Arctic Research at Point Barrow, Alaska

Laurence Irving[1]

Swarthmore College

AS THE MOST NORTHERN PROJECTION of Alaska into the Arctic Sea, Point Barrow has been an important location for exploration of science and commerce in the American Arctic. From these explorations has arisen a rich literary record of expeditions for the examination of Arctic environments and life in Arctic regions. At present, Arctic resources of petroleum and information about weather, communications, and air travel through the area are of vital interest to us, and Point Barrow serves as an advanced base for these Arctic operations.

At this frontier point of practical scientific operations the Office of Naval Research has provided an establishment for pure scientific investigations. As a start, a scientific party of five from Swarthmore College and two from Cornell University arrived at Point Barrow on August 6, 1947, for a year's program of physiological research upon metabolism in Arctic climates. In mid-December it was possible to report briefly upon the work done. Inasmuch as laboratories for more extensive Arctic research are now in preparation, the experience of the first party may serve to guide future operations.

Physiological studies have determined the metabolic rate of about 8 air-breathing and aquatic, cold-blooded animals at various temperatures. The curves relating metabolism to temperature are similar to those of animals in temperate and tropical regions, but the Arctic curves are so placed as to show considerable metabolic activity at low temperatures, where tropical and temperate forms are inactive. In these curves is shown one aspect of the suitability of Arctic forms to their climate. Important inferences could be made from the results, but since the empirical relation of metabolism to temperature is not yet well determined for tropical forms, it would be better to await exposition of the natural contrast of metabolism in the tropics.

Measurements of the oxygen consumption and respiratory quotients of buds and roots of plants and of lichens show easily measurable amounts of metabolic activity of plant parts hitherto considered metabolically dormant in the Arctic winter. This activity in winter is enough to be significant to the natural metabolic economy. It is also measurable in ways which permit analytical study of the physiology and chemistry underlying the winter metabolism of Arctic plants. As in the case of animal metabolism, it is best not to project analytical studies until an examination of the tropical plant counterparts shows, over a broader natural range, the empirical relations between metabolism and temperature.

Measurements of the transfer of heat through the skin, fur, fat, and blubber of warm-blooded animals have been made upon a series of Arctic species—mountain sheep, caribou, reindeer, Arctic fox, Arctic least weasel, lemming, seal, ptarmigan, and snow bunting. The number of species of warm-blooded animals in the Arctic is so small that it is possible to survey them all and arrive at early conclusions as to the means used by animals for insulation against Arctic cold.

These few physiological studies outline Arctic problems of broad interest. The small number of species appears to facilitate obtaining conclusive results above broad biological lines. The few species can be well known. They are often the sole representatives of large taxonomic divisions, and their lives are dominated by the cold of the Arctic climate. Thus, natural conditions in the Arctic have eliminated the abundance of animal forms and environmental factors which in the tropics confuse the observer in his attempt to survey the relations between life and environment.

Other types of research appear especially appropriate to Point Barrow. Studies on the physiology of human acclimatization to cold will have for subjects native Eskimos, mechanics experienced in the Arctic and selected for that work, and comparative newcomers to the Arctic climate. The circulation in exposed faces and in hands and feet could be examined for vascular adjustments in the cold. Metabolism and nutrition of men in an Arctic construction camp provide for heavy work with varying amounts of exposure to cold. Certain native groups subsist mainly upon meat.

The numerous ponds, lakes, and rivers of the Arctic coastal plain show various stages of formation, drainage, and drying, with invasion by plant material and implicit association of animals. During the brief summer, growth is rapid—almost explosive, and sharp local temperature gradients develop at the surface of the ground and at the bottom of pools of water lying over black muck. Such conditions must operate to

[1] Scientific Director, Arctic Research Laboratory, Office of Naval Research, Point Barrow, Alaska.

select faunal and floral associations and sequences. The sudden emergence of plants and animals into summer activity which rapidly provides for growth and reproduction is a striking phenomenon.

Along the shore of the Arctic Ocean ice scrapes the sea bottom during many months, but that offshore beds yield rich fauna is shown by the animals cast up by occasional summer storms. Seals, walrus, whales, and polar bears are sufficiently numerous to indicate a considerable productivity of the Arctic Sea. Quantitative surveys of productivity and the life histories of these animals of the Arctic Sea and ice will be interesting when their pelagic phases are well known.

In the early summer great numbers of water and shore birds fly to the shores of the Arctic Sea, breed, and depart in a few months. Bird migrations are widespread, but in the Arctic the sudden arrival and departure of vast numbers is a striking event. Some species—the King Eiders, for example—follow narrow flight paths near the shore, and the concentration of their flights should be favorable for examination of the metabolism which supports their long and rapid migratory flights, as well as for investigation of the guidance which makes possible their navigation.

In referring to fields outside his own, a biologist is likely to see other sciences as aids, but it is obvious that all of the sciences are closely concerned with each other in the Arctic. The flat, rockless shores of the Arctic Sea are constantly forming bars and lagoons while being eroded by steady winds. The effects of ice are visible everywhere, and the sea ice is always near for investigation of the cyclic changes in salinity and finer and coarser structures which occur during seasons and even years. During most of the year a small snowfall drifts with rather steady winds, recording in the drifts the detailed occurrences at the air-snow interface which determine the characteristics of the snow cover. In the snow, men, animals, and plants obtain shelter where temperature and wind effects are moderated. Studies of the microclimates in snow promise interesting results in themselves as well as being necessary for defining the Arctic conditions of life and surface geology.

For 9 months of the year the ground surface is frozen. Frozen ground is always within a few feet of the surface, modifying the conditions of life no less than the progress of changes in surface geology. Subsurface masses of ice lie under mounds and cracks in the tundra. These are exposed in shore and valley cuts, indicating many peculiar localized influences of subsurface ice. The uneven tundra is a great record of superficial temperature changes which makes travel and construction difficult but which reveals the surface effects of frost in many scales of magnitude.

Although the ground is frozen hard for many months, the record of changes by seasonal frost from above and in the permafrost below is an impressive indication of the constant change in the surface of the Arctic plain through all seasons. Deeper effects of permafrost are being surveyed by physical methods and by drilling in connection with the exploration for petroleum, which lies in the sedimentary layers and occasionally seeps out to the surface.

The Office of Naval Research now has two laboratories at Point Barrow, each 40 by 100 feet, with the second floor of smaller area because of their hemispherical section. One is designated for the Natural Sciences, with rooms labeled for physiology, zoology, botany, limnology, oceanography, climatology, and geology to indicate, but not restrict, the range of subjects which can be profitably associated in describing the life and environment of the Arctic Plain.

The second building is designated for the Physical Sciences, and it will suffice for a biologist to remark that physical and chemical research on the ice, sea, earth, and atmosphere during the Arctic seasons is much needed to extend our knowledge of the earth. In these extreme but steadily changing conditions are experimental and observational backgrounds which can serve to extend the physical sciences.

These laboratories receive local maintenance and supplies from the Bureau of Yards and Docks through the Arctic Contractors, who operate the base camp. Lodging and food for personnel, common cold-weather clothing, local transportation, and native technical assistance are also provided through the Arctic Contractors. Judging from the experience of the group of physiologists, the support given to research is excellent. While not all facilities of an urban center are available, the speed, skill, and ingenuity shown by the local services excel that obtainable at home, for the personnel are selected by the Contractors and by conditions for ability to work rapidly and well in a situation where work is the main concern.

Although it is not proposed to stock the laboratories with instruments, certain basic laboratory equipment is accumulating. Equipment and clothing for field work, while in large part locally available, should be selected to suit needs of the field work in prospect.

Arrangements for research at the Arctic Research Laboratories are made by the Office of Naval Research, which may be expected to entertain proposals according to their practicability and for their contribution to the current of Arctic research. It is desirable to keep in view that the strongest individual programs will best fit practical conditions and aid in common progress.

Careful planning and preparation are essential for the successful outlook of an Arctic research program.

While there are cases in which valuable data may be obtained during a short visit, in general the cycle of the seasons must be observed to relate the subject of research truly to Arctic conditions. Freezing and thawing progress in long cycles, and ice and snow change rapidly under the influence of winter winds. While the summer is most spectacular superficially, there is more winter in the Arctic, and it cannot be known without the winter season.

The question may be raised as to whether it is now wise to establish a facility for research upon the extreme frontiers of civilization when routine teaching and regular research at home are short of personnel and facilities. Everywhere in the world today there is doubt as to the condition at these frontiers and fear of what may lie beyond them. Certainly, some of the men of science should be trying to explore and define accurately the frontier conditions under which man, in his ignorance, clashes with his environment and misguided social and economic forces have regularly led to war. Scientific exploration at the Arctic frontiers, where natural forces are strong and clear, can guide the domestic operations of science in lines leading realistically forward.

Arctic research in the past has greatly enriched our culture, and no similar extent of temperate or tropical coast line can list names and works of such distinction as those which have derived their information from exploration along the Arctic Coast of America. There may be a great literature based upon Soviet Arctic researches, but this we cannot know until all workers in Arctic research freely exchange views across the Arctic Sea.

NEWS and Notes

Lawrence E. Stout, professor of chemical engineering, Washington University, has been appointed dean of the School of Engineering. Dr. Stout's appointment will be effective July 1, when **A. S. Langsdorf** retires.

Reidar F. Sognnaes, recent winner of a Norwegian dental prize for his contribution toward the understanding of the reduction in dental decay which occurred in Norway during the war, was recently named associate professor of dental medicine in the Harvard School of Dental Medicine.

William F. Hewitt, Jr., formerly of the Research Division, Smith, Kline & French Laboratories, has been appointed assistant professor of physiology in the School of Medicine, Howard University.

Jack Purdue, associate professor, will become chairman of the Department of Chemistry, Oklahoma Baptist University, Shawnee, effective in September.

Robert A. Dreyer, associate professor of geology, University of Kansas, has recently been appointed chairman of the Department, to succeed **L. R. Laudon,** who will go to the University of Wisconsin after the spring semester.

Joshua Lederberg, formerly a research fellow at Yale University, has become assistant professor of genetics at the University of Wisconsin, where he is organizing a program in the genetics of bacteria and other microorganisms.

B. F. Skinner, of Indiana University, has been elected professor of psychology at Harvard University. Beginning in September 1948, he will offer a course in general education on Human Behavior and continue his researches on the behavior of organisms in the new Harvard Psychological Laboratories.

William A. Dreyer, University of Cincinnati, **Sherman C. Bishop,** University of Rochester, and **William M. Ingram,** Mills College, California, have been appointed to research fellowships at the Edmund Niles Huyck Ecological Research Station at Rensselaerville, New York, for the summer of 1948.

Jesse P. Perry, Jr., who was recently graduated from the Duke University School of Forestry, has been appointed instructor in forestry at Virginia Polytechnic Institute, Blacksburg.

Thomas B. Niven, formerly head of the biochemistry section of Economics Laboratory, Inc., St. Paul, has joined the staff of the Food Technology Department, Oregon State College, Corvallis.

Grants and Awards

The American Academy of Arts and Sciences announces availability of grants for chemical research from the Cyrus M. Warren Fund. The grants cover expenditures for apparatus, supplies, or for the construction of special facilities for research in chemistry or in closely allied fields but do not cover salaries. The amount available to an individual is seldom in excess of $300. Applications must be filed prior to May 1, 1948. Application blanks may be obtained from the Chairman, Frederick G. Keyes, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

The Louis Livingston Seaman Fund of the New York Academy of Medicine has available $1,200 for furtherance of research in bacteriology and sanitary science during 1948. Provided by the will of the late Dr. Seaman, the funds may be used for securing of technical help, aid in pub-