

## PROBLEMS OF HUMAN ECOLOGY IN THE NORTH AMERICAN ARCTIC

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**A**LTHOUGH nearly everyone who has written about Eskimo culture has admired its specialized adaptation to the arctic environment, almost no one in recent years has studied in detail any ecological problem connected with the Eskimo, except in physiology and health. Since these two fields are outside the scope of this article, a survey of ecological research on Eskimo and white man's culture in the American Arctic could be made very quickly, but it is necessary to take account of all the bits of ecological information scattered through the literature before recommendations can be made for future work. Most of the relevant literature in anthropology, human geography, sociology, demography, archaeology, and biology, published since 1940, has been considered to ascertain the trend of recent research and the most serious gaps in our knowledge.

First, it is necessary to decide what adaptations have been made. Ideally, what a people started with in a given environment and the changes in that environment in the early stages of human occupation should be ascertained. The ecology of prehistoric man should be an important section of both archaeology and human ecology. Prehistorians of the Old World, dealing with long time-cycles, had to consider climatic changes, and prehistorians of the American southwest and western plains and plateau similarly assumed that early man had to deal with big changes in climate, flora, and fauna. Archaeologists of the American Arctic, however, did not relate the large postglacial changes to Eskimo development because they assumed that the Eskimo were more recent.

One of the principal effects of this assumption has been the further assumption that the climate has been as cold as or colder than now during the entire Eskimo occupation. (The increasing shallowness of the arctic seas was about the only recognized change). These assumptions would be acceptable if the Eskimo sojourn in the American Arctic had been only two thousand years, but if it were five thousand or more years old, a stable physical and biological environment could not be taken for granted. Fortunately, meteorology, glaciology, botany, and archaeology have advanced tremendously in knowledge and methods in the past fifteen years, so that prehistorians of

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the Arctic can get much assistance in ascertaining local climatic changes and their effects. Archaeologists now have little excuse for ignoring changes of environment through time.

The origin of the Eskimo, as well as their climatic environment, appears to have been oversimplified. The classic picture portrayed a people from central Siberia, central Canada, or northern Europe, developing and preserving a very specialized culture, then migrating in isolation, and meeting no one for generations. It was accepted that a few, rather superficial ideas later were imported from the eastern rim of Asia—lower Amur river, Japan, and the Kuril'skiye Ostrova—and a few more came still later from the Norse in Greenland. However, Eskimo history now appears to have been less simple. The culture developed different specializations in different places and at varying rates in different regions. There were diffusion of ideas and local adaptation as well as migration. It has now been recognized, if somewhat reluctantly, that Eskimo culture has had many variants.

Marsh and Laughlin, for instance, have recognized this fact for the "Aleut-Eskimo community" which Laughlin (1952, p. 36) has expressed as follows:

"Consideration of the variability in single material traits alone forces one to place more emphasis on the processes of innovation. The ground slate semi-lunar knife, common among the recent Aleuts and Eskimos, is confined to the later strata in the Aleutians. It was, however, preceded by a chipped semi-lunar knife which was, in turn, only one of several kinds of knives. If the single category of knives were considered for all past and present Aleut-Eskimo cultures, it would be apparent immediately that there has been considerable innovation. The number of such traits is so far in excess of the number uniformly found among all the peoples that neither diffusion from neighboring peoples nor migration of more distant peoples can be very useful in explaining their presence. One is perforce led to consider the processes of innovation. In view of the fact that innovation is known to have been specifically encouraged, this area of the culture must receive more thorough consideration before the 'sources' of Aleut-Eskimo culture can be exposed."

Even though Laughlin's emphasis on invention and local adaptation is justified, the possibility of migration of people to account for specific cultural resemblances across great areas cannot be rejected entirely. In 1941 Thalbitzer (1941, p. 635) published what seemed an extreme hypothesis:

"... the Ammassalik culture reveals such a striking resemblance to the western Eskimo culture in certain localities even as far south as southern Alaska . . . that in some way or other there must be a definite connection. An explanation is needed. We might imagine the immigration of a special group from Alaska into Greenland, skirting the homogeneous Greenland culture known to us from other places, a wedge right through the Thule culture, ending on the east coast of Greenland."

If we could know more about the social structure, the ideology, and the personal and community ritual of Eskimo in intervening regions, such as Baffin Island and west Greenland, as they existed three hundred or five hundred years ago, we probably would find there, too, much of this Alaskan culture that Thalbitzer saw in east Greenland. Influence on the originally Alaskan Thule culture from the earlier Dorset people and later from Danes and other white men, also the influence of a worsening climate, induced the Thule people to change, and to relinquish much of their old way of life. Since there are

other good explanations, it is not necessary to postulate a small, rapid, wedge-like migration in order to account for similarities between Angmagssalik and Unalakleet. The movements, the patterns of change in one place and relative stability in another place, were more complex than a simple migration. Recently, however, Knuth's finding of an umiak, which is probably late Thule in date, in northeast Greenland gives new support to the theory of a migration around northern Greenland and down its east side (Knuth, 1952).

We have now reached a point at which it is wise to have no general theory. New archaeological finds are coming too fast, and it would be unsafe to assume, without really conclusive evidence, that there was or was not one long movement of Eskimo across the Arctic. At present we have greater need for hypotheses on specific local developments than for grand schemes to explain cultural resemblances between peoples far apart. To show that there are certain resemblances in technology and art is useful; to assert that one therefore has the same culture or the same period of prehistory could misdirect future research and explanation. We must especially avoid thinking in such general terms as Asiatic versus American or inland versus coastal origins.

There is also need for a certain amount of introspection on the nature of our thinking and theorizing on Eskimo culture. Scandinavian and British prehistorians of Europe and the Mediterranean world have developed a strong tradition of explaining cultural resemblances by migration, while American cultural anthropologists, in contrast, have as strongly emphasized diffusion from people to people. European and American archaeologists in the American Arctic have tended to follow the traditions of their respective scientific backgrounds. Neither group has relied on one kind of explanation exclusively, but the Danes have more frequently postulated migration, and the Americans have more frequently assumed diffusion among Eskimo and between Eskimo and other peoples.

Summarizing Eskimo ecology, Kroeber (1939, p. 22) made the following concise and penetrating comment:

"What emerges from the total array of his [Steensby's] succinctly analyzed data is not the primacy or priority of one particular economic adaptation, but a picture of the totality of Eskimo culture as a unit, modified by emphasis or reduction of its traits in direct response to local exigencies. Here seals are the important food, there whales, or walrus, or caribou, or birds, or salmon, while others are as good as unavailable."

He could have added that where several of these animals are available, then all of them are hunted. What is remarkable about Eskimo is their versatility.

We still need to know not only that people do adapt but also the processes by which they do it. It is necessary, for this purpose, to study closely the recent past and the present, since for these periods we have information instead of speculation as to what the people started with on a given road of cultural change. Anthropology includes and requires both history and science. In addition to making studies of ancient arctic history, as such, Eskimologists can also contribute to science inductively derived principles of cultural adaptation. Many opportunities are open to those willing to undertake new lines of research. The following are some suggestions.

### Population size and distribution

To obtain the data required for population problems a detailed study should be made of one area, for example, the Eskimo groups west of Hudson Bay. This study would be difficult, but most worthwhile. Genealogies for three generations back should be made for families in the region, or any part of it, from Chesterfield Inlet and Eskimo Point to Repulse Bay, Cambridge Bay, and Coppermine, and should indicate what groups the individuals came from. These data would be valuable to the physical anthropologist and public health worker as well as to the student of geographic mobility and group contact. There are already some data for part of this region and the coast farther west. Knud Rasmussen obtained the distribution of population between Bathurst Inlet and the Mackenzie River from the Eskimo whom he visited in the spring of 1924. For each settlement and camp he recorded the inhabitants of each house by name, including more than a hundred households. He also identified immigrant families from northern Alaska and elsewhere (Ostermann, 1942, pp. 36-44).

Another area where physical mobility needs to be studied by means of genealogies is northwestern Alaska, particularly the region from Deering to the Kobuk villages, from Anaktuvuk Pass to Wiseman, and from Barrow to Kotzebue.

The cost and physical difficulty of field work in these areas, especially the Canadian Barren Ground, and the social and emotional obstacles raised by reluctance to discuss the dead are great. No other kind of study, however, will give so many data useful for so many purposes as will good genealogies, which should include the usual information on the place and supposed cause of death, sequence of marriages, and adoptions.

Other specific studies should be made of the following problems:

1. *The effect of epidemics on social groupings and geographic distribution of people:* Poliomyelitis epidemics in a few localities between Hudson Bay and the Alaska boundary in recent years might provide useful starting points for this study. The facts to be ascertained include the number of families affected by death or paralysis that combined to help each other hunt and travel, the pre-epidemic relationship of these people, the number that moved elsewhere permanently, and any changes in relationship between Eskimo and white men brought about by the experience.

2. *Birth rates compared with trends in size of adult population and of abortion and premature birth rates:* Recent information shows that the Eskimo population in Canada and Greenland is now increasing. Studies should be made of the reasons for its decline at certain times and also of the present situation in Alaska, where the Eskimo population is more static than in Greenland. In a declining population are there simply not so many births or are both birth and mortality rates high?

3. *Change in population size compared with change in the volume and variety of the natural resources utilized:* Regions where, because of scarcity

of resources, there is a real population pressure, no matter how sparse the population is, should be identified. Full development of this large research problem would probably require study of the past as well as the present size and pattern of settlement. There is much information from Greenland and some from Canada and northern Alaska, but almost none for southwestern Alaska. The practical problem of uneconomic Eskimo settlement has already received much attention in Greenland, especially on the east coast, and in northern Labrador. In Alaska, the areas needing prompt attention because of serious economic pressure are the Aleutian Islands, the Alaska Peninsula, and the tundra between the Kuskokwim and Yukon rivers.

4. *Numbers of persons in the advanced age-brackets, their location, and their support:* We know in a general way that there has been a big change in the Eskimo's treatment of their aged. But our knowledge should be more exact. In this example of reaction to changed culture (specifically changed morality), we have a welfare problem because maintenance of the aged affects food-sharing, composition of the household, and other material as well as social conditions.

5. *Effect of any changes in customs of adopting young children:* Again, we need to know exact figures on adoption and its effect on the household.

#### **Evidence from biology and geography, or, better, from a combination of these with anthropology**

1. *The social and emotional factors affecting the hunting of caribou and herding of reindeer:* The resistance to reindeer-herding apparently goes deep into the Eskimo value system. It involves not just habits but also factors of prestige and religion. If we can understand this resistance, we probably will understand much of Eskimo culture. In caribou hunting, the continuing or changing tabus, folklore, rational lore, and emotional factors, now possibly modified by the use of guns, need attention. Because caribou have been a staple and because in some places reindeer might also be, this study has basic survival value. It could best be made in sample areas in Alaska and possibly in Canada.

2. *The Eskimo's scientific knowledge of plant and animal life, and human anatomy:* Although many people have said that the Eskimo had aboriginally a remarkable knowledge of their natural environment, only recently have field workers been recording this scientific knowledge, with proper identification of species and organs, in a comprehensive fashion. William Laughlin (Laughlin and Marsh, 1951) and T. P. Bank, II (1953) have independently worked on this problem in the Aleutian Islands, and Laurence Irving has begun a similar study of the inland Eskimo of the Brooks Range. These observations should be extended to other localities.

3. *Occurrence of fishes and other resources not now developed:* There is obvious need to know why a resource has not been used, any economic

changes and technical requirements for its development, such as larger boats or dependable water supply, and the factors affecting its abundance.

4. *The uses of aircraft for getting knowledge of natural resources and their utilization:* This study could best be made in Alaska, where bush pilots and small airlines are more numerous than in Canada or Greenland, and where aircraft have already been used for locating caribou herds and the concentration and movements of other animals, for carrying frozen fish and reindeer meat to local markets, and for informing the local people of sea and river ice conditions. The knowledge obtained would principally benefit the Eskimo in Canada and possibly also in Greenland. As a partial alternative to public relief in the north of Canada it might be worthwhile subsidizing bush pilots to help the native population (*see Arctic*, Vol. 5, pp. 193-5). Often Eskimo need to be transported or guided to better areas for caribou hunting, fishing, or trapping to take advantage of seasonally more abundant resources.

#### **Studies of adaptation to natural environment, using chiefly archaeological and ethnographical data**

The following problems need attention, and there appears to be enough material to make a good start. The researcher is urged to avoid reconstructing history just for the sake of history. Whether a people brought an idea ultimately from central Siberia or central Canada does not matter greatly in its local usefulness in building a better house or kayak.

1. *A functional and ecological study of Eskimo-Aleut housing, past and present:* Each local housing-complex should be considered in relation to its site, principles of construction, available materials including the tools, such as mattocks and knives for digging turf, and, where recent groups are concerned, the number of people accommodated, and uses of structures for other than family housing. The mechanical and thermal problems of each local house-type should be analysed and their architectural solutions compared. To obtain evidence of the principles of construction, as well as simply describing the structure, joint field work between an engineer-geologist and an anthropologist would seem necessary. This should include examination of such features as the use of skins, or bark, with turf, wood, and snow, with or without air spaces for insulation, adaptation to slopes (old beaches, kitchen middens) and to permafrost level, and the solution of drainage problems. In considering prehistoric housing, special attention must be given to the climate at the time the house was built. Recent meteorological and glaciological work should make this possible.

2. *A comprehensive study of Eskimo clothing:* It is surprising that a study of Eskimo clothing has not yet been made. It should include data on unusual materials such as bird, dog, and fish skins, fur of small mammals, and woven grass, as well as the usual caribou, seal, and bear skins. The greatest variety of materials seems to have been used in the east Bering Sea area, where, for example, some villages still wear fishskin boots. Adaptations in stitching and tailoring patterns to the various materials and their specific uses should

also be studied. The variety of stitches was greater, especially in southwestern Alaska, than most ethnographers realize. The assistance of a textile and clothing expert would be useful, perhaps essential.

3. *A functional and ecological comparison of the various kayaks and umiaks:* The team needed for this study should include a marine designer and an ethnographer. Data on the rational lore and folklore of the construction and uses of kayaks and umiaks should be obtained soon from the old people, especially in those areas in which plank boats have supplanted the skin-covered ones. Such Eskimo principles as that the body measurements of the kayak-man should be used in constructing his boat might be worth investigating, also the variations in shape and proportions in different areas. Both the local people's explanation of adaptation to shore and ice conditions and the observer's explanations would be necessary. In many places it will be difficult to reconstruct an adaptation which is already outdated, but undoubtedly something can be retrieved.

4. *A new survey of types of dogs and their uses:* A person or a team with technical competence in both mammalogy and ethnography would be required for this survey. The emphasis of the study should be on dogs and on man's use of them, as affected by religious belief, social-status value on dogs, and the importance of dogs for food and fur, rather than on sleds and hitches. Although much has been written about Eskimo dogs, further work is necessary because new breeds have been found in the archaeological discoveries of recent years, for example Haag's "Large Kodiak Island Dog" (1948). In southwestern Alaska where dogs were not needed for sledging on sea ice, they may have been used for packing, and a big strong animal may have been preferred. The area around Goodnews Bay and Bristol Bay, a gap in our knowledge regarding most aspects of Eskimo culture, would be particularly interesting for this study. Because of culture loss and forgetting, it would not be easy to get information, but something could be learned about changes in the ecological place of the dog.

5. *Case histories of the annual cycle:* The social and ceremonial, as well as material, factors influencing families' decisions to move for the various kinds of fishing, hunting, trapping, and wage work should be recorded. This kind of research requires close acquaintance with the people, real frankness, mutual reliability, and an understanding of the mechanisms of rationalization. It is important because in some areas poor decisions on places for hunting and caching food can be a matter of survival.

6. *A thorough ecological study of one community:* Two areas suggested for such research are the Yukon delta and the lower Kuskokwim River. Such villages as Akulurak and Pastolik around the delta would be good for a study of the importance of birds and fish in this rich bird-breeding area, as compared with that of sea-mammal hunting. The region at the mouth of the Kuskokwim River has many similarities to that at the mouth of the Yukon, but it is less specialized. Villages like Kwigillingok near the mouth of the Kuskokwim River could be compared profitably with others along the coast, as well as

with those farther upstream where there is no sea-mammal hunting. Lake fish and small fur-bearing animals are used by the people in these areas as sources of food and clothing materials. In Canada the Perry River region might be good for showing a combination of inland and coastal hunting. Finally, a re-examination of the groups that Franz Boas knew on Baffin Island is about due.

These studies should be quantitative and not limited to the pattern of relationships between human communities and environment, expressed in general terms. They should ascertain the species and number of birds and animals killed within a given period of time, the quantity of fish taken, and the gear used. The community should of course be assured that the anthropologist or zoologist is not a game warden. Function-and-form studies will be needed when considering human use of resources. New materials can be used for old purposes, for example an empty five-gallon gasoline can in place of a sealskin float. Or an old material can be given a new function, for example ivory napkin rings made for sale. Many changes, however, are more complex and difficult to discern. Man approaches a new environment not merely with needs and habits but also with ideas about the proper way to do the jobs confronting him. The observer's task is to see how he implements his ideas, how his very perception of the environment is affected and limited by his preconceptions, and how in time he changes the ideas and redefines his situation. The materials that are found and used will influence or limit in turn the form of implements and ultimately perhaps their whole function. Generally, though, the function is the most durable, for ideas can at times be even more influential than the natural environment. Verbal tradition adds, for human ecology, another dimension to those of the remainder of the animal world.

### **Adaptation to social and cultural change**

So much research is needed on adaptation to social and cultural changes that it is difficult to know where to begin. The cooperation of economists, sociologists, and psychologists on most projects in this field would be necessary.

1. *Economic and social effects of a technological change:* One important change is the shift from skin-covered to plank boats. A study of this change might well be made in conjunction with the project on kayaks and umiaks (p. 313, No. 3). A start has been made in Berreman's work on Umnak Island (1954). The whole question of the present adequacy of locally owned boats should be considered. It has been suggested, for example, that the Scoresby Sund people should have larger boats so that they can go farther into the fiords for hunting (Mikkelsen and Sveistrup, 1944, p. 118). Tanner expressed surprise at the substitution of heavy plank boats for kayaks by Eskimo on the east Labrador coast, since these boats are not so well suited as kayaks, he thought, to seal hunting at the floe edge (1944, p. 529).

The prestige value of the different kinds of boats, their practical usefulness, the cost of importing or building, the cost of maintenance and means of

financing, the changes in travel, and economic activity directly traceable to the new boats are all problems to be considered.

Although the umiak has disappeared in most areas, it is still used and cherished in the Bering Strait region. The changes that have adapted it to modern needs are taken for granted locally, but are not known to many outsiders. Factors influencing adaptive changes and continued use of skin-boats might provide an instructive contrast with factors favouring the new means of water transportation elsewhere.

2. *The process of adaptation under urgent economic pressure:* Because of disastrously poor salmon-fishing in 1953, some of the Bristol Bay canneries had to close in 1954. The sudden diminution in the long-established commercial fishing industry will require a readjustment in local economy, modified and perhaps directed by a government program. This problem begs for immediate attention, for scientific as well as humanitarian reasons.

3. *Reaction to resettlement:* The removal of Thule village and the future move of Aklavik provide opportunities to study this problem, which is not so common today as it was in the nineteenth and early twentieth centuries, when epidemics, the whaling fleet, and the first establishment of trading posts and missions forced or encouraged Eskimo to relocate their settlements.

It would be interesting to determine whether or not individuals' places within the social system change or whether the system itself alters in the new physical situation. For example, do new leaders appear, and if so, by what means? Are there greater opportunities to become prosperous and greater opportunities for leadership in community planning?

The movement of people from outlying districts to large central villages and towns must be considered, especially in Greenland and Alaska. What changes in occupation, in relationship to natural resources, does this movement foster or require? What are its effects on family and community organization?

4. *Changes in relations between Indians and Eskimo and the nature of the relationship in one locality:* The Mackenzie delta seems to be an excellent place for such research. Some aspects to be considered are the possible and the actual personal relations in such matters as recreation, religion, and work; competition between the two peoples, and the nature and scarcity of the things for which they compete; superordination and subordination in the over-all status system, and the white man's preference for one ethnic group over the other. Honigmann (1951, 1952), in his study of Eskimo-Indian-white relations in the Great Whale River area, has shown what can be done in even a short field study. Similar research in other areas would also be useful.

5. *The process of adaptation in one clear-cut change in a social situation:* One such change is the shift of a village school in Alaska from the federally supported and administered Native Service to the Territorial Department of Education. Year by year more schools are shifted from one system to the other. The two school systems have different philosophies and policies of education, teachers are hired for different periods, and their extra-classroom

duties are different. The processes of reaction in the community are likely to be complex, and there may be unforeseen reactions in the school system itself. This is a study to be made periodically through two or three years, emphasizing the process itself and describing the causes and relationships of the various steps in the change. Pre-judging of this changeover should, of course, be avoided.

In Canada, as well, the appointment of welfare teachers where there have been none, or at least no government-supported teachers, will promote local changes that require attention (Grantham, 1951).

In Greenland, the teaching of Danish in the lower schools, although not so big an innovation as the initial establishment of a school, is also likely to start an interesting chain of development. The study of any European language affords new literature and experience, and at the same time establishes a linguistic division in the community.

6. *Effect of an administrative rule on family organization and community relationships:* For example, the changes traceable to policies in granting Family Allowances in Canada or the Aid to Dependent Children in Alaska should be studied.

7. *Effects of a public health program on other aspects of life besides health:* The rehabilitation of arrested tuberculosis cases in both Alaska and northern Canada is especially worthy of research. It would be well to consider the role of the returned patient as an innovator, and to note his effect on old concepts of disease and medical practices. There are also important questions to be answered in psychology, but they cannot quite be considered ecology.

8. *Effect of rapid increase in contact with the larger "outside" community:* Greenland's relation to Denmark, and indeed to western Europe and eastern North America, has become so much closer since the Second World War than it was before that the cultural environment, except possibly for the far northern settlements, is almost new. Previously the outside culture came through the church, or second- or third-hand through a few Danes resident in Greenland. Now by means of such things as the radio, adult education in Greenland, advanced education of young Greenlanders in Denmark, trade contacts, and political participation, the Greenlanders are experiencing Danish culture directly. It should now be ascertained whether there is a conflict, especially for young people, between local authority and that of this larger community. Are there new concepts of property and wealth and is property handled differently as a result of the introduction and the rapid expansion of private enterprise in commercial fishing, of new methods in sheep raising, and of taxation? Are changes in the personality or national character of Greenlanders visible between the middle-aged and the young adults? If there are consistent differences, they might be related to the expanded culture of Greenland.

9. *Form-and-function relationships in non-material aspects of culture:* Form-and-function studies of the technology have already been mentioned. An example in non-material culture is the present social meaning of Christmas,

which has become a very big event in many Alaskan Eskimo villages and apparently also in Greenland. In Alaska it seems to have taken on many of the old psychological, social, and economic functions and some of the old religious function of the Bladder Festival, the Messenger Feast, and other hunting festivals. (In the east Bering Sea area these festivals were formerly held in or near December). These impressions need to be tested, possibly by formulating hypotheses regarding the degree and kind of borrowing from pre-European ceremony. This celebration seems to be an example of local re-interpretation of a new form, and transfer of a function from an old to a new form of ceremonial.

10. *The impact of Christianity on beliefs and practices concerning nature:* For example, the effect on food resources should be studied. Are there new protectors of the game animals and new sources of guilt feelings relative to hunting practices, and new concepts of wrong-doing with regard to the natural world? Are there new explanations of natural phenomena? How satisfactorily do new ritual and beliefs replace the old in fulfilling the material and emotional needs of the Eskimo?

11. *A regional survey, including most of the above problems:* Labrador seems to be the most promising place for this survey, as Tanner (1944) has already compiled much of the necessary background data, not only on the natural environment but also on the introduction of disease and the establishment of missions and trading posts, in a brief historical review. Some of his explanations of cultural reaction will require re-examination, but his observations made in 1939 would provide interesting comparisons with current observations. Moreover, his suggestions that the geographic extent of the Eskimo was related to the distribution of the seals (p. 478) and that their withdrawal was related to the settlement and behaviour of white men and Indians (pp. 479-82) should certainly be considered.

Hamilton Inlet in Labrador is the only place where a white community (in contrast to occasional missionaries, traders, or travellers) has taken up the Eskimo system of seal hunting at blow holes, using the sealskins for dog harness and clothing, and eating the meat of the young seals. It is therefore an excellent area for studying the mutual exchange of cultures. Labrador has had a settled white population, making its living from the country, rather than from ministering to or administering the aboriginal population, longer than have most parts of Eskimo territory. Despite the numerous semi-popular writings on Labrador people, there is still a good field for social anthropological and ecological research on all three ethnic groups in east and north Labrador.

### **Balancing of factors in ecological adaptation**

To see the direction and progress of a people's total change, the biological and cultural factors must again be considered, but in different ways.

1. *Factor of health in total behaviour:* It is important to consider the diet and health of individuals, that is, their physical and emotional capabilities, as well as their motivation and cultural equipment when judging their prospects

for making use of any given resource, whether it be a technical training program or the introduction of reindeer.

2. *Adequacy of cultural substitutions made in the course of acculturation:* Before considering the integration of the whole way of living, it would be well to make an inventory of the changes occurring in sample villages. In which elements of culture has there been an absolute loss, with nothing to replace the old skills and old means of achieving prestige? In which has there been an absolute gain? What substitutions have occurred, such as that of rubber boots for oil-soaked sealskin boots? How adequate are the substitutions in satisfying basic needs? For instance, how does the new community control of anti-social behaviour compare with the old? What are the effects of new forms of art on aesthetic expression and recreation? Do both young and old men now do carving and what materials do they use, do the old people know the new popular music, and do women have new means of artistic expression? Finally, how does the present recognition of life crises compare with the pre-European? Are new life transitions recognized or ignored? For example, a boy was honoured for the first seal or bear he killed, but is he likely to be honoured publicly for his first regular, paid job?

3. *Balance of integrative and disruptive factors in a local situation:* Improved health care, new sources of income, legal protection, and other measures for human conservation may be outweighed by the loss of craft skills and the greater need for money to buy tools and other goods, by economic and personal waste in excessive use of alcohol, by religious and ideological conflicts, by competition for satisfactions rarely attainable, and by community disorganization and loss of self-respect. The decrease in murders and accidents may be outweighed by the death of tubercular patients. On the other hand, a conflict between the village and the trader may be less disturbing than a former conflict between the settlement and a member accused of sorcery. The research worker should try to identify and evaluate both destructive and constructive factors. It is especially important not to overlook the subtle psychological factors that may build up or tear down a people's self-esteem and morale. Loss of these can destroy a people's will to adapt.

4. *Local awareness of ecological problems:* Many ecologists have paid little or no attention to people's ideas about the demands and benefits of their own environment, and about their own ability to deal with it. We hear most dramatically from some Aleuts, but perhaps we could hear elsewhere if we would listen, a conscious acceptance of the fact that they are a dying people, hopelessly facing extinction. In other cases Eskimo want to fight for life and perhaps know better than their white administrators what they need in order to deal with their difficulties, although they are seldom asked. It would be useful to find out just how much they do understand of their changing environment.

No specific research projects are suggested here on the substitution of commercial fishing for sealing along the west Greenland coast, although it is

the biggest change in natural resources in the past fifteen years and has resulted in serious cultural changes, since this shift has already been given much attention.

In concluding this account of suggested research projects, four recommendations, which apply to almost any ecological study, should be emphasized:

1. Group research is needed. Different disciplines should be concentrated on one time and place. Too often research workers try to relate the culture of seventy-five years ago with the distribution of fauna today, failing, moreover, to see fauna through a biologist's eyes, and to interpret culture with an anthropologist's understanding.

2. Specific ecological field research is needed to replace the usual system of taking ecological data from material collected for other purposes. For better focused and delimited field research, hypotheses should be formulated and tested.

3. The study should be repeated at intervals. Human adaptation, especially in this period of frequent innovation, is a step-by-step process. In technology this is clear. We can visualize and understand what is involved in the mechanical process of printing a newspaper or the process of making a pottery bowl. In making a new cultural adaptation, the same basic principles operate: certain things cannot happen until certain other things have happened. Hence in any study of process, frequently repeated observation is necessary.

4. Finally, the criteria of adaptation should be stated. Certain changes that seem to the casual observer to be unadaptive may actually be adaptive from the standpoint of community solidarity or of the self-respect of the Eskimo. Conversely, economic aggressiveness and acceptance of new means of livelihood may be good adaptive behaviour in one segment of life, but at the same time may disrupt the extended kin-group responsibilities and induce social disorganization, at least for a transitional period. Disorienting and disorganizing tendencies are almost always present along with the integrative and reconstructive ones. The student's task is to assess their balance, and to try to predict which way it will tip.

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