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**CONFERENCE ON  
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IN THE ARCTIC AND ANTARCTIC**

**Geneva, 28 August - 1 September 1962**

**Report**

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# **CONFERENCE**

## **ON MEDICINE AND PUBLIC HEALTH**

### **IN THE ARCTIC AND ANTARCTIC**

#### **Report**

The WHO Conference on Medicine and Public Health in the Arctic and Antarctic met in Geneva from 28 August - 1 September 1962. This Conference, the first of its kind to be sponsored by the Organization, was opened by Dr P. M. Dorolle, Deputy Director-General, on behalf of the Director-General.

Dr Dorolle pointed out that the Conference was exploratory in nature ; it was intended largely to be a forum for the exchange of experiences on health problems in the high latitudes, and for the pooling and analysis of progress so far made in coping with health problems in cold climates. From these exchanges it was hoped that there might emerge some clear indications on which to base a worthwhile programme of activities in this field. Such a programme might perhaps be carried out on a co-operative basis.

Dr Karl Evang was elected Chairman of the Conference and Dr P. G. Law Vice-Chairman.

#### **GENERAL CONSIDERATIONS**

The Conference on Medicine and Public Health in the Arctic and Antarctic covered a very broad field. The first requirement was to discuss the general characteristics of the area concerned and of the people living there, as well as any special features of the diseases from which they suffer. The arctic and antarctic regions can be subdivided on climatic, botanical and zoological grounds, or on physical ones such as presence or absence of permafrost or permanently frozen soil. Latitude itself is a poor guide ; the tree line extends 1 000 km south of the Arctic Circle in Canada, but 400 km or more north of it in Norway. The simplest division is into the polar, tundra and taiga areas : polar, with snow, ice and rock, and little or no flora or fauna ; tundra, with permafrost but a considerable flora

rich in mosses and lichens, a limited fauna, and seasonal abundance of insects; and the taiga, or coniferous forest areas.

There are many difficulties in the choice of a convenient term to describe all these areas and the phrase "high latitudes" has much to recommend it. In the north, these latitudes are the home of 1.5 million people in Scandinavia, 0.25 million in Alaska, 32 000 in Greenland, and 24 000 in Canada. The Siberian population is considerably larger, possibly totalling 18 million.

The indigenous peoples outside Siberia include the Lapps (33 000), Eskimos (56 000), Indians (21 000) and Aleuts (6 000). These have a high birth rate and a high, though declining, infant mortality. Their numbers are increasing at the rate of 3-3.5% per annum in an area of very low population density (1-5 per square mile).

The indigenous people have ancient but diversified cultures, vast distances frequently separating the various groups. After centuries of virtually complete isolation, there has been increasing contact with "southern" people during the last 50 years, and today there are probably no Eskimos who have not experienced such contact.

The characteristics of the areas concerned include (1) low temperature, (2) snow-covered and/or frozen soil for long periods, (3) prolonged darkness and prolonged light, (4) special features of flora and fauna making agriculture very difficult, (5) low density of population, (6) communication difficulties, (7) low economic strength. Amongst the physical consequences are difficulties in providing water supplies and sewage engineering.

The biological features include an enormous plague of mosquitos and other biting Diptera in the spring and summer months. These insects pose a pest problem unparalleled elsewhere, although on present knowledge mammals, birds and fish are more important agents for the spread of human disease in the north. In this connexion, the close contact between man and animals, particularly the dog, should be noted. So should the fact that pathogens can survive long periods at low temperatures, remaining infective for years in ground contaminated with sewage. Also, the pattern of light and darkness may have biological consequences, for example, the amounts of sunlight or ultra-violet light may be inadequate for the prevention of rickets.

In these areas there is a dilution of life, and this affects the provision of medical services. There are five necessities:

1. Well-planned preventive services.
2. All-purpose front line personnel.
3. Simple local medical institutions for first aid and diagnosis.
4. Effective transport.
5. Special financial arrangements.

There are four types of northern population :

1. Stable indigenous population, who have only relatively recently been in contact with "southerners" and who were initially exploited; this contact produced a marked change in the pattern of their life, leading them to adopt a money economy and to import food.
2. Stable population of the same stock as characterizes the more southerly parts of the country and not regarding themselves as in any way different from their fellow citizens.
3. New settlers, who have brought with them their "southern" patterns of life, forming urban communities and frequently by their demands stimulating the development of health services.
4. Transient population, e.g., members of polar expeditions, who are very sophisticated and who require exceptionally high standards of medical care.

There is no evidence as yet of any diseases specific to high latitudes; the special health problems of the area are those imposed by such factors as distance and low temperature.

The development of health services must parallel economic development. The northern lands are no longer isolated. More and more links are being established with the national life of the countries to the south. There is increasing urbanization and amongst the indigenous population there is a rapid change from a nomadic existence to one based on a money economy. Four levels of health can be distinguished: (1) simple survival, (2) freedom from disability and disease, (3) assured and effective work performance, (4) enjoyable living. The very rapid development of northern lands has resulted in a confusion of historical periods, and there is an increasing demand to jump direct from simple survival to enjoyable living.

Progress in these areas is irregular, owing to the unpredictable nature of new developments based on the discovery and exploitation of natural resources. Other factors responsible for unequal development include the virtual absence of agriculture, the rugged nature of the country, urbanization, and the greater ease of exploring areas formerly inaccessible.

Since the development of the northern lands is practicable but highly expensive, human needs must be considered in terms of priorities. These should include: (1) transport, (2) education, (3) housing and health services, (4) a sound, durable economic basis for life.

The major health problems in Alaska, which appear to be similar to those in other northern areas, are: (1) infectious diseases, particularly tuberculosis and gastroenteritis; (2) accidents, especially drowning and death or injury by fire; (3) sanitation; (4) mental illness; (5) effects of social disruption; (6) inadequate maternal care; (7) infant morbidity and mortality; (8) school health, complicated by unsafe water, permafrost and

low temperature ; (9) undernutrition ; (10) defects of vision and hearing ; (11) dental caries.

All these health problems would be lessened if the economic basis of the community were improved. Life in the north is inherently more costly than in temperate zones. It seems certain that the population of the northern lands will increase, and those concerned with health in these areas must be aware of the consequences this will have. Also, they must take into account other features, for example, the youthfulness of the Alaskan population at present as compared with the population of the USA as a whole, and the possible effects of an increased tourist industry on the problems of water supply, food protection and sewage disposal. Health problems can nowhere be considered in isolation, but in high latitudes it is even more urgent than elsewhere that they should be viewed as part of the whole picture of life. The northern areas have a great deal in common with one another, in spite of such specific differences as are to be found, for example, between Greenland and Alaska.

The problems of the Antarctic are different. Here there are no permanent dwellers, but only the inhabitants of polar bases, who have been selected after very careful medical examination, are all young, and are all men. Medical practices differ at different national bases ; in some, all members of Antarctic expeditions must have their appendices removed before going south, in others this procedure is confined to the doctors, and in some the appendix is left intact in everyone. There is a high standard of medical care and possibly the highest ratio of doctors to population to be found anywhere—an average of one doctor to twenty or twenty-five persons.

The main health hazards in the Antarctic are accidents and mental instability. The latter is probably related not to the harsh environment, but to the problems of life in a small, isolated community.

The detailed discussions of the various health problems of high latitudes follow in the reports on the technical sessions.

### EPIDEMIOLOGY AND SPECIAL DISEASE PROBLEMS

The isolated and widely scattered groups of people of low economic status who live in the high-latitude areas have to contend with extreme cold, low humidity, inadequate housing conditions—conditions that hamper sanitation—lack of education, and malnutrition, as well as disease. These factors, together with a lack of adequate health services, result in high death rates. In Canada, for example, the death rate for Eskimos is nearly three times the rate for the “white status” population, and for Indians it is almost twice. Infant mortality is high and accounts for 57% of all Eskimo deaths and 37% of all Indian deaths.

Tuberculosis has been an important cause of death in North American Indians and Eskimos since the middle of the last century. In Alaska, an annual morbidity rate of 675 per 10 000 was estimated for the indigenous population in 1953, compared with 33 among the whites. In 1954, an intensive control programme was undertaken with considerable emphasis on ambulatory chemotherapy. As a result of this vigorous anti-tuberculosis campaign, there has been a dramatic decline in incidence. The average annual infection rate among children under three years of age fell from 24.6% in 1949-51 to 8.5% in 1957 and 1.1% in 1960.

Tuberculosis still dominates medical activity in the Canadian north. The incidence of new, active cases among Eskimos is about twice as high as among Indians, and eight times that for the "white status" population. Among Alaskan natives, tuberculosis still requires more medical attention than any other condition; emphasis is given to early detection of the reservoirs of infection and their efficient neutralization through chemotherapy in hospital and at home. Large-scale chemoprophylaxis trials are under way in Greenland and Alaska to study the applicability of this control tool in the North. There is also a high incidence of phlyctenular keratoconjunctivitis in the indigenous population.

In 1960, respiratory diseases other than pneumonia of the newborn and tuberculosis caused 10% of the deaths in Alaska. Among the indigenous population the incidence was 20% compared with 3% in the remainder of the USA in 1959. Pneumonia is the chief cause of death in Canada's north; including "pneumonia of the newborn" it accounts for at least 32% of all deaths. Middle-ear disease, which is common, is usually a sequel of pneumonia.

Disorders acquired by ingestion include acute intestinal infection and parasitic diseases. There is a scarcity of information on the prevalence and etiology of diarrhoeal diseases, and the relative roles of water-borne, food-borne and man-to-man modes of communication are poorly understood. In Alaska, from 1954 to 1957, more than half the residents in some Eskimo villages suffered from diarrhoea at some time during the one-year observation period, usually during the summer months. The most frequently isolated organisms were *Shigella*, although *Salmonella* were also found. The incidence of intestinal infection due to viral agents is unknown.

In Antarctica there is no permanent population; the inhabitants of the polar bases remain there for periods of a few months to two years. Polar station personnel are healthy subjects selected after careful medical screening. There is, however, no medical check on arrival, and what is more serious, there is no medical screening of short-term visitors. Pre-posting medical checks should include immunization against smallpox, typhus, diphtheria, poliomyelitis, typhoid and paratyphoid. These procedures could well be followed in the Arctic, too.

In the Antarctic there is a need to prevent contamination of the vast surface area, which up to the present has remained virtually sterile.

There are several factors that favour the natural transmission of infections between man and animals in the far north. Wild animals, able to serve as reservoirs of disease, abound, and so do potential vectors. Both are freely contacted by the indigenous people, many of whom are still dependent upon hunting and fishing. New settlers, entering natural foci of infection, are also at risk. Large numbers of dogs are kept for sled-hauling and reindeer herding, and live in closer contact with man than elsewhere. Rigorous climatic conditions make adequate disposal of waste difficult and gross contamination of village areas with the excreta of dogs is usual. Under these conditions parasitic zoonoses and such diseases as rabies assume special importance.

Both the cystic and (to a lesser extent) multilocular types of hydatid disease are found in arctic and subarctic areas, although the latter fortunately is limited to only a few localities. Cystic hydatid disease is maintained in a wolf-elk cycle in the wild state and in a dog-reindeer domestic cycle. The multilocular form has a fox-rodent (microtine) cycle but dogs can become infected with the adult parasite.

Eskimos are subject to fish tapeworm infections (diphyllobothriasis) as a result of their cultural practice of eating raw or partially cooked fish. There are several reports of a 30% incidence, and one as high as 77%. Similarly, the eating of raw meat from polar bears or walrus is considered responsible for the prevalence of trichinosis, with its usual mortality rate. Current studies to develop practical control methods by more efficient curing and other processing of fish for human consumption should be pursued. Following this, effective control methods adapted to the culture of the indigenous populations should be instituted. The geographic distribution of diphyllobothriasis requires further study.

Among the non-parasitic zoonoses, rabies and tularaemia deserve attention. The former is fairly common among wild canines (foxes, wolves) and often takes a heavy toll of sledge dogs and reindeer. For some reason human infections are rare. Tularaemia is common among the abundant rodent populations but there are few clinically evident human infections.

Brucellosis has been detected in reindeer and the caribou with occasional extension to man. Leptospirosis has not proved important where investigated. Antibodies against the psittacosis (ornithosis) virus have been found in Eskimos living in the Canadian arctic. It is presumed that this infection may exist in a sub-clinical or mild form resembling influenza. Tuberculosis has been reported in reindeer in Russia. Anthrax has recently occurred in bison in Northern Canada with two human infections.

Economic and aesthetic considerations would render it difficult to eliminate natural foci of many of the zoonoses in higher latitudes; control

measures should aim at the attainment of higher standards of sanitation, canine as well as human:

The efficacy of control measures against communicable diseases, including the zoonoses, would be furthered by maintaining better records, using central data processing techniques, and improving administrative and logistic support of personnel engaged in field operations.

There is need for co-ordination and exchange of information on preventive measures to be taken by the countries concerned. The Fourth World Health Assembly realized that precautionary measures additional to those specified in the International Sanitary Regulations are needed to protect isolated communities where the introduction of epidemic diseases other than the six quarantinable ones may cause considerable morbidity and mortality. Such measures should be taken only in respect of those isolated communities situated in areas or territories which the health administration concerned has notified in advance to WHO as being specially at risk and which have been approved as such by the Organization.<sup>1</sup>

## THE ORGANIZATION OF HEALTH SERVICES IN THE ARCTIC

### Problems of transportation, supplies and equipment

The organization of health services in the arctic and subarctic areas is complicated by the great distances involved, the poor communications, the sparseness of the populations, and the relatively high morbidity.

The first requirement is to get medical personnel in touch with their patients. This gives rise to a number of transport problems, since in most parts of these regions roads are poor or non-existent. The solutions adopted vary from one area to another, mainly in accordance with geographical features. In Alaska, Canada, northern Sweden and northern Finland the use of aircraft is commonplace, in north Norway and Greenland transportation is frequently by motor-boat. In many places dog teams, reindeer-drawn sleighs or motor-sledges are used during the winter time. There is a need for aircraft specifically designed for arctic conditions. Furthermore, there are other logistic problems, including the development of radio communications and the design of special radio sets that will operate in the difficult conditions of high latitudes. Other questions in need of study are the design and contents of first-aid packs, and techniques for the air drop of medical stores and equipment.

There is often discussion as to whether the patient should be brought to the medical centre or the doctor to the patient. While recognizing that

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<sup>1</sup> Resolution WHA 4.79, *Off. Rec. Wld Hlth Org.*, 1952, 35, 52.

certain diagnostic procedures cannot be undertaken away from a medical centre, it should be emphasized that from the standpoint of environmental health it is highly desirable that medical personnel should be afforded every opportunity to observe the patients' living conditions and natural surroundings.

#### **Types of medical institution**

On the one hand, all possible facilities for obtaining medical help must be afforded to populations thinly scattered throughout vast areas. On the other, rapidly developing specialization in diagnostic and therapeutic techniques calls for the centralizing of knowledge, skill and equipment. At the outset, the organization of health services in the Arctic is thus faced with two directly opposing needs.

Most of the health administrators concerned have chosen to compromise by providing a range of medical institutions of different types. The smallest of these units (called the "nursing station" or "health station")<sup>1</sup> forms the front line of the health services. It contains facilities for personnel, usually a nurse or a public health nurse, sometimes a midwife or even a doctor. A consulting room is provided, and there are a few beds for obstetrics, and for the reception of patients for treatment or to await further transportation. The station is equipped with the necessary instruments and wherever possible with a small X-ray apparatus. Here the doctor, travelling in his district, can carry out clinical examinations and minor surgery. Furthermore, the nurse in such a station can supervise the health of the local and surrounding population, including health education activities.

The medical institution next in size is the local hospital, providing accommodation where patients with communicable or other diseases can be treated separately, and where there are an operating room, X-ray room, out-patients' department, laboratory and other ancillary facilities. The staff includes one or two doctors who may be whole-time, but in the special conditions in the polar regions it is probably preferable that they should work in the hospital and as general practitioners as well.

In addition to the nursing stations and local hospitals, there is the regional or central hospital, which is similar to the general hospitals found in other parts of the world. Other types of hospital, including mobile units of the kind developed in northern Sweden, may also be required. In Greenland, for example, there are approximately 150 inhabited localities served by a central hospital in the capital, 16 local hospitals and 8 nursing stations.

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<sup>1</sup> The terms "nursing station" or "health station" have different meanings in the various countries, e.g., in Canada "health station" signifies little more than a supply storehouse kept locked between visits.

In many of the arctic regions medical specialists travel widely, particularly during the summer, to treat patients and to advise local medical practitioners. In several regions, e.g., Canada, Greenland and Norway, ships are used as floating clinics for the diagnosis of such diseases as tuberculosis and for therapeutic purposes.

It is essential to have more hospital beds in relation to the size of population than in other areas, owing to the higher morbidity and the fact that many patients may have to stay in hospital for prolonged periods because of bad housing conditions or lack of facilities for nursing care in their homes.

Dental treatment and preventive dental care are subjects which should receive the attention of the Health Service Authorities.

### Personnel

Virtually all the personnel of the health services come from low latitudes.

(a) *Doctors* : They must either be specialists (for the central hospital) or have had the broadest possible medical education (for local hospitals). Doctors at local hospitals must be able to perform the commonest types of surgical operation in acute cases and should have had public health training.

(b) *Dentists* : These also require the broadest possible training.

(c) *Nurses* : Special training for public health nurses is required. Multiple competence (public health, clinical and midwifery) helps the initiative of the nurse, but complete independence of medical supervision should not be encouraged.

(d) *Midwives* : Usual training required.

(e) *Laboratory assistants, secretaries* : Usual training required.

(f) *Sanitary inspectors* : There is an increasing need for sanitary inspectors able to accept a high degree of responsibility.

(g) *Auxiliary workers* : Working under supervision, auxiliary workers make an important contribution and are used extensively.

It is considered useful that, before final assignment, health workers of all categories should be given detailed information about their working conditions, and should also receive some teaching in the local languages.

Recruiting of indigenous people and their training at recognized medical or nursing schools for qualified positions in the health service should be encouraged, with emphasis on the need for them to return and contribute to their community welfare.

In view of the difficulty of recruiting adequate numbers of suitable personnel to work in the north, it is necessary to pay special attention to

incentives, including attractive salaries and promotion and re-employment benefits.

Careful medical and dental examination of personnel before their departure to high latitudes is strongly recommended.

The necessity of a central direction of the health services must be stressed to ensure an equal distribution of personnel and equipment and the recording of medical data for the entire area. Statistical data are fundamental for further progress; this was well demonstrated in Greenland after central control was set up in 1950.

No rigid limits can be set for the size of the medical staff, as staff requirements depend on special regional conditions. In general, the ratio of medical to non-medical personnel needs to be higher than elsewhere because of factors already emphasized, e.g., high morbidity, time spent travelling, and the difficult conditions of work. Facilities for staff rotation are important. Health education must not be overlooked.

#### **Organization of mental health services**

This should follow the usual pattern, but it is particularly important that the public health and mental health services are fully co-ordinated. The "front-line" health workers should be trained to recognize gross evidence of mental ill health.

Community mental health programmes can be established in the larger communities.

As stated in the introduction, it must not be forgotten that the most important and effective way of improving health is the raising of the standard of living.

### **ENVIRONMENTAL HEALTH**

Of concern to the Conference were the following factors in man's management of his environment in the high latitudes:

- (1) adequate and safe water supply;
- (2) safe and sanitary disposal of liquid and solid waste matters;
- (3) physical and mental discomfort caused by biting insects;
- (4) high rates of accidents.

Reference was also made to food storage and food-borne disease.

The nature of arctic and subarctic environments explains the primitive development of needed resources of water, fuel and food, the prevalence of disease, and most of the difficulties that hinder the creation of satis-

factory living conditions. Within the terms of reference of the Conference, the following conditions were reported as of most significance :

- (1) climate in general ;
- (2) low precipitation—winter snows and rapid spring run off ;
- (3) vast expanses of shallow pools and lakes ;
- (4) permafrost ;
- (5) paucity of food stuffs ;
- (6) available sources of meat and other foods ;
- (7) the intimacy of association between the canine and human populations.

### **Water supply**

Cold, low precipitation (much of it as snow), rapid spring run off and permafrost hinder the development of adequate and safe water supplies. In summer, the scattered indigenous population of the tundra dips its water from the pools, ponds, and lakes that dot the landscape. In the autumn, ice is cut for storage in permafrost pits, in cellars below the ground, or in stacks on the ground surface.

The spring melt of snow and ice makes for rapid run off from the frozen ground. If the permafrost is deep, impoundment of surface flows becomes difficult, if not impossible, because the frozen ground gradually thaws and no longer supports the required impounding structures.

It is generally agreed that deep geological strata may eventually yield the most promising sources of water, and a stream of cold water has been used to jet wells through permafrost up to 35 metres deep. Simple means for getting the water from such wells to the surface without freezing are still to be developed.

Melting a shaft vertically downwards into the impermeable ice structure of the Greenland glacier yielded water of excellent quality and proportional in quantity to the heat applied. The sub-surface cavities thus formed retained their contents unfrozen for long periods of time.

Some Alaskan wells contain up to 100 mg/l of iron. Successful reduction to 1 or 2 mg/l by precipitation with soda ash, oxidation (and disinfection) with calcium hypochlorite, aeration, and settling was reported. Cold slows down chemical reactions so much that it may pay to heat the water.

Water has been stored satisfactorily in earth basins lined with impervious plastic membranes, and thought has been given to winter storage of fresh water in flexible rubber containers of large dimensions that are weighted and submerged in the ocean for use by coastal communities.

In sizeable settlements, water and other piping is installed successfully in heated "utilidors", or the water is heated and conveyed to the consumer through circulating single or double piping systems. In single systems, two "pitorifices" directed respectively against and with the flow, create enough difference in pressure to circulate water through loops of service piping. The upstream orifice faces the flowing water. In double systems, the service inlet is connected to the high-pressure supply pipe, the outlet to the low-pressure return pipe.

### **Waste disposal**

Bucket latrines, chemical toilets, and privies (sometimes in the form of removable tubs) continue to be used in arctic dwellings. At the Arctic Research Station of the United States Public Health Service a chlorinated recirculated waste system and an aerobic recirculation system have each been operated successfully for six months.

In the chlorinated recirculated waste system, water-carried toilet wastes are chlorinated and discharged into a settling and storage tank from which the supernatant is recirculated to the toilet. The tank contains ethylene glycol antifreeze. The aerated recirculation system is like that used also in temperate climates. Stabilization ponds and flow-through extended aeration are under study both in Alaska and in Finland. Grinding of solid wastes with subsequent addition to fuel oil and destruction by incineration in an oil burner has been perfected. Separate collection of urine and faecal matter has permitted the incineration of the faeces in oil-drum destructors at Antarctic stations of Australian expeditions; this requires only a small expenditure of fuel. On the Greenland ice cap, water-carried camp wastes are discharged into a shaft melted through the porous glacial snow down to the more impermeable ice layer. The wastes flow laterally outward from the shaft until they are frozen.

### **Insects of public health importance**

Biting Diptera are extremely abundant in arctic and subarctic regions of the Northern Hemisphere, but are absent from Antarctica. They cause much physical and mental distress, but are not known to be of significance as vectors of human diseases at present. There remains the possibility, however, that if left uncontrolled they may become dangerous as polar populations increase. Four important groups of biting flies characterize the high latitudes of North America: mosquitos (Culicidae), more especially members of the genus *Aedes*; black flies (Simuliidae); punkies or biting midges (Heleidae); and horse flies (Tabanidae). In addition, the biting snipe flies (Rhagionidae) and domestic flies, notably the lesser house fly, *Fannia canicularis*, may be or become of public health concern. From a

veterinary standpoint, myiasis-producing blow flies and warble flies are responsible for losses among reindeer, and certain of the biting flies transmit blood parasites to which domestic geese and ducks are highly susceptible. Tick-borne brucellosis and haemorrhagic fever have been reported from the USSR.

Biting flies have aquatic or semi-aquatic developmental stages, the ponds, marshes and bogs of the north providing countless larval habitats for mosquitos, biting midges, and tabanids. The streams of the granitic areas satisfy the breeding requirements of black flies, which, unlike mosquitos, do not trouble man much beyond the tree line. Not only may these flies cause significant blood loss under certain circumstances, but severe psychological reactions may be associated with their bite, noise and impact.

Measures commonly taken in the north against biting flies include the use of repellents, protective clothing, bed nets, smudge fires, and—in the case of permanent buildings—adequate screening. The wide dispersal of the population means that under normal conditions effective employment of insecticides is economically impracticable except near settlements of some size. There appears to be hope in biological control through the use of specific pathogens, parasites and predators, but thorough ecological investigations will be an essential prerequisite.

### Accidents

Throughout the Arctic death rates from accidents are high. Drowning and fire take many lives in the native population. Hunters traversing the sea in kayaks and other native craft live a dangerous life, as do those who travel over land by dog sled. Transportation accidents have mounted with the introduction of travel by car and plane.

Dog bites are common and especially dangerous to small children. Because of this, Greenland requires that the cuspids of all dogs be clipped at eight months of age. However, it has been reported from Alaska that although there is rabies in the wild animals of the region there is no significant transmission of the disease to man by dog bite.

Accidental deaths of infants are often caused by "overlying" on the crowded common sleeping floor. Children playing next to the stove may suffer burns or be scalded by hot liquids. In Greenland, the frequencies of accidents indoors and outdoors are about equivalent. Accidents at sea are most commonly fatal. Warming the water in shallow coves by separating these from the sea and thus exploiting the heat of the summer sun will encourage the population to learn to swim, and there may be fewer deaths by drowning as a result.

Alcohol plays a part in many accidents and there is a need to reduce its consumption.

### **Housing**

A serious hazard and cause of injury and death is fire in the home, the high frequency of which is associated with the poorly constructed housing. There are also many other housing problems. In general, houses used by the indigenous populations in high latitudes are poorly ventilated and overcrowded, and the associated conditions are major causes of the high morbidity and mortality rates from respiratory and enteric diseases. Studies of low-cost housing, including the possibilities of using locally available materials and the development of designs adapted to the climate and to the native culture need to be pursued. Particular attention needs to be paid to the foundation problems of construction in permafrost; other necessities are adequate heating and ventilation, with appropriate vapour seal barriers, and the provision of household sanitary facilities. It is also important to discourage the custom of sleeping on the floor.

## **MENTAL HEALTH**

### **Indirect stresses**

The psychological problems of the inhabitants of high latitudes appear to be in general similar to those found elsewhere. The specific environmental conditions impose indirect stresses such as cramped living conditions and isolation. There are, in addition, the current problems of rapid cultural change affecting the indigenous populations. Solutions to these problems have to be sought in the context of their particular setting, although experience from other situations may prove valuable.

### **Indigenous populations**

The present outline is concerned with psychological problems among northern indigenous populations that until recently have been ethnologically distinct and culturally remote from their adjacent national populations. Examples are the Lapps, the Eskimos, the Aleuts and the Indians of northern regions. For other indigenous northern populations that are not ethnologically distinct from the national population, such as those found in the northern regions of Norway, Sweden, Finland and the USSR, the study of mental health problems must be considered in terms of the general overall health service pertaining to the national population as a whole.

The effect on mental health of the long northern winter and the weeks or months of continual darkness is still a matter of controversy. A condition has been described under the name "psychosis arctica", which

appears to be a mixture of manic depression and features resembling schizophrenia. A possible etiological cause is the long winter night. During the winter, a condition known by the Lapps as Kaamos is said to occur. This is characterized by psychomotor inhibition and general passivity.

A more critical study of both these conditions is required before these terms can be accepted as describing definite clinical entities.

Although the introduction of new cultural values has inevitably produced anxieties and tensions, no increase of mental illness has been observed amongst the Eskimos, for example. In this period of change, it is important that attention be paid to the indigenous people to ensure that they do not become uprooted and lose their "identity".

The participation of trained indigenous people as teachers, nurses and general agents of cultural transmission is important in that such persons can facilitate the integration of the new and old cultural values. (See also section *The organization of health services in the Arctic*, page 11).

#### **Civil servants, settlers, seasonal workers, etc.**

The sudden change in environment can be disturbing for these people, who find themselves exposed not merely to fewer stimuli but to a new range of stimuli totally different from those experienced in their normal lives. This change can lead to desolation, despondency, a feeling of "arctic imprisonment", claustrophobia, apathy, depression, and even suicide. Conditions of overstrain can occur among seasonal workers, e.g., loggers. Uncertainty regarding the availability of obstetric care can be a source of anxiety to pregnant women of the non-indigenous population.

School programmes bringing together the children of new settlers and those of the indigenous population may facilitate cultural change.

It is of vital importance to recruit suitable personnel for civil service in the North; they should not have a history of mental disease, drug addiction or alcoholism, and they should have sufficient inner resources to overcome loneliness and to bear the monotony. Furthermore, for rest and reduction of tension where appropriate, rehabilitation leave might be provided for civil servants in addition to their statutory annual vacation. For seasonal workers like loggers, subject to long periods of great strain, periods of rest could be organized.

#### **Station personnel**

A considerable amount of research has been carried out on the psychological adaptation of personnel in small antarctic stations. Research findings from Argentina, Australia, Chile, France and the USA, for example, are in agreement as regards delineating (a) the general stresses of station life, (b) the characteristic responses and emotional states of

individuals and groups over the course of the antarctic year, (c) the general criteria of psychological adaptation.

The general stresses imposed upon a group of station personnel include the geographic and social isolation from parent cultures, the relative confinement to the physical boundaries of the station, the social boundaries prescribed by the station members, and the climatic conditions of coldness and extended periods of darkness and light. The response to these stresses varies according to the individual's own cultural pattern and also his national cultural pattern.

Responses and emotional states characteristically observed among station personnel from different countries are the following: (a) increased insomnia during the winter months, although this may be more qualitative than quantitative in nature when considered in terms of hours of sleep actually obtained; (b) an increased incidence of headaches during the winter months, which may be as much a function of the indoor lighting and gas fumes as of psychological origin; (c) an increased desire for privacy throughout the year; (d) a tendency to exaggerate experiences which in a normal environment might have gone unnoticed; (e) a tendency for aggressive feelings to be pent up, owing to knowledge of the disruptive outcome of overt aggression; release may be obtained through hard work, through forms of verbal interaction, and through other types of abreaction; (f) a tendency for group members to shut themselves off psychologically from the outside world during the winter months; (g) a tendency for group morale to be lowest during the mid-winter period; and (h) sexual deprivation, although this does not appear to be a problem having a disruptive influence on station life in so far as can be determined by manifest behaviour.

The criteria for adaptation upon which the various studies focus are work proficiency, industriousness, and social compatibility. There may be a level of work proficiency below which a man will not be accepted by his group members, regardless of how socially competent he might be. Above this level, however, social compatibility appears to be more closely related than work proficiency to overall acceptance of an individual by group members. More research on this particular problem is certainly warranted. It has been observed that an individual who isolates himself socially from the group can be well accepted so long as his work performance is adequate.

Preventive mental health measures include psychiatric and psychological advice in choosing personnel. Greater use might be made of interviewers who have had experience in Antarctica and who have participated in the selection of men for previous antarctic expeditions; in particular the techniques for the selection of leaders require further study. It has been indicated that accurate briefing and indoctrination of station personnel and their families about expedition life needs to be carried out before departure to the polar regions. The hazards should not be over- or under-

emphasized. Medical officers should be in a position to recognize and cope with mental disorders occurring in station personnel.

Leaders must be alerted to the importance of giving individual recognition for achievement. They should also be made aware of known psychological reactions to seasonal variations. Greater consideration might be given to the problems of recreation, such as the encouragement of various forms of competition or activities in which all group members can engage and release tension. Attention might be given to improving the ways in which communication can be established between the station members and their families or close friends: inter-station communication might also be encouraged. The effects of inclusion of female personnel may need to be studied. The possibility of taking wives should also be considered.

### PHYSIOLOGY

The influence of the polar climate upon the physiology of man has been the subject of scientific interest since the early days of polar explorations. The emphasis has been mainly on investigations on the effect of cold, and a considerable amount of information is available on this subject. Less information has been obtained on the influence of other physical factors characteristic of the polar climate. Information is almost completely lacking on the influence upon bodily (and mental) functions of the tremendous seasonal changes in the diurnal lightness/darkness patterns and in the amount of sunshine. The ecology of life in the Arctic may also affect bodily functions, playing as it does a determining role in the behaviour, the level of physical activity, and the general way of life of the inhabitants. Diet, nutrition and working capacity are all influenced, higher levels of physical activity tending to improve the efficiency of the physiological functions concerned.

In man, acclimatization to cold may occur through diminished heat loss achieved by increased thermal insulation and/or increased heat production. Fall in body temperature may also be part of an adaptive process, and it has been suggested that hormonal changes may be implicated too. Data on the problem of acclimatization have been obtained from studies on subjects exposed in climatic chambers and on persons long resident in cold climates, as well as from comparisons between the indigenous peoples of polar regions and other inhabitants staying for varying periods in these regions.

The sensitivity of extremities, such as fingers, when exposed to cold stress seems to diminish up to about 7-8 weeks. Such local acclimatization, which may involve the nervous system as well as vascular changes, may be of greater significance than general acclimatization. An increase in the thickness of subcutaneous fat, independent of physical activity and

food intake, has been found to occur in men residing at polar bases as part of polar expeditions. A reduction in the clothing worn has also been noticed as a result of prolonged periods in cold climates. There is no clear-cut difference between the basal metabolic rates (BMR) of populations indigenous to polar regions and temperate ones. Changes in BMR on exposure to cold have been found to vary in different populations and are inconclusive. On the other hand, decrease in shivering has been noticed as one of the possible mechanisms of adaptation to cold. It was noted, too, that there exists a rapid psychological type of cold acclimatization. On the whole, the relevant data obtained in various studies on man still remain meagre and equivocal.

The physical fitness of various groups of indigenous arctic peoples has been investigated by measuring maximum oxygen consumption during exhaustive muscular exercise on a bicycle ergometer. Observations made on Lapps showed that "aerobic capacity" increases with age in children, reaching a peak at about 20 years in boys and somewhat earlier in girls. In men, a gradual decrease in aerobic capacity was found up to 55 years, the maximum age studied. In women no decrease was detected up to 40 years of age. The average values for a small number of arctic Indians and Eskimos were lower than in Lapps of comparable age.

The aerobic capacity observed in adult male Lapps, Indians and Eskimos when compared with that of the Norwegian groups fell in between that found in athletes on the one hand and sedentary or industrial types of workers on the other. It appears that the northern populations have a somewhat higher state of physical fitness than their counterparts engaged in sedentary and industrial occupations.

Information was presented on food and nutrition in the Greenland region of the Arctic. The diet varies according to season; mealtimes are irregular, as also is the supply of food. Among the foodstuffs obtainable are a variety of fish, mammals and birds, fish eggs, and a few vegetables and berries. People in the arctic regions are still living to a considerable extent on domestic products; however, imported foods are being used in increasing amounts.

Opportunities for regular diet surveys are comparatively rare but a few detailed surveys of diets in Greenland were undertaken between 1937 and 1952. They revealed marked seasonal variation in food consumption with low intakes usually in the months between February and April. In earlier surveys it was found that nearly 90% of calories were derived from fresh seal and stored and fresh meat. Vegetables and local herbs were responsible for the remainder. Salt intake was low, especially in winter. Intakes of vitamins A and D were plentiful, whereas those of ascorbic acid were low in winter.

In more recent studies, considerable differences in foodstuffs used have been recorded between inhabitants of towns and trading posts. The

availability and hence consumption of fish and meat at trading posts was considerably higher than in towns. On the other hand, bread and flour consumption was higher in towns than at the trading posts. The results showed that whereas the intake of most nutrients was reasonably adequate, that of calcium and iron tended to be low. Flour imported into these regions is now enriched with calcium, thiamine, riboflavin and iron.

With regard to the question of nutritional requirements in the polar regions, it appears that the concept that the calorie requirement is temperature-dependent is not entirely valid because the inhabitants of polar regions avoid extreme cold. They are well protected by their clothing made of caribou fur and, apart from very brief periods of outdoor exposure during bad weather, spend on an average 1-4 hours daily outdoors in winter and about 5-9 hours during summer. This does not necessitate marked elevation of metabolism. Estimates of average energy requirements lie in the vicinity of 3000 calories per day. Careful diet surveys have shown that the average calorific value of food consumed by indigenous people in the polar regions is approximately the same as that for US military personnel in Alaska. The composition of diets of Eskimos and the US military personnel has also been studied. There is no indication that additional quantities of protein, fat or carbohydrates exert any favourable effect on human performance in cold climates. Although animal experiments indicate that thiamine and ascorbic acid requirements may increase in cold climates, no such indication is obtainable in man. In fact, there is evidence that man can get along for long periods on 15 mg of ascorbic acid per day without showing evidence of deficiency.

It was considered that general physiological changes in response to a cold environment may be small compared with factors such as experience, training and fitness. Life in cold climates does not ordinarily involve a nutritional stress.

Dietary studies of a total population of 1800 Indians and Eskimos living in 11 villages have been carried out in Alaska. These people buy part of their food in stores, 60% of the calories in their diet being derived from imported food. Local sources of food are moose and caribou meat, fish, seal and walrus, depending upon the situation of the village. Only 4% of calories are derived from fat obtained from local sources. Local berries and vegetables gathered in varying amounts serve as a principal source of ascorbic acid. Feeding practices and dietary habits vary only slightly. 60% of children below two years of age are not breast fed; most of them receive diluted canned milk. However, supplementary foods other than milk are introduced into the infant diet later than in the USA.

The calorie intake of older children and adults is lower than the usual standards, even after making a correction for body size. The average proportion of calories derived from fat in the diet is similar to that in the USA. However, at all ages calories derived from protein are high, varying from

19 to 30%. Comparatively little variation was observed in different seasons. Calcium and iron intakes were found to vary a great deal: when whole fish was eaten both could be high. The intake of vitamins varies in different seasons; in general, it is satisfactory, but very low values for ascorbic acid were observed in the winter months in certain villages.

Under the present conditions, it will probably not be possible for Indians and Eskimos to live entirely on foodstuffs locally secured. However, they must be encouraged to utilize such foodstuffs to the fullest extent. The impact of imported foods on dietary habits is likely to lead to a deterioration in nutrition and hence it is necessary to take steps to impart education in nutrition as a preventive measure.

Finally, attention is drawn to the possibility of contamination of foodstuffs of both animal and vegetable origin with radioactive isotopes.

## RESEARCH NEEDS

### Cultural studies

The first stage in any investigation of the health of indigenous people should be a complete study of their cultural values and cultural dynamics, including their attitudes towards health services. Such a study should greatly assist such people to make the difficult transition between traditional nomadic life and a technologically advanced culture.

### Mental health

#### *Indigenous populations*

The study of the culture of indigenous people will assist the work on the classification of mental diseases, as the interpretation of symptoms based on the concepts of other societies might be invalid.

#### *Station personnel*

In Antarctica mental health difficulties are probably the most important of all health problems. The research needs include the development of selection and screening techniques and their continuous validation. This requires an objective assessment of performance in the field.

Objective methods for the assessment of group interaction and leadership need to be developed and tested.

The progress to date in this field encourages the hope that a stage of useful application is approaching. This process would be accelerated by some standardization of tests between countries so as to increase the number of personnel under study. For this reason further close and

detailed collaboration by experts in this field within the near future seems indicated.

### **Physiology and nutrition**

Although much attention has been paid to the effects of cold on man, there are still many unresolved problems in this field. Studies of men in the very young and very old age groups, and of women in all age groups, are completely lacking. The relatively small number of healthy adult men who have been subjected to examination show changes which are difficult to interpret since major control studies have not been undertaken.

Although local acclimatization to cold seems clearly established, its nature and the mechanisms of control still need elucidation.

There exist only limited data on the work capacity of human subjects in the cold. A great deal more work should be done in this area while it is still possible to study indigenous populations who follow a nomadic culture.

Amongst many other physiological problems, the effect of seasonal changes in light intensity is one that may be of great importance, yet about which practically no data are available. Climatic variables, including the human micro-climate, require further study.

These studies necessitate large technical and scientific resources and must therefore be spread over several laboratories in different countries. International co-operation is thus essential for their prosecution.

Nutritional studies of indigenous populations should be carried out to investigate the effects upon health of the current changes in dietary patterns and habits, and the factors responsible for these changes.

Recommendations for nutrient requirements are often based upon fragmentary knowledge. Investigations relating the diet of arctic people to their state of health may throw additional light on this complex problem.

### **Environmental health**

The salient research need in environmental health is concerned with the further development of a good water supply, an objective complicated by the limited precipitation and the ease of contamination. Novel methods of putting the cold to work by freezing out salts and other contaminants might be investigated. Meriting attention are the development of appropriate materials, including flexible linings for reservoirs and storage tanks; the use of indigenous materials for water purification; and the use of waste products of fission to produce heat.

Concerning waste disposal, fruitful areas of research are likely to be the fate of waste materials in the snow and ice with particular reference to pathogenic organisms, and the ecology of oxidation ponds. Further

study of oxidation ponds as a source of food for domestic animals and as a source of transmission of infections by migrating birds should also be considered.

Detailed knowledge of the ecology of biting insects and of all relevant host-parasite relationships are necessary preliminaries to effective insect control.

#### **Epidemiology and special disease problems**

The problems facing northern indigenous populations are largely those of infectious disease. This requires an understanding of the epidemiology peculiar to this region, including the relative roles of water-borne, food-borne, and man-to-man transmission of disease. The possible effect of migration of the indigenous population to non-arctic areas should be studied. The relationship between environmental temperature and respiratory diseases merits further work.

#### **Organization of health services**

Although the well-established standard principles of public health organization are also valid for northern areas, their application is modified by geographical, political, logistic and other factors, not the least of which is the culture of the indigenous populations.

Under these conditions medical research is essential to provide a reliable basis for all public health work and medical care and to ensure the best organization of health services appropriate to the population.

The study of the epidemiology of non-infectious diseases could be encouraged to explain the pattern of morbidity and mortality statistics.

Finally, it may be noted that isolated communities and sterile areas can be of the greatest value as laboratories for research in many fields of human biology.

### **CONCLUSIONS**

1. The Conference concludes that there is urgent need to stimulate research in the several specific areas discussed, and suggests that WHO should explore effective ways and means to foster and support such research and to assemble and disseminate information on the status and progress of research on health problems in high latitudes.

2. The Conference, after a broad review and discussion of health problems in high latitudes, concludes that early attention should be focused on: (1) environmental health, with special regard to the development of fresh water resources, their protection from biological and chemical pollution, and satisfactory waste disposal; and (2) problems of mental health,

especially in relation to transient populations, including station personnel.

3. In view of the great influence of various meteorological factors on life in the Antarctic and Arctic, it is suggested that a study should be made of the present meteorological observation programmes in these regions to ensure that the elements of interest to research workers in medicine and public health are adequately covered, and that efforts should also be made to ensure that the resulting data are presented in a form that is convenient for these research workers. It is also suggested that the World Meteorological Organization be invited to collaborate in this study and in ensuring that the resulting recommendations are implemented by the responsible meteorological services.

4. The Conference notes with satisfaction the resolution of the Scientific Committee on Antarctic Research (SCAR) relating to co-operation with WHO in the development of medicine and public health in high latitudes.

5. The Conference concludes that WHO is the appropriate international body to encourage and facilitate the effective exchange of information between nations and between institutions concerned with research and investigations on health problems in high latitudes, and it urges WHO to explore practical means for such action.

6. The Conference concludes that it would be most useful if the more important papers and reports presented at the sessions were published as early and as fully as possible by WHO.

7. The Conference concludes that when sufficient new information on high-latitude health problems has come to hand a second conference of this kind would be most appropriate and beneficial and that it might concentrate on one or more specific topics.

8. Taking note of the success of this first conference as a much needed mechanism to exchange views, outline status and explore needs, the Conference invites the Director-General of WHO to continue by such means as he considers appropriate the study of the health problems in high latitudes.

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## Annex

## List of participants

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