology of the Arctic. In *The Arctic: Environment, People, Policy,* edited by M. Nuttall and Terry V. Callaghan, pp. 339-373. Harwood, Chur, Switzerland.

Shepard, R. J. and A. Rode
1997 *The Health Consequences of "Modernization": Evidence From Circumpolar Peoples*. Cambridge University Press, Cambridge.

Shields, G. F., K. Hecker, M. I. Voevoda and J. K. Reed
1992 Absence of the Asian-specific Region V Mitochondrial Marker in Native Beringians. *American Journal of Human Genetics* 50:758-765.

Shields, G. F., A. M. Schmiechen, B. L. Frazier, A. Redd, M. I. Voevoda, J. K. Reed and R. H. Ward
1993 mtDNA Sequences Suggest a Recent Evolutionary Divergence for Beringian and Northern North American Populations. *American Journal of Human Genetics* 53:549-562.

Slobodkin, L.
1968 Toward a Predictive Theory of Evolution. In *Population Biology and Evolution*, edited by R. S. Lewontin, pp. 187-205. Syracuse University Press, Syracuse.

Sokal, R. R. and P. H. A. Sneath
1963 *Numerical Taxonomy*. W. H. Freeman, San Francisco.

Stewart, T. Dale
1953 The Age Incidence of Neural-Arch Defects in Alaskan Natives, Considered from the Standpoint of Etiology. *Journal of Bone and Joint Surgery* 35-A:937-950.

Street, S. R. and Scott, G. R.
1995 *Preliminary Report on the Human Remains From Golovin Bay, Alaska. Part II. Morphological Affinity Assessment.* Submitted to Repatriation Office, Smithsonian Institution, Washington, D.C.

Szathmary, E. J. E.
1977 Genetic Characteristics of Athapascan-Speakers: the Problem of Genetic Relationships. In *Prehistory of the North American Subarctic*, edited by J. W. Helmer, W. Kense and S. Van Dyke, pp. 111-119. Archaeological Association of the University of Calgary, Calgary.

1979a Blood Groups of Siberians, Eskimos, Subarctic and Northwest Coast Indians: The Problem of Origins and Genetic Relationships. In *The First Americans: Origins, Affinities and Adaptations*, edited by W. S. Laughlin and A. B. Harper, pp. 185-209. Gustav Fischer, New York.

1979b Eskimo and Indian Contact: Examination of the Craniometric, Anthropometric and Genetic Evidence. *Arctic Anthropology* 16:23-48.

1981 Genetic Markers in Siberian and Northern North American Populations. *Yearbook of Physical Anthropology* 24:37-73.

1983 Dogrib Indians of the Northwest Territories, Canada: Genetic Diversity and Genetic Relationship Among Subarctic Indians. *Annals of Human Biology* 10:147-162.

1984 Peopling of Northern North America: Clues From Genetic Studies. *Acta Anthropogenetica* 8:79-109.

1993a Genetics of Aboriginal North Americans. *Evolutionary Anthropology* 1:202-220.

1993b mtDNA and the Peopling of the Americas. *American Journal of Human Genetics* 53:793-799.

Szathmary, E. J. E. and N. S. Ossenberg
1978 Are the Biological Differences Between North American Indians and Eskimos Truly Profound? *Current Anthropology* 19:673-701.

Thomas, J. W., M. A. Stuckey, H. S. Robinson, J. P. Gofton, D. O. Anderson and J. N. Bell
1964 Blood Groups of the Haida Indians. *American Journal of Physical Anthropology*. 22:189-192.

Turner, C. G., II
1967a *The Dentition of Arctic Peoples*. PhD Dissertation, Department of Anthropology, University of Wisconsin, Madison.

1967b Dental Genetics and Microevolution in Prehistoric and Living Koniag Eskimos. J*ournal of Dental Research* (Suppl.) 46:911-917.

1969 Microevolutionary Interpretations From the Dentition. *American Journal of Physical Anthropology* 30:421-426.

1983 Dental Evidence for the Peopling of the Americas. In *Early Man in the New World*, edited by R. Shutler, Jr., pp. 147-157. Sage, Beverly Hills.

1984 Advances in the Dental Search for Native American Origins. *Acta Anthropogenetica* 8:23-78.

1985a Dental Evidence for the Peopling of the Americas. *National Geographic Society Research Reports* 19:573-596.

1985b The Dental Search for Native American Origins. In *Out of Asia*, edited by R. L Kirk and E. J. E. Szathmary, pp. 31-78. Journal of Pacific History, Inc., Canberra.

1986 The First Americans: The Dental Evidence. *National Geographic Research* 2:37-46.

1988 A New View of Alaskan Population Structure at About Historic Contact. In *The Late Prehistoric Development of Alsaka's Native People*, edited by R. D. Shaw, R. K. Harritt and D. E. Dumond, pp. 27-36. Aurora Monograph Series 4, Alaska Anthropological Association, Anchorage.

1991 *The Dentition of Arctic Peoples*. Garland Publishing, Inc., New York.

Turner, C. G., II and J. D. Cadien
1969 Dental Chipping in Aleuts, Eskimos and Indians. *American Journal of Physical Anthropology* 31:303-310.

Turner, C. G., II, W. S. Laughlin and A. B. Harper
1985 Dental Morphology and Oral Health of the A.D. 1764 Medvedev Party, Nikolski, Alaska. *OSSA* 12:211-219.

Utermohle, C. J.
1984 *From Barrow Eastward: Cranial Variation of the Eastern Eskimo*. Unpublished PhD Dissertation, Department of Anthropology, Arizona State University, Tempe.

1988 The Origin of the Inupiat: The Position of the Birnirk Culture in Eskimo Prehistory. In *The Late Prehistoric Development of Alaska's Native People*, edited by R. D. Shaw, R. K. Harritt and D. E. Dumond, pp. 37-46. Aurora Monograph Series 4, Alaska Anthropological Association, Anchorage.

Utermohle, C.J.
1975 *Analysis of Eskimo Dental Attrition by Progression of Dentine Exposure.* M.A. Thesis, University of Alaska, Fairbanks.

Utermohle, C. J. and C. F. Merbs
1979 Population Affinities of Thule Culture Eskimos in Northwest Hudson Bay. In T*hule Eskimo Culture: An Anthropological Retrospective*, edited by A. P. McCartney, pp. 435-447. National Museum of Man Mercury Series, Ottawa.

Verano, J. W. and J. Urcid (Editors)
1994 *Physical Anthropology Laboratory Data Manual*. Repatriation Office, National Museum of Natural History, Smithsonian Institution, Technical Reports, No. 1. Washington, D.C.

Waugh, L. M.
1937 Dental Observations Among Eskimos. *Journal of Dental Research* 16:355-356.

Zegura, S. L.
1971 *A Multivariate Analysis of the Inter and Intrapopulation Variation Exhibited by Eskimo Crania.* Unpublished PhD Dissertation, Department of Anthropology, University of Wisconsin, Madison.

1975 Taxonomic Congruence in Eskimoid Populations. *American Journal of Physical Anthropology* 43:271-284.

1978 The Eskimo Population System: Linguistic Framework and Skeletal Remains. In *Eskimos of Northwestern Alaska: A Biological Perspective*, edited by P. L. Jamison, S. L. Zegura, and F. A. Milan, pp. 8-30. Dowden, Hutchinson and Ross, Stroudsburg, PA.

Zimmerman, M. R. and A. C. Aufderheide
1984 The Frozen Family of Utqiagvik: The Autopsy Findings. *Arctic Anthropology* 21:53-64.

Zimmerman, M. R. and G. S. Smith
1975 A Probable Case of Accidental Inhumation of 1,600 Years Ago. *Bulletin of the New York Academy of Medicine* 51:828-837.