Commentary

The Purpose of Studying Eskimos and their Population Systems

WILLIAM S. LAUGHLIN[1]

The Eskimos are a remarkably successful group of mankind. Their ability to adapt to difficult circumstances and to expand is accurately reflected in their geographical distribution. They stretch longitudinally around a large sector of the circumpolar world, and latitudinally from the subarctic into the high Arctic. With their closest relatives, the Aleuts, they occupy the longest linear distance of any single group in the world. Although this unique geographical distribution provides objective and conclusive evidence of their ability to expand, rather than simply survive, it does not automatically elucidate the processes of adaptation which are responsible. We must look at individual Eskimos and at communities of Eskimos through the methods of many disciplines, and then sift and integrate this information within the larger context of their population systems.

Their physical abilities, their inventiveness, and their cheerfulness are as well known to the world as the words "Eskimo," "igloo," and "kayak." However, we do not know to what extent there are organic connections between physical endowments, genetic variability, inventive ingenuity, and cheerfulness of disposition. The fact that these characteristics correlate with each other, that they coexist in the same persons, does not in itself provide etiological information. How do these characteristics develop, what is their relationship to each other, and what role have they played in Eskimo adaptation?

For several thousands of years they have been masters of marine hunting. They used methods that were successful for every size of marine mammal from the small sea otter, the seals and walrus, through the large whales. Fishing, fowling and land hunting also were important activities in their hunting system. Much of their energy and their intellectual activity has gone into their hunting system. This has entailed the development of a rich material culture, of boats, harpoons, lamps, knives, hats, clothing suitable for dry cold and for wet conditions, sleds, etc., always with appropriate alterations for local environmental conditions. Beginning in western Alaska, on the coasts of the now submerged Bering land bridge some ten to fifteen thousand years ago, the ancestors of the present Eskimos and Aleuts expanded into the Aleutians and from Alaska into Siberia, Canada, and Greenland (Laughlin 1967). The prehistoric record, composed of human skeletons, artifacts and faunal remains, provides evidence that the Eskimos are not newcomers to the arctic. Present patterns of adaptation have considerable time depth, and there have obviously been enough generations for the evolutionary agencies of selection, genetic drift and mixture to translate the effects of their behaviour and of the environmental stresses of climate, nutrition and disease into the composition of the Eskimos as we see them today.

---

[1]Professor of Biobehavioral Sciences and of Anthropology, The University of Connecticut.

Eskimos are acknowledged masters of "survival techniques." This achievement should not obscure the more significant achievement that they have done considerably more than survive. They have flourished and expanded into a harsh environment with relatively meagre resources. They have not been stultified nor diminished by their environment. Their biocultural patterns of adaptation and expansion have not been determined nor frustrated by environmental adversity. Rather, the Eskimos have conducted the crucial experiment in human adaptability. They have prospered and expanded as hunters, spreading over an enormous area while at the same time they have maintained gene flow and linguistic integrity within their population system. They magnificently illustrate the way in which man, the species, spent ninety-nine per cent of his evolutionary history as a hunter, and prepared himself for the rapid acquisition of civilization at many different places in the world. Our task is to read this experiment and to delineate the traits, processes and conditions which brought it to successful fruition.

A unique consequence of the geographical distribution of Eskimos is their citizenship in four different nations (USSR, U.S.A., Canada, and Denmark). It is for this reason that international cooperation is uniquely appropriate and necessary. The Eskimos have defined themselves as the one population system in the world with geographical and genetic continuity who hold a fourfold international membership.

Three communities selected for intensive and long term study (Wainwright, Igloolik, and Upernavik), together with the related communities necessary for various sample and interpretative requirements (such as Gambell, Point Hope, Nunivak, St. Paul, et al.) can each be studied as separate functional units. The data for each of the disciplinary studies, cardiology, growth or dental, can be integrated in a form of systems analysis for that community or cluster of communities. These same three communities can also be studied as natural population units within a larger population system. A quantitative basis on which comparisons can be made for points of similarity and dissimilarity and for a study of the interpopulation processes can then be achieved. This must follow after the initial years of investigation. The study of Eskimos as members of a complex population system of ever more inclusive units can only be achieved by genuine international cooperation.

Just as there are specifiable scientific benefits in studying Eskimos for the research goals of several disciplines and for their integration, there are also specifiable dividends for collaboration under the International Biological Program. In addition, there are real and tangible benefits to the Eskimos themselves. As citizens they are entitled to both the immediate and long term benefits of these studies, benefits which have for a longer time been made available to citizens of the same nations who live in warmer climates.

INTERPOPULATION ASPECTS

Though all groups of people in the world are worth studying, they are not all equally informative on the processes of human adaptability. Eskimos have been found to be scientifically rewarding by researchers of many different nationalities and many different disciplines. The advantages and unique opportunities available in Eskimo population studies are worth listing for the value they serve as guidelines in our thinking. These reasons for studying are at the same time characterizations of the Eskimos. They may also indicate some of the deficiencies in our knowledge and suggest problems and the way in which they can be solved.

Owing to the fact that the Eskimos constitute a complex population system composed of ever more inclusive units ranging from small village demes to the largest population unit which includes all Eskimos, it is possible to study simultaneously traits and processes at the cellular and individual level and also at the interpopulation level of organization. With each additional advantage or characteristic added to this list, the unique value of Eskimo studies becomes increasingly obvious.

MULTIPLE SAMPLES

Since there are several groups of Eskimos, rather than one, good estimates of genetic variability can be secured because of the large number of generations represented. The process of gene flow between isolates is especially well delineated.

POPULATION DELIMITATION

No one lives north of the Eskimos. This obvious fact has protected them from hybridization on one side. Contact with American Indians and with Chukchi in Siberia, was minimal. The problem of knowing where Eskimos leave off and other kinds of people begin is immediately apparent. The greater amount of hybridization with Europeans is amenable to quantification and the hybrids provide invaluable scales for genetic controls and for examining the effects of hybridization.

LINEAR, LATITUDINAL AND LONGITUDINAL DISTRIBUTION

As coastal people with major ecological adaptation to the sea, the Eskimos have arrayed themselves in linear fashion, in a chain of isolates over long distances. Two unique distributional variations are the latitudinal array of isolates in Greenland and in western Alaska, and the longitudinal array in the Arctic between Greenland and western Alaska, and the 1250 miles of the Aleuts. A linear system automatically maximizes differentiation between the ends of its population system. The terminal isolates cannot exchange genes with the same relative frequency as those isolates closer to the centre.

DEMOGRAPHIC VARIATION

Two polar comparisons stand out between those groups with low population density, great distances between small isolates and generally harsh living conditions, and those larger groups with higher population density, short distances between isolates and generally milder living conditions. Population numbers, age, and sex composition, infant mortality, and longevity differ markedly between these two kinds of populations.

ENVIRONMENTAL VARIATION

There are large variations in the major environmental conditions stressing these populations in climate, nutrition and disease. The length of the open water season affects both intertidal collecting and open sea hunting. These correlates affect in one way or another every aspect of population dynamics. The Upernavik Eskimos are confined to the coast by the Greenland Ice and have little access to caribou and other land mammals available to the Wainwright Eskimos. The micro-environment is different in each of the three study communities, and the macro-environment varies significantly over the entire range of the Eskimos.

TIME DEPTH

Owing to the presence of rich archaeological sites the living Eskimos and Aleuts can be reliably traced back over 4,000 years on skeletal evidence. Infant mortality, length of life, selected pathologies (separate neural arches, arthritis, anemia, malnutrition, dwarfism) can be usefully identified so that a realistic picture of the health problems of the earlier populations can be described. At the same time studies in systematics on these skeletal series, often numbering in the hundreds, provide a basis for detecting trends or direction in the evolution of the populations, and for estimating rates of evolution, and they are also useful for establishing benchmarks for measuring secular changes in recent populations.

Early church or government registers provide time depth of some four or five generations and are often invaluable in providing such benchmarks.

These six aspects, taken in combination, present us with a rare series of comparison matrices. Genetically diverse populations inhabiting similar Arctic habitats, together with the genetically similar populations occupying more diverse habitats offer a comparison matrix in which generalizations can be tested. If the focus is on environmental effects, then the genetic differences between Lapps and other Scandinavians in the Arctic, those between Europeans and Eskimos, and those between Greenlandic, Canadian and Alaskan Eskimos provide natural scales. The repeated suggestion that climate has influenced selection of body form can be tested in sophisticated fashion. It appears that there is less physical differentiation in Greenlandic Eskimos, over a north-south distance exceeding 1200 miles, than there is in Aleuts, over an east-west distance of over 1200 miles. The necessary genetic controls and measurement of environmental factors, plus the historical data for time depth and direction of migration, can be assembled for the solution of many such questions. In brief, there are many factors which can be cited as important correlates. Owing to the six characteristics cited, it is possible to improve substantially our delineation of causes and consequences among these many correlates.

Neither the Eskimo people nor their environment is homogeneous. The genetic variation is assessable and it is contained within a definable population system or systems. In the course of their expansion, they have performed a series of experiments in human adaptability, both genetic and physiological. They have distributed themselves in an ideal fashion for testing and interpretation.

INTRAPOPULATION ASPECTS

Our goal in the study of a single community is essentially to learn how a group of Eskimos converts animal, fish and bird proteins into more Eskimos who continue to do the same thing. This rather stark phrasing highlights the systems aspect. Our task is to decompose the system so that it can be studied in pieces appropriate to our techniques and disciplines and then reassemble it in a verifiable and scientifically quantified form.

Eskimo communities are noted for their cohesiveness and for their durability. They have efficient energy conversion systems. Their ability to maintain themselves over time and to expand has both biological and behavioral components in naturally integrated systems. The fact that each community can operate as an independent unit with a high degree of isolation is illustrated most quickly by the Polar Eskimos. They originally numbered some 250 persons at the time of their discovery in 1818. At this time they thought they were the only people in the world. The effective breeding size (the number of persons actually in their reproductive years counting from the birth of the first child to that of the last born) gives a figure of roughly one third of the total group size. The effective breeding size of this isolate was only 80-85 persons for at least two hundred years of total isolation. The frequency of deleterious genes and the inbreeding effect are not known. They could maintain themselves but they could not expand. Other communities have got into areas where they could not expand, and a few have had to decompose or to become extinct as in the case of the Sadlermiut Eskimos of Southampton Island, N.W.T., who became extinct in 1903. From such examples we are able to form some notion of the environmental limits conducive to expansion, to maintenance without expansion, and of those that predispose to extinction. However, we do not yet have a systematic analysis which permits us to analyse the population dynamics of a community and to assess the role that the several diverse elements play.

There is a general correspondence between the three major factors of 1) ecological base, 2) population density and distribution, and 3) population structure. The ecological base consists of the natural resources as they are defined by the people. Their exploitational system, consisting of the technological equipment of boats, harpoons, sleds, dogs, etc., and the ways in which the food and fabricational resources are procured and the numbers and kinds of people employed, importantly defines the usable environment and the efficiency with which the community exploits it. Whales are not as much a resource where the people do not have the technical equipment and traditions for whaling and therefore use only stranded whales, in contrast to those communities where whaling is one of the major hunting occupations.

The exploitational ecology directly affects the size of the population and its density. Size and density are directly related to the breeding structure, and this in turn leads to the genetic structure and the cultural system which corporately describe the population dynamics when viewed functionally as a conversion process.

One outstanding component is the extent to which children, pregnant women, aged and arthritic men and other disadvantaged persons can contribute to the economy and especially to their own subsistence. In the open water area south of the winter ice, such persons can secure large amounts of their own food by collecting and fishing in the intertidal zone, for a large part of the year. Winter ice on sea or shore inhibits the activity of these persons and makes the entire community more dependent on a smaller number of hunters who have the strengths and skills necessary for ice hunting. In Wainwright the community regularly passes through a periodic constriction in exploitational personnel and an expansion of the area they exploit. As winter comes on, progressively fewer men are able to hunt, and they hunt a larger area than is exploited by the village during the summer months. Infant mortality is higher and longevity is depressed, in contrast to Eskimos and Aleuts in the open water area.

Where effective population sizes are low and the population passes through an annual bottleneck, we may examine several consequences and correlates. We would expect the genetic variability to be reduced, a low number of deleterious genes and possibly a genetic tolerance to inbreeding. To the extent that the limited choice of mates produces homozygous genotypes for recessive traits, the speed of selection may have been augmented and the deletion of deleterious genes accomplished in significant proportions. We might expect a reduction in fecundity with inbreeding which, if not present, would require explanation. Genetic tolerance to inbreeding effects may have been developed. The number of loci that can respond to selection in a small group must be fewer than the number in a larger population. However, the speed of selection may be greater. It becomes extremely important, then, to define the actual mating system. Assortative mating, combined with inbreeding, could promote more rapid change.

We know that it is possible for selective mating to contribute to "founder's effect" or to "drift." All the genes for blood group B in the Anaktuvuk Eskimos were contributed by one able hunter who had several children. They in turn had a disproportionate number of the children in the ensuing generation. The value of the B gene has risen to a high value, now the highest among any Eskimo group. This high value testifies to the reproductive success of the original donor, not to the value of blood group B as such. Many circular effects are built into such a system. It appears likely, at least as a definable hypothesis for testing, that able hunters have access to more mates and produce more children and, that the children are more likely to survive because they are better fed. Thus, there are two major reasons why it is essential to secure genetically verified genealogies for the community. First, with known degrees of relationship, it is possible to study the heritable component in many continuous traits, such as heart size, stature, thermoregulation, disease resistance, sequence of tooth eruption and epiphyseal union, and of discontinuous traits such as cusp numbers and numbers of vertebrae. Second, the genetic pathways provide the natural basis for demographic analysis.

EXPERIENTIAL AND PERFORMANCE WORLD OF THE ESKIMO

The world in which the Eskimo lives is configured by his habitual activities and by the environmental elements to require a high degree of physical fitness and to meet extraordinary peak load demands and also a constant monitoring of sensory information. Kayak hunting and ice hunting share in common the fact that the hunter is operating on a moving surface. Unlike the land, it is a rapidly permeable surface through which he may pass rapidly and disastrously. Not only is the surface on which the Eskimo may spend some one-fourth of his life a constantly moving surface, it also lacks the gross complexity of most other geographic zones. There is the constant need for observing small cues in the water or on the ice, or in the snow if sledding, together with wind and light, in order to navigate. The horizon is commonly flat with minor relief. There are no trees or forest canopy. The visual cues are often small, consisting of subtle changes in the colour of the ice, of small patches of snow which reveal wind direction and intensity, of water texture and slight indications of tidal changes and currents. The available cues are obscured and diminished by fog, snow, wind, rain, glare, darkness, ice, and low level contrasts that camouflage the animals as well. Seal hunting at the breathing hole epitomizes the use of reduced cues including the trip prior to location of a breathing hole, the killing of a seal that may be harpooned before it is visually sighted, and a return trip that requires use of minimal cues for a satisfactory conclusion (Nelson 1969). The environment is characterized by the most dramatic transformation states, those in which water is changed to ice, and soft meat is transformed into a condition in which it can be used as solid plastic material for artifacts. The world in which the Eskimo can travel by foot or dog sled may expand by 200 per cent or more during the winter season and require extensive changes in his clothes, hunting and travel equipment and in his habits.

The Eskimo himself lives in a micro-environment that is warm, dry, and that insulates the entire body with the sole exception of the face. Boots, mittens, pants and parka, protect the body and importantly reduce many sensory impressions. It is possible then that the face serves more functions, that it assumes a greater importance in collecting information than in people who are not as well insulated. Though masks are occasionally worn, and the parka ruff may be pulled out in front to form a tunnel, and goggles or visors may be worn to protect the eyes, the face is ordinarily exposed. Humidity, wind direction, and velocity and temperature are recorded through the face alone. At the other extreme, a remarkably large amount of information comes in through the feet.

The texture and many other characteristics of the travel surface, ice, or snow, are tested and recorded by the feet. An interesting problem in thermoregulation derives from the fact that the face is the only area through which the clothed Eskimo can lose heat both constantly and rapidly. Thus, the micro-environmental world of the Eskimo buffers sound, texture and temperature stimuli and imposes a greater information load on the face, eyes, and the feet.

Many Eskimos tested to date show high levels of physical fitness though these are decreasing in more acculturated groups, and their disease pattern is changing. This is especially interesting in view of the long periods of inactivity. An important characteristic that emerges from physiological, cardiovascular and behavioral studies is that Eskimo males must have a cardiovascular system capable of pumping large amounts of blood upon demand. The single kayaker or the umiak crew caught in a storm must perform with high energy expenditure promptly and often for a long period of time. Harpooning a seal at the breathing hole, after a long period of careful immobilization, is another example of this peak demand following inactivity. Performance is under the constant hazard of penalties that are considerably more than deferral till another day. Mortality attributable to accidents is high in Eskimo communities. Death in cold water is relatively fast because of the accelerated heat loss in water as well as the enormous exertion required to get out. Death by freezing on land is slower, the victim may persist for several days, rather than minutes. Hunting accidents directly involving animals, polar bears, walrus and certain seals, are by no means insignificant. In all cases a high state of physical fitness is favourable to the Eskimo. The penalty is frequently complete deletion of an individual from the population and not simply a loss of food or equipment.

In general, then, we can say that the Eskimo must perform in an arena which has many high level constraints on behaviour and which offers little guiding information. The Eskimo concern with orientation and sequence, manifested in their unusual mechanical abilities, inventiveness, navigational skills, their anatomical knowledge and in the structure of the language itself, represents an intellectual adaptation with a neurophysiological base and important genetic correlates.

The large and extensive changes in diet, economic support, living conditions, breeding structure, use of snowmobiles in place of dog teams, contraceptive devices, education, legal problems of land ownership, loss of natural resources, etc., have multitudinous ramifications. No community is immune to them and some have been transformed much more than others. The increasing exploitation of oil resources on the Arctic Slope of Alaska highlights in dramatic fashion trends that had actually been initiated by the first European visitors.

THE VALUE OF THE INTERNATIONAL BIOLOGICAL PROGRAM STRUCTURE

The value of working within the IBP lies in the facilitation of research through cooperative efforts. The basic theme is simply that a corporation of researchers can voluntarily commit their interests to enduring, long term research and to multidisciplinary research. Even though particular researchers may not return year after year, the studies will be carried on within a structure that insures continuity. This consortium of scholars proceeds on the demonstrable fact that cooperation between scientists of the same and different disciplines is economical and productive. It importantly assumes that the total integrated efforts will exceed the sum of the parts. Some scientists are interested to participate because their studies will contribute to other kinds of studies and may therefore be of greater value than if performed singly. Conversely, some scientists are attracted by the fact that the other studies provide the context in which their findings can be verified and extended. What is central for each scientist is contextual for the others.

The structure is ideal because it is minimal and focused on the prosecution of research, not on empire, institute or agency building. There are no political goals but only those of science and a concern to see that the benefits of these researches are made available to the members of the study communities as well as to other segments of these nationalities.

Each project team (panel or consortium may be more accurate terminology) is composed of researchers, with their supporting personnel, not all of whom work in the field. In some cases one or two persons may work in the village collecting specimens or making examinations, whereas the larger part of the laboratory or clinic they belong to processes the data brought back by the field workers.

The project directors and field directors have a multitude of functions. These include: (1) Exchanges of information between researchers before as well as after the field work. (2) Scheduling of researchers in the village. The sequence of examinations must provide the least possible interruption in the village schedule, the least possible waiting time for the subjects, and conform to many practical considerations, e.g., saliva specimens should be secured before an impacted molar is extracted. (3) Maintenance of informed relations with the Eskimo community. Cooperation can only be secured by informing the community of what is being done, the values and significance of the research, and practice of effective methods of respecting the privacy of each person, i.e., the use of code numbers rather than names. (4) Maintenance of appropriate relations with all agencies concerned, whether state, federal, local, private or public, academic, research or mission oriented. (5) Financing. (6) Travel arrangements. (7) Exchange of research personnel between study communities. In some instances an individual or group may work in a community other than that of their own nationality. It is desirable that some of the same observations be made by the same persons in all three communities. These arrangements may be more simple than appears at first sight because there has already been collaboration between scientists of these three areas, reflected in joint publications, and such collaboration can now be more easily facilitated. The techniques needed to reveal the essential components and their interactions within a human population system belong to no one traditional discipline.

An important aspect of the IBP program is the training of new and younger researchers. Provisions for scholarships and for specialized kinds of training are among those matters which are highly recommended, but which cannot be accomplished by formula or contract. The universities and laboratories involved are already giving attention to the preparation of younger researchers.

Basically, our structure is developed from the ground up rather than from the top down (see Table 1). It depends upon volunteered interest, upon cooperation and collaboration and upon a continuing exchange and review of information.

TABLE 1. Functional table of international organization

Eskimos of	Alaska Wainwright	Canada Igloolik	Greenland Upernavik	Greenland Angmagssalik
Project Directors and Field Directors	United States	Canada	Denmark	France
Researchers in	Population Dynamics Growth, Constitution and Anthropometry Physiology Nutrition Health and Epidemiology Behaviour Ecology Population History			
International Coordinator (Rotating)	Currently D. P. Hughes (University of Toronto)			
Chartering Bodies	Human Adaptability Sections of National Committees of the International Biological Program.			
Supporting, Sponsoring, and Funding Agencies	International, federal, state and private agencies such as WHO, NIH, NSF, Arctic Institute of North America, NRC of Canada, Carlsberg Foundation, Wenner-Gren Foundation, universities.			
Reports and Publications	FROM: Individual researchers, combinations of researchers, project directors, field directors, consultants. TO: Sponsoring agencies and scientific journals.			

The individual researchers come first and they are diagrammed in this fashion. The international coordinator rotates between the four principal nations involved: Canada, Denmark, France and the United States. The organization exists for tangible goals, not as a structure in search of people and functions which will perpetuate itself.

The principal advantages of performing our studies within the IBP framework then lie in the facilitation of research. Contextual information is provided, interrelations are examined and an integrated systems analysis is conceived. This is economical. The same body of information is useful to several kinds of researchers and need not be collected more than once. Continuity is engendered and information is made available for subsequent or continuing studies as well as for short term projects. The structure encourages the participation of "old hands," those whose experience and interest has been demonstrated over a period of years and in many publications. Unused and unpublished data will be exhumed and utilized. Scientists who have accumulated more data than they have had time or facilities to analyse and publish will receive help in bringing their data into communicable condition. The Eskimos and Aleuts will receive the attention of leading researchers in many different fields and the various bodies of information, such as normative growth tables, will be of enduring value. The broad format and rationale for such studies has been laid down by various international agencies, chief among them the World Health Organization (Laughlin 1968a, 1968b, WHO 1968). We have among us a number of persons who have participated in the preparation of these international documents and who can therefore provide helpful advice first hand. In short, the IBP structure provides us the opportunity to maximize our research with a minimum of superstructure in three different nations.

REFERENCES

LAUGHLIN, W. S. 1967. Human Migration and Permanent Occupation in the Bering Sea Area. *The Bering Land Bridge*, D. M. Hopkins, editor, Stanford University Press, Stanford, pp. 409-450.

———. 1968a. Guide to Human Population Studies (with foreword by J. S. Weiner). *Arctic Anthropology*, 5: 32-47.

———. 1968b. Adaptability and Human Genetics. *Proceedings of the National Academy of Sciences*, 60: 12-21.

NELSON, R. K. 1969. *Hunters of the Northern Ice* (with foreword by W. S. Laughlin), The University of Chicago Press.

WHO. 1968. Research On Human Population Genetics. *World Health Organization Technical Report Series*, Geneva, No. 387.