GREENLAND

– a modern society

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CONTENTS

KNOWLEDGE CREATES UNDERSTANDING, INSIGHT AND CRITERIA

Greenland is a rapidly changing society. Just a few decades ago it was a simple hunting and fishing community; now, it is a modern consumer society. Its development is to some extent shaped by present-day trends within, for example, public health, environment, trade and industry, the labour market, education, social services and infrastructure.

The public debate sometimes bears signs of sharply opposed interests, and it can be difficult for outsiders to follow it. It is our intention with this publication, "Greenland – a modern society", to provide an introduction to the main problems facing Greenland today and thus give readers greater insight into the political debate.

Denmark and Greenland have long enjoyed good and constructive cooperation on a range of environmental projects. Since 1994, Denmark has focused particularly on Greenland as an element of its environmental assistance to the Arctic, and this has led to close environmental cooperation with the Home Rule Government of Greenland.

The aim of the Environmental Assistance to the Arctic is to protect, monitor and rehabilitate the Arctic environment. Through the supported projects, knowledge is being acquired that provides an important basis for the debate on sustainable development in Greenland.

Through its environmental assistance to the Arctic, Denmark is also involved in projects in Greenland with broader objectives than traditional environmental projects. These projects, their background and their importance to Greenland form the backbone of this publication, which offers 15 topical stories within the areas housing, energy and public health.

Both the Home Rule Government and the Danish Government hope that the publication will help to disseminate further knowledge about the discussions on sustainable development in Greenland – and will thus also lead to greater understanding of modern Greenland and the challenges facing it in the years ahead.

Minister for Environment
Hans Christian Schmidt

Home Rule Minister for Health and Environment
Edward Geisler

Finn Pedersen

INTRODUCTION

By the Danish Environmental Protection Agency

The publication "Greenland – a modern society – on housing, energy and public health" follows up on "The Danish-Greenlandic Environmental Cooperation – twelve stories about environmental projects in Greenland" published by the then Ministry of the Environment and Energy in 2001. The earlier publication described a number of projects in Greenland supported by Environmental Assistance to the Arctic, mainly concerning utilisation of Greenland's flora and fauna and environmental protection. This led naturally on to the idea of also describing a number of supported projects within other sectors – projects that to a greater extent concerned modern Greenland society, but with particular focus on housing and the supply side.

The Environmental Protection Agency therefore asked the author of the first publication, environment journalist Hans Pedersen, to write another, but with a different focus. In addition, Rasmus Ole Rasmussen, Senior Lecturer at Roskilde University Centre, has written an article on sustainable sheep farming in south Greenland, which is included since the theme of the publication is precisely sustainable development – in housing, the supply sector and public health. The various articles therefore necessarily cover broader issues than can be directly related to individual supported projects, and there is also necessarily some degree of personal interpretation and evaluation by the authors.

Therefore, besides providing information about Greenland's modern society in a fine and inspiring way, the publication must inevitably be seen as a contribution to the public debate on current trends in Greenland. It is not intended as such, but if it leads to reflection and to a feeling of suddenly having learnt something new about Greenland, it will definitely have achieved its aim. There is a pressing need in Denmark for knowledge about modern Greenland and the rapid development Greenland society is undergoing. The publication is also being translated into Greenlandic and will be widely distributed in Greenland, so that people can see what is written about the rapidly changing society of which they are a part.

WHAT IS SUSTAINABLE DEVELOPMENT IN THE ARCTIC?

The sustainability concept normally covers three dimensions: economic and social development, and protection of the environment. That is how the concept is used in the Danish and Nordic work on the development of national strategies for sustainable development.

In the Arctic, however, there is a desire for a special, fourth dimension. In the description of its Sustainable Development Programme, the Arctic Council states that objectives must:

" … advance .. opportunities to protect and enhance the environment and the economy, culture and health of indigenous communities ….". The Arctic Council has thus broadened the concept of sustainable development by including protection and enhancement of the culture of Arctic communities in the concept of sustainable development.

Culture is related to welfare, and welfare is in turn related to the individual's control of resources in the broad sense of the word (education, work, hunting and fishing, politics, etc.). The fundamental political thinking is that lack of access to social benefits – that is benefits normally available in the Nordic welfare societies – should not necessarily be interpreted as a low level of welfare in small, isolated communities. Furthermore, the concept "traditional knowledge" is a prominent element of the Arctic perception of welfare and is thus of importance both for the social dimension and for protection of the environment and nature conservation.

New and old meet everywhere in Greenland

The discussions on the concept of sustainable development in the Arctic have mainly concerned the management of natural resources, or lack of management; trade barriers; public health (including social diseases) and education; and broad agreement on the precise meaning of the concept seems to be lacking. However, no one disputes the need to include human activity and to assign relatively great weight to it. Human activity includes political and economic systems, cultural factors and technological development.

Sustainability in the Arctic is therefore not simply a question of adjusting the political and economic structures or rules of Arctic societies in the direction of a future sustainable development in different sectors of society. It is also necessary to include living conditions, informal groupings in the population, political and demographic resources for change, and attitudes, values and welfare priorities in the population. Here, however, the Arctic peoples and the Arctic societies in the USA and Canada, Northern Europe and Siberia are very different and have very different starting points.

It can be said that the sustainability concept in the Arctic includes a special human dimension, since the inhabitants of the Arctic are a vital resource that is undergoing rapid development generated by lifestyle and technological pressures from outside. Things are moving very fast, and the Arctic peoples must today live with the values and conditions of life of both the past and the future. They are both fishermen/hunters and wage earners. The economy is a mixed economy of cash and kind. Culture and attitudes are mixed and to some extent generationally determined.

Greenland's first and so far only traffic lights – in the centre of Nuuk

The social relationships and changes must be brought into the sustainability discussions in a way that makes the discussions appear relevant to inhabitants and politicians in the Arctic. However, that demands an interest among the Arctic societies in understanding and influencing the trend of events, not only on their own lifestyle premises and on the basis of their own perception of culture, but also in a wider context. There must be willingness to accept change at the local level as well.

Change demands common economic, cultural and political awareness in relation to individual behaviour and mutual responsibility. In the sustainability concept in the Arctic great importance is thereby attached to the individual and his responsibility for himself and his neighbour because, in the Arctic societies, the individual bears a heavy responsibility.

Lifestyle studies show that it is difficult to transfer the Scandinavian model uncritically to Arctic societies, including Greenland. The Scandinavian model is based on a number of assumptions concerning social and economic homogeneity, parallel industrial development, and a common cultural and historical profile that do not apply in the Arctic. In parts of Greenland, the Greenlandic population has a relatively low score on such traditional indicators as education, income, quality of housing and social services, but even so, inhabitants and politicians fight for the right to live in peripheral districts in Greenland. There are thus other things that count and that must be included in a fruitful discussion of sustainability, since it is the population that ultimately manages resources and is thus responsible for over-consumption or under-consumption.

ENVIRONMENTAL ASSISTANCE TO THE ARCTIC

Environmental Assistance to the Arctic was established in 1994 as a consequence of Denmark's accession to the Arctic Environmental Protection Strategy (AEPS), entered into by the eight Arctic countries with the adoption of the Rovaniemi Declaration in 1991. The reason for this was that although the Arctic has practically no sources of pollution, the region and its peoples receive and are affected by chemical pollutants that are discharged in the industrialised countries and carried to the region by wind and sea currents. Since then, the Arctic countries have adopted a number of other declarations that together form the political basis for Environmental Assistance to the Arctic.

Environmental Assistance to the Arctic is thus the economic basis for the Realm's international environmental cooperation on the Arctic and also enables solution of the special environmental problems that could not be foreseen at the time the Act on Home Rule for Greenland was passed. Under the Home Rule scheme, the Realm, i.e. Denmark, is also responsible for international agreements on trans-frontier pollution and pollution of the sea and air outside the 3-mile limit. The action is also an element of Denmark's follow-up to the Rio Declaration from 1992 on environment and development.

One of the main purposes of the AEPS is to provide the Arctic governments with scientifically based advice on necessary measures to improve the state of the environment in the Arctic. The scientific evidence is mainly procured through a joint Arctic Monitoring and Assessment Programme (AMAP), which each country is responsible for implementing in its Arctic region. Denmark is thus responsible for implementing AMAP in Greenland and the Faroe Islands. The activities include studies that cast light on the consequences of the critically high levels of environmental toxins for the populations of Greenland and the Faroe Islands. Owing to the geographical extent and the special logistical problems in the Arctic, studies in Greenland are relatively costly.

Environmental Assistance to the Arctic also constitutes the economic basis for continued strengthening of the scientific work going on in the environmental field at Danish research institutions and under Greenland's and the Faroe Islands' environmental administrations and, through that, to some extent also for the implementation of international agreements and obligations. Projects carried out up to the

Lars Moseholm

present time include the consequences of climate change and ozone depletion; mapping physical and biological conditions in the waters off west Greenland for use in connection with oil emergency planning; utilisation of the population's local knowledge in connection with the professional biological advisory services; and the importance of tourism and raw material extraction for nature and the development of society. The results help to ensure sustainable utilisation of Greenland's living resources, biodiversity and unique landscape and they provide a basis for strengthening Greenland's environmental legislation, public information, and education.

Fuel supply has always been a problem in Greenland. In particular, it has been difficult to solve the waste problem of empty oil drums from expeditions and exploration for mineral resources.

In accordance with the AEPS on protection and rehabilitation of the Arctic environment, regular activities are carried out to improve and conserve the local environment and foster environmental awareness and action in Greenland. These activities include developing technological solutions to specific environmental problems in Greenland, including waste management and ensuring clean drinking water, developing environmental standards for the oil and mining industry, mapping things left behind after earlier exploration for mineral resources, military activities, expeditions, etc., and clarifying and incorporating Greenlandic

Finn Pedersen

How can one ensure sustainable use of Greenland's unique nature?

factors in the preparation and implementation of international agreements and conventions. The initiatives are usually in the nature of pilot or demonstration projects and can, for example, cover physical installations, information activities and administrative tools. They are practically oriented initiatives implementing joint declarations by the Home Rule Government and the Danish Government.

Ensuring sustainable development in Greenland is a long, tough task on which the Home Rule Government of Greenland and the Danish Ministry of the Environment are working in tandem.

Denmark's Environmental Assistance to the Arctic is administered by the Danish Environmental Protection Agency in consultation with the Advisory Committee for the Arctic, which is chaired by the former Member of Greenland's Cabinet (Landsstyret), Marianne Jensen. The Environmental Protection Agency also approves the sector programme for environmentally friendly, low-energy housing refurbishment in Greenland based on a government agreement with the Home Rule Government of Greenland from 1999. In accordance with the provisions of Finance Act, the Environmental Protection Agency evaluates the programme and its progress together with the Danish Energy Agency with a view to presentation to the Advisory Committee for the Arctic. The programme runs until the end of 2003.

Environmental Assistance to the Arctic thus provides grants for a wide range of activities that help to create a more sustainable development in the parts of the Realm that lie in the Arctic. The action is long-term and is based on close institutional cooperation between the Danish Ministry of the Environment and the Home Rule Governments in Greenland and the Faroe Islands. With this publication it is hoped that some of the results will reach a wide circle and will also be put in a broader context. In this connection, the Danish Environmental Protection Agency wishes to send special thanks to the people who have agreed to be interviewed for the publication.

Aqqalu Rosing-Asvid

Mads Fægteborg

COOPERATION ON MAJOR PROBLEMS

**The big building boom in the 1960s was not free of building defects, and there has been little systematic maintenance of housing stock and institutional buildings since then.
Now, a DKK 1.3 billion refurbishment programme has been launched with a view to promoting sustainable development and energy efficiency in the housing sector.**

In the middle of the 1990s, news of an outbreak of tuberculosis in a settlement shook Greenland's politicians. Investigations showed that the standard of Greenland's housing stock was shockingly low and that hygiene standards in the drinking water supply system and waste disposal left much to be desired. On that occasion, several members of the Greenlandic Parliament expressed the view that the local politicians had neglected their duty, and the Parliament and the Cabinet took steps to remedy the situation.

Just a few years later, however, Greenland's Premier added a far more serious economic problem to his agenda with the Danish Prime Minister. The Home Rule Government's analyses of the maintenance of buildings etc. revealed a catastrophic lack of maintenance that required immediate action. The question was, how exactly the matter should be handled, what it would cost and who should and could pay for it.

On 12 May 1998, it was agreed between the Danish Government and the Home Rule Government of Greenland that, at the request of the Home Rule Government, the Danish Government would provide technical and scientific assistance with a view to mapping the need for refurbishment and that the discussions on the question of refurbishment should continue.

As always with political decisions, a committee was appointed – the so-called Coordination Committee, with representatives of the Danish Government, the Home Rule Government and Greenland's National Association of Local Authorities (KANUKOKA). Working in cooperation with affected authorities and institutions, the Coordination Committee was to establish a professionally sound basis for the Home Rule Government's further work on the refurbishment project, which would also form the basis for the continuing discussions between the Danish Government and the Home Rule Government on how the big refurbishment project was to be tackled and financed.

The Committee worked fast – after just one year it delivered a report summarising the problems from the building boom in the post-war years, particularly in the period from 1960 to 1980. The Danish Government was already familiar with some of the problems from a similar building boom in many other places in Denmark. On top of that came documentation of a lack of maintenance and a lack of new investment in the electricity supply system and the drinking water supply system.

The report concluded that a complete refurbishment programme was needed and that this would cost around DKK 4 billion.

HOW COULD THINGS HAVE GONE SO WRONG?

DKK 4,000,000,000 is a lot of money, and the fact that it has got to be used to pay off a kind of debt – to make up for the lack of normal maintenance, old building damage and necessary reinvestment in water pipes and power stations – does not make the figure look any smaller. Besides that, a large part of the bill will basically have to be paid by about just 15,000 households or families. It is therefore natural to ask how things could have gone so wrong.

To answer that question in the year 2002

Modern industrialised building methods are efficient because of the repetition factor, but in the event of shoddy building, there is a risk of defects also being repeated.

It is a long way from the settlements to the building tradesmen that have the job of maintaining the houses.

we have to go fifty years back in time. In many parts of the world the 1950s were a time of reconstruction and the setting of new goals for society. This also applied to Denmark and Greenland. In Greenland, one of the goals was to combat tuberculosis with its catastrophically high mortality, and another was to improve the country's housing stock. These two goals supplemented each other because it was well established that better housing and more space reduced the risk of tuberculosis infection.

Intensive action was taken on the housing front from the mid-1960s onwards, and from 1965 to 1985, the number of dwellings in Greenland doubled – from around 7,500 to 15,000. At the same time, the number of new cases of tuberculosis fell dramatically and the

proportion of deaths from tuberculosis fell to 2% in 1979. At the same time, the general health of the population improved, and the size of the population increased by 33% from 1960 to 1970.

The measures to provide better housing and improve public health were thus highly successful, but success brought a need for even more homes.

MODERN INDUSTRIALISED BUILDING METHODS

One might wonder how it was possible at all not only to provide all this new housing, but also to supply the new homes with electricity and drinking water. The answer lies in the technological development in the building industry at that time. Precisely in that period, industrialised building culminated in Denmark and in many other parts of the world as well. Housing construction at that time was symbolised by large, completely identical blocks of flats with balcony access, made of prefabricated concrete components lifted into place and assembled by large building cranes. In the building industry, importance was attached to the repetitive element, but also to new ways of reducing construction costs – in connection, for example, with choice of building materials and methods of construction. In both Denmark and Greenland this resulted in the use of new materials and methods that did not keep their promise and that later became weaknesses that developed into building defects.

The industrial uniformity and the repetitive element unfortunately resulted in the introduction of an appallingly large number of defective materials and new, untested building methods. On top of these technical building defects came what we today call shoddy building, which was undoubtedly the rule rather than the exception because of the extremely fast building tempo.

It was thus the success of industrialised building technology that laid the foundation of the present need for refurbishment.

DETERIORATION OF HOUSING THROUGH WEAR AND TEAR

Buildings in Greenland suffer from the same basic defects as buildings in Denmark and Europe, but the wear and tear to which they are subjected and the maintenance they receive have undoubtedly differed.

The wear and tear on a dwelling are inextricably related to the number of occupants and the effects of wind and weather. In Greenland, both have been very different from elsewhere in Denmark. Besides that, there is

Aqqalu Rosing-Asvid

Mads Fægteborg

the question of whether the dwellings have been designed to meet the occupants' needs.

There is a difference between "urban dwellers" and "rural dwellers". It lies, for example, in both occupation and housing needs. Farmers and fishermen need single-family detached houses with plenty of "yard space". Unfortunately, a large proportion of the hunting and fishing population in Greenland have moved into "town" – into small flats that are neither large enough nor designed to cope with the job of a fisherman or farmer, and that are therefore often subjected to extraordinary wear and tear.

The average size of dwellings in Greenland is smaller than in the rest of Denmark. In 1960, there were almost three times as many occupants per room as in the rest of Denmark, and in 1990, there were still over 50 per cent more occupants per room in Greenland. Even today, the average home in Greenland is about 40% smaller than the average Danish home. All else being equal, the far more intensive use of homes means greater wear and tear – a well-known phenomenon in any housing association.

One last factor that makes the housing problem in Greenland different from the warmer part of the Realm is, of course, the weather. Not that there are not similarities, for there are: in large parts of Greenland, as in southern Denmark, the weather is characterised by frequent changes in temperature and by rain and wind. That has a wearing effect on dwellings. Besides this, however, there is the special Arctic climate, with rapid falls in temperature down to heavy frost. These changes can quite literally cause frost cracks in any building that has not been designed and built for the prevailing climatic conditions.

REGULAR MAINTENANCE OR MAJOR REFURBISHMENT

With so many factors leading to increased wear and tear on buildings in Greenland, one would think that Greenland had a tradition for intensive and systematic maintenance of its housing stock. Unfortunately, this is not the case – quite the reverse.

One unfortunate result of the immense changes in Greenlandic society and in the pattern of settlement was that the individual occupant paid almost no attention to the maintenance problem. Moreover, the individual tenant had no influence on maintenance and no financial incentive to carry out any maintenance.

At the same time, during that entire period, there was a constant need for new housing, which meant that the Danish Government and, later, the Home Rule Government paid little attention to the way the housing stock was operated or to the lack of maintenance. The lack of attention paid to these basic operating factors on both sides inevitably led to an immense backlog of refurbishment work.

Towards the end of the 1980s, the wear and tear of homes built before 1975 was so serious that the Home Rule Government initiated an analysis of the need for refurbishment of its rental housing stock. The analysis ended in 1992, but its first phase alone led to initiation of the most urgent repair work, and at the end of 1991, the Greenlandic Parliament adopted a refurbishment programme costing DKK 1.3 billion.

It turned out that neither the programme nor the amount set aside for it was sufficient.

SECTOR PROGRAMME – AN AGREEMENT WITH OBLIGATIONS

In light of the considerable cost of a proper refurbishment programme, the Danish Government, in a joint declaration with Greenland's Cabinet on 2 June 1999, undertook to provide financial assistance for an extraordinary refurbishment programme.

In the Finance Act for the year 2000, the Folketing (the Danish Parliament) defined the assistance and granted DKK 50 million per year for a four-year period for a sector programme for environmentally sound, energy-efficient housing refurbishment in Greenland. As an innovation in the cooperation within the Realm, the Danish Government's grant to the Home Rule Government was earmarked and certain conditions were attached to it.

One of the main conditions for the DKK 50 million grant is that the Home Rule Govern-

Mads Fægteborg

ment itself uses between DKK 200 and DKK 275 million per year on the refurbishment programme. At the same time, the Home Rule Government is required to draw up a complete sector programme for the refurbishment of housing stock, institutional buildings and supply systems.

The sector programme idea implies a requirement of involvement of all affected sectors in the project – working across the affected sectors, including the environment sector. The overarching aim is to ensure a sustainable process, and as a check on the process, the Finance Act includes a requirement that the programme be presented to the Advisory Committee for the Arctic and approved by the Danish Ministry of the Environment. In addition, at some time, the realisation of the entire programme must be evaluated externally.

The programme is now entering its third year. The Home Rule Government has had to cope with a major organisational task, consisting in defining the various forms of refurbishment, including bathrooms, new thermal glazing and better insulation, heat regulation, water meters, renovation of drinking water pipes, and conversion of old power stations into small combined heat and power plants, with use of the residual heat in the local district heating network. And this could be the easiest part of the task, despite the great technical challenges.

The fact is that the idea of future sustainability means that attention has to be paid to such questions as training programmes for the necessary manpower. Strange as it may sound, the use of prefabrication and the lack of maintenance for many years have resulted in a shortage of qualified manpower – or, without mincing words – to a shortage of good building tradesmen that master the difficult art of remedying the sins committed by others. Then come such formal questions as how homes are to be insulated, wet rooms renovated, new drinking water pipes established, etc. This should not be taken to mean that there are no building regulations or other rules for this – for there are. Greenland is in many ways as closely regulated a society as the rest of Denmark, but a DKK 4 billion refurbishment programme in a small society obviously needs careful consideration – and so, for instance, does the question of how best to incorporate environmental and energy thinking in the choice of materials and methods.

Mads Fægteborg

Is this a block of flats from Sønderborg in Denmark or Nuuk in Greenland?

In the Finance Act, the Folketing has also provided for funds to be used for future sustainable development of the affected sectors and sound environmental implementation of the refurbishment programme. The Home Rule Government has made good use of this provision for a number of initiatives, including a revision of the building regulations, improvement of the planning basis for drinking-water and energy supply systems, better control instruments for the various contracts to ensure the introduction of environmental management in the firms involved in the project, and better training programmes for coming building tradesmen.

All in all it must be said that, with this four-year sector programme, the Danish Government and the Home Rule Government have taken a number of important new initiatives to tackle a major challenge.

The future will show whether the initiatives chosen are sufficient and the right ones.

During the big building boom in the 1960s, the aim was to build as many homes as possible as quickly as possibly – and preferably to build them well enough to minimise maintenance.

THE SINS OF THE PAST

The Danish Government and the Home Rule Government of Greenland have granted funds for extraordinary refurbishment of housing stock and institutional buildings in Greenland. It is a condition of the grant that the refurbishment be environmentally friendly. Some of the money will therefore be devoted to energy-saving measures. Such measures will not only benefit the Arctic environment but will also result in lower heating bills for the people of Greenland. Another condition is that the refurbishment programme be followed by planned maintenance.

The reason why buildings in Greenland are in such a miserable condition today is an ugly mixture of the ravages of wind and weather, shoddy building, tough use, a style of building that often takes no account of local Greenlandic conditions, and – last but not least – poor maintenance.

In this chapter we look at maintenance. Many of the buildings are in such an awful condition that it is not enough just to earmark some of the rent for general maintenance. Extraordinary action is needed.

The all too clear evidence of the sins of the past has given rise to gigantic task that consists of two elements: refurbishment of housing stock and institutional buildings; and planning future refurbishment.

NEW TIMES – NEW NEEDS

But what will refurbishment mean in practice? And is it always right to refurbish a building?

Let us take an example: If part of the school in Uummannaq is a wooden hut from 1945 that is obviously in great need of renovation, it should obviously not be reinstated in its original form. It would be simple common sense to demolish the building and replace it with a modern one – mainly because school life has changed fundamentally since 1945. There is no need for small classrooms connected by a long corridor. Life in today's schools is entirely different, so this refurbishment project involves far more than just tightening windows and repairing doors. As with the schools, so also with nursing homes, local government offices, and kindergartens. New times bring new needs.

One of the main problems is therefore to find out from which sources the money for the obviously essential projects is going to come.

MAPPING THE NEED FOR REFURBISHMENT

Prior to the agreement between the Danish Government and the Greenlandic Cabinet (see box), a mapping exercise was carried out to determine the need for refurbishment. This task was taken care of by a Coordinating Committee with participants from the Danish Government, the Home Rule Government and Greenland's National Association of Local Authorities (KANUKOKA). The Committee's final report includes the statement that:

"(…) there is no doubt that more thermal energy than necessary is used in large parts of Greenland's building stock."

About 85% of all energy consumption in Greenland is used for heating homes and institutions. In this area there will be great possibilities for improving energy efficiency. Bringing the thermal insulation of buildings up to present-day standards will reduce the cost of heating buildings. This will benefit both the people of Greenland and the Arctic environment.

INI

How could such a situation have arisen? Why have the buildings not been repaired and refurbished year by year? Have funds not been set aside for such maintenance as in any normal housing association? The answer to these questions can be seen in the joint declaration between the Danish Government and the

Refurbishment is intended to make homes healthier and more energy-efficient.

Greenlandic Cabinet: "The housing stock has suffered from poor maintenance. One of the reasons for this is that new building has been given priority over maintenance because of the very big need for housing." Let us look at that again. Greenland's politicians have decided to build housing because of a big, acute need for homes. Money has therefore not been available for the necessary maintenance of the existing housing stock. INI (Inissiaatileqatigiiffik Ini), a limited company responsible for managing the publicly owned housing stock, agrees with this evaluation. Construction Manager Jesper Johannesen puts it like this: "The reason for this situation is insufficient planned and systematic maintenance over the years. And no money was set aside for this before 1995. In that year, INI took over the management and operation of most of the rental housing stock. For this housing, money is set aside for planned maintenance and is now being used for preventive maintenance work.

Extract from "Declaration between the (Danish) Government and the Greenlandic Cabinet on Extraordinary Building Refurbishment":

(…) there is a considerable, extraordinary need for refurbishment in Greenland, due in part to building damage and lack of maintenance.(…)
On that basis agreement has been reached on the following:

- The Danish Government is prepared to increase the annual grants within the Arctic part of the Environment, Peace and Stability Fund by DKK 50 million with a view to a sector programme to co-fund environmentally friendly and energy-efficient refurbishment projects. A proposal on this will be included in the Budget for the year 2000, including the budget estimate for 2001-2003. The grants will be transferred to the Home Rule Government in accordance with the sector programme.
- The parties ascertain that the Home Rule Government of Greenland intends to spend more than DKK 275 million a year on refurbishment projects, reinvestments, increased training and increased maintenance in the years 2000-2003. Of that sum the Home Rule Government intends to spend at least DKK 200 million per year on actual refurbishment and deposit this amount in a refurbishment fund.(...)

2 June 1999

For the Danish Government	For the Greenlandic Cabinet
Mogens Lykketoft	Jonathan Motzfeldt
	Josef Motzfeldt

The agreement between the Danish Government and the Home Rule Government was thus signed long ago. Binding contracts to a total value of DKK 674 million were prepared for the years 2000 and 2001. Of these, contracts amounting to DKK 106 million are described as "environmentally friendly and improving energy efficiency". Although there are as yet no builders and carpenters to be seen at work on scaffolding, the refurbishment projects have been agreed, grants made for them, and the projects are now being planned.

"THE COUNTRY SHALL BE FOUNDED ON LAWS"

Greenland's housing legislation states that money must be set aside for maintenance and for refurbishment when the time comes for that. Despite this, the necessary refurbishment has fallen further and further behind, which is the reason for the agreement signed by Mogens Lykketoft and Jonathan Motzfeldt (see box).

In Sisimiut, a pilot refurbishment project covering two blocks of flats has been completed. "It has nothing at all to do with refurbishment," says Ole Rud, Director of the Employers' Association of Greenland (Kalaallit Nunaanni Sulisitsisut Peqatigiifiiat). "These are high-quality improvements. Money for this is simply not available."

There is much to indicate that from now on the grants will be used for two things: the building envelope (facade cladding with insulation) and wet rooms. The outer body of houses must be sealed tight, and the bathrooms must be sealed using modern wet-room treatment. This is all that can be done for the money available.

This is at any rate the conclusion reached by a three-man committee, the Building & Construction Committee, appointed by the Greenlandic Cabinet. The tough job facing the Committee was to decide what could actually be called refurbishment and what the Danish Government and the Home Rule Government had granted money for. The group of investigators consists of three very experienced people. One of them has worked in the central administration since Greenland's Technical

Organisation (GTO) reigned supreme in the building and construction sector; one has been an employee of the Employers' Association of Greenland for many years, and the third is a representative of one of the firms of consulting engineers that have always been needed on building projects in Greenland.

In the autumn of 2001, the Building & Construction Committee presented a draft circular. The circular has been thoroughly discussed with INI. It proposes deciding between refurbishment and rebuilding. If this is not done, it will never be possible to get rid of the existing backlog of refurbishment work.

RETURN OF REFURBISHMENT

Buildings do not last for ever. The big question is whether today's situation will return halfway through the projected lifespan of the present housing. Ever since 1994, legislation has laid down that rents must be composed in such a way that each dwelling is checked, maintenance plans are drawn up and money is set aside every single year. However the

It is easier to keep heating costs down in a block of flats than in a detached house.

Mads Fægteborg

The trend within modern housing construction, infrastructure and communication is the same in Greenland as in Denmark.

Finn Pedersen

dwellings have never been completely registered, so no one knows the full extent of Greenland's housing stock, and a report on the condition of all dwellings in Greenland that had been prepared as long ago as 1986 had been shelved. A plan could therefore not be drawn up for maintenance because no one had actually been out and looked at the dwellings at that time.

Ole Rud is optimistic. He says, "Together with the sector programme we have now got the housing stock registered, and the management at INI is completely au fait with the situation, so I think things will be OK in the future and that we will be able to get rents fixed in accordance with the legislation and money regularly being set aside for annual maintenance."

Finn Pedersen

THE BUILDER FROM NUUK

Building refurbishment in Greenland cannot avoid coming up against a number of problems. Some of them can be solved in advance through thorough planning and by accepting a lengthy building phase.

Søren Rom Poulsen has been a builder, first in Qasigiannguit (Christianshåb) and now in Nuuk (Godthåb), since the 1960s. He, like all Greenland's other building tradesmen, has just been on a course to equip him to bid for coming building refurbishment assignments in Greenland. Most of the assignments will concern blocks of flats from the 1950s to the 1980s. However, schools and other institutional buildings are also in a state of decay. The main forms of refurbishment will be improved insulation, new windows, and new bathrooms.

As a tradesman, the builder from Nuuk realises that it may be extremely difficult to decide what should be refurbished and what ought really to be modernised.

"It is going to be difficult to separate the two things," says Søren Rom Poulsen. "It will

be necessary to make some kind of schedule distinguishing between refurbishment and modernisation – in other words, anticipate cases of doubt."

He also thinks there may well be some delicate battles ahead about causes – poor maintenance, shoddy workmanship, hard-handed use, etc. In many cases, the full extent of the damage will only become clear after the refurbishment work has started.

"There has been some shoddy building – no doubt about that! And we have naturally also seen cases of lack of maintenance."

SHODDY WORK AND BUILDING STOP

"Does that mean," I ask, "that you as a builder risk having to stop work in the middle of a refurbishment job to get a decision on whether the job is refurbishment or whether some parts of the building have to be rebuilt? Just as when builders come across the remains of a building from Hans Egede and Gertrud Rask's time during excavation work, and the work has to stop because archaeologists have to be called in?"

Søren Rom Poulsen replies, "That kind of situation will undoubtedly arise many times during the coming refurbishment programme. Those bridges will have to be crossed as they arise, on the spot by the supervision – architects and engineers. It is they who are responsible to the client."

Asked whether there are going to be enough qualified building tradesmen, Søren Rom Poulsen says that this depends on the rate of building refurbishment, and whether the Home Rule Government is thinking particularly about the Greenlandic part of the labour force and willing to ensure stable work for many years to come. A proper plan and proper management would be good for Greenlandic society and for employees, and would make it possible to attract apprentices to the building trades. One of the biggest problems in Greenland is that there are too few apprentices within the building sector.

If a building gang comes up from Denmark, the men will usually want to earn some money in a hurry so they will be interested in as many hours of work as possible. That is not what the Greenlandic part of the labour force wants. What they want is not hectic periods of work, usually in the summertime, but stable work over a long period of time.

Thomas Bjørneboe Gomez Berg

AS IN DENMARK, SO IN GREENLAND

"Those buildings," I say, pointing over my shoulder to some blocks of flats in the centre of Nuuk, "are modular buildings as we know them from provincial towns in Denmark. Have any of the buildings been built specifically for conditions in Greenland?"

"No," says the builder from Nuuk. "The old blocks of flats were built at a time when Greenland's Technical Organisation (GTO) was in charge of building projects, together with Danish architects. Those flats could just as well lie in Skanderborg. And the dwellings in Qasigiannguit were not built for Greenlandic hunters. They were not designed for dragging a seal in and onto the kitchen floor!"

It is difficult to determine whether the Arctic climate erodes or preserves buildings in Greenland. There are opposing factors. However, nothing can be done about the weather except taking the elementary precaution of siting buildings in the best possible place for them. A building envelope that is perfectly adapted to Arctic conditions must await an architectural competition and in-situ testing.

ENERGY IN GREENLAND

By investing heavily in hydropower, Greenland is finding it far easier than Denmark to reduce its carbon dioxide emissions.

"For environmental, economic and social reasons, future development within the energy sector should be based on sustainability principles without impairing the conditions of life of future generations." The vision on which Greenland's energy plan for the period up to the year 2020 is based could not have been formulated more elegantly. And Greenland's ambitions go further still: "In an energy planning context, this means that as much energy production as possible must be based on renewable forms of energy."
What that means in Greenland can be put very briefly: oil consumption must be reduced, mainly by means of hydropower.

NO WIND TURBINES IN GREENLAND

But first a few words about other potential forms of energy. From the start of modern energy planning in Greenland it was investigated whether wind turbines were an option. The consulting firm NIRAS, in cooperation with RAMBØLL, PA Energy, Risø National Laboratory, and P.A. Pedersen, took on the task of staking out the basis for future energy planning in Greenland. The project was financed by Dancea. On the face of it, it seemed obvious to transfer the Danish experience with wind power and establish wind farms in Greenland. There are some fundamental advantages to erecting wind turbines in Greenland, compared with Denmark. One of the most costly items when erecting a wind turbine in Denmark is the foundation. That costs almost nothing in Greenland if the turbine can be bolted into the bedrock. There are other advantages as well – for example, the physical difference that the density of cold air is greater than that of warmer air, so, in principle, more energy can be obtained from the wind in the Arctic.

However, wind turbines are only used in certain parts of the world, largely in areas with prevailing westerly winds, i.e. around the middlemost latitudes. Wind turbine trials carried out outside that zone have not been successful. For that reason alone, it is difficult to imagine that wind power could be a viable solution in Greenland.

Another factor is that the wind in Greenland varies greatly locally, depending on fjord systems and mountains. For that reason, it can be very difficult in practice to calculate where a wind turbine should be sited. Purely for this reason, studies to determine the siting are very costly.

A third factor is the construction itself.

The dam at Greenland's first hydroelectric plant – Buksefjord Power Station. This hydroelectric plant supplies electricity to Nuuk.

Jørgen Raa Andersen

Here, as with all other construction works in Greenland, the cost of transport is important.

A fourth factor is that it is technically difficult to get a wind turbine to operate in tandem with the rest of the electricity supply system in a very small community.

Despite all this, the consultants have investigated the possibilities for introducing wind power in Greenland's energy system extremely thoroughly, even contacting the test station for small wind turbines at the Risø laboratory. The test station has carried out some wind turbine tests on the Cape Verde Islands off the west coast of Africa. The documentation for these tests shows that only half of the wind turbines are working. Henrik Mai, NIRAS's project manager on the task of mapping the renewable energy sources for the Home Rule Government of Greenland, says, "It is therefore my recommendation to the Home Rule Government that we do not carry out any tests on introducing wind power in Greenland. Interconnecting wind power plants and other energy sources in isolated communities must be shown to work in other places before they are considered in Greenland."

This conclusion has shocked people who thought that it was a sensible idea, but as Henrik Mai says, why should wind turbines be viable in Greenland when they are not always financially viable elsewhere in the world? By financially viable, Henrik Mai means in comparison with what society otherwise has to pay for the energy.

According to Henrik Mai, Denmark has an entirely different reason for investing so heavily in wind power. In connection with the ratification of the Kyoto Protocol, Denmark does not have many other options. But Greenland does because it has some far more effective renewable energy sources.

SOLAR ENERGY

Henrik Mai also gives the thumbs down to the use of solar energy – at least for heating utility water. Greenland has the same number of hours of sunshine as Denmark, and solar heat is a simple technology, so on the face of it, this form of energy might appear very promising. However, as in the case of all other low technologies, transport costs are a weighty consideration.

As far as concerns using the sun to supply energy to solar cells, i.e. for production of electricity, Greenland, like the rest of the world, is waiting for the development of financially viable production of solar cells.

Solar cells are high technology but have the advantage that they do not weigh very much. So transport costs are not such a weighty consideration in connection with the establishment of solar cell installations. This is one reason why, strange as it may sound, Greenland today has the highest per capita use of solar cells in the world. Even so, however, total production from these solar cells is minimal.

FROM PRECIPITATION TO ELECTRICITY

Denmark, like many other western European countries, has a big problem in fulfilling its international obligations under the Kyoto Protocol. To reduce its CO_2 emissions, Denmark is investing heavily in wind power. While Denmark has difficulty in fulfilling the CO_2 quotas allocated to it, Greenland can reduce its CO_2 emissions far more easily by introducing hydropower.

So far, only one hydroelectric plant has been built there - Buksefjord Power Station. This hydroelectric plant supplies electricity to Nuuk. A decision has also been made to build a hydroelectric plant to supply Tasiilaq with light and power, and similar projects are being studied in connection with the towns Narsaq, Sisimiut and Qaqortoq.

Hydropower offers many advantages. It is a very old, very well tested energy technology. Hydroelectric plants can be designed for all sizes of community in Greenland. Unfortunately, however, the biggest possibilities for using hydropower lie far from inhabited areas.

Compared with present-day diesel power plants, hydroelectric power stations are far more costly to build, but far less costly to operate and maintain.

Since there are usually big fluctuations in electricity consumption throughout the year, it must be possible to tap the water behind the

Compared with present-day diesel power plants, hydroelectric power stations are far more costly to build, but far less costly to operate and maintain.

Henrik Højmark Thomsen

power station dam in step with consumption. However, since it is anyway necessary to have diesel power plants for emergency supply purposes, the plants can also be used during periods of extreme drought.

The determining fact is, of course, the trend in electricity consumption. Consumption is rising in Greenland, just as it is in Denmark. If that continues, every hydroelectric power station will at some point become too small unless there is a possibility of enlarging it.

SAVING ENERGY

It is, of course, wrong to start with the supply side. It would be far better, and more sensible, to start by finding out how the demand for energy can be reduced. The lower the demand for energy, the easier it is to meet it.

Both electricity consumption and heat consumption can be greatly reduced without affecting people's comfort in their homes. In 1993 a number of energy-saving measures were carried out in Block 10 in Nuuk. Many of the measures were very simple – they included replacing weather stripping, repairing joints, installing thermostats on radiators, and adjusting the heating system. This resulted in a reduction of no less than 25% in heat consumption in the block.

In addition to this, there are savings in households and – perhaps most profitable – changes in behaviour. There has never been an energy-saving campaign in Greenland. In the report to the Home Rule Government, RAMBØLL recommends looking into the effect on heat consumption of introducing heat meters in different types of property.

New building regulations are at present being prepared for Greenland. If they follow the Danish regulations, they will include a requirement concerning thicker insulation. This would reduce the need for heating, but the insulating material itself costs twice as much in Greenland as in Denmark because of the transport costs.

However, there is one place where energy savings can be achieved: Greenland's factories. For example, it has been calculated that the company Royal Greenland could reduce its energy consumption by 10% at little cost. But it does not do so because it has no incentive for saving energy since it gets its electricity at a special price.

The very best solution would be to adapt the building envelope to the local conditions. That would really save energy. Up to the present time, Danish modular building has simply been transferred uncritically to Greenland.

The water behind the dam typically comes from lakes and rivers. In Ilulissat (Jakobshavn) it is planned to use the water melting from the ice cap. A hydropower plant is a gigantic project but the technology of hydropower plants is well known.

A hydropower plant is a gigantic project but the technology of hydropower plants is well known.

Jørgen Raa Andersen

WATER AND ENERGY CONSUMPTION IN GREENLAND

The EU's Drinking Water Directive dictates the quality of water in Greenland because Greenland exports food products to the EU countries and elsewhere. No effort is made to save energy or water in either the fishery industry or private households in Greenland.

Water, heat and electricity. The people of Greenland are supplied with these three basic necessities by Nukissiorfiit (Greenland's Energy Supply Company), which is owned by the Home Rule Government of Greenland.

Let us take water first. While the water that comes from Danish taps is mainly groundwater, the situation in Greenland is completely different. The water supply comes from surface water, which means that there are fundamentally different problems to consider than in Denmark, where surface water is only used very exceptionally.

Greenland's water is renowned as some of the finest in the world. The purity of the water has been measured at various locations in Greenland in order, so to speak, to set the instruments used for measuring pollution at zero.

However, that does not change the fact that there are special factors in Greenland that have to be taken into account when water is piped into the towns for use by households and the fishery industry.

FROM NATURE TO NATURE

When the snow and ice melt, enormous quantities of water are released in a very short space of time. The water gushes down the mountainsides and into lakes and rivers, where some of it is led into pipes to the waterworks.

In the wintertime, decomposition in nature takes place very slowly. This means that leaves and remains of animals, including excrement, have hardly decomposed at all when the spring thaw (freshet) starts. A large part of this plant and animal residue is called humus.

The spring thaw carries large quantities of humus and silt (which is finer than sand) down to the waterworks, where particles are too fine to be retained by the waterworks' sand filters. Therefore, particularly during the spring thaw, consumers sometimes find yellowish-brown water coming out of their taps. However, this discolouration has no effect on health.

In all towns, the water is chlorinated to combat harmful bacteria in the drinking water at the waterworks. When the content of humus and silt is high, so-called trihalomethanes sometimes form in connection with chlorination. Trihalomethanes are suspected of being carcinogenic, so there is every reason to try to prevent them from forming. There is international focus on trihalomethanes, and limit values have been set for them in the new EU Drinking Water Directive, which is expected to be implemented in Greenland in 2002. We shall return to this Directive later.

TOWNS AND SETTLEMENTS

I ask how one avoids trihalomethanes in practice. An employee from Nukissiorfiit replies, "We looked into that and carried out some tests in Ilulissat (Jakobshavn) during the spring thaw five years ago."

As mentioned, trihalomethanes occur when chlorine combines with humus, even when there is only a little humus in the water. The humus binds to the silt. "What we do in Ilulissat," says the employee, "is add aluminium sulphate to the water at the same time as we aerate the water. This causes the aluminium sulphate, humus and silt to collect in clumps, which can then be filtered off. The water is only chlorinated after that. The humus and silt are removed first so that trihalomethane compounds do not form."

Surface water is only chlorinated in towns.

In some settlements, as here in Sarfannquaq, people get their water from a number of tapping points.

In settlements, where the water is not chlorinated, this may mean that food products cannot be directly processed for export. The EU's Drinking Water Directive demands a water quality that is free of micro-organisms, parasites and substances in quantities or concentrations that present a potential risk to health. Greenland is not a member of the EU, but will abide by the EU's Water Framework Directive just as it abides by all other sensible EU rules. All new waterworks are designed and constructed to meet the EU's requirements for reasons of public health and the export of Greenlandic food products.

If a company in the fishery industry wants purer water than dictated by the EU's Water Framework Directive, it must pay for it itself.

AGGRESSIVE WATER

Drinking water planning in Greenland is based on analyses carried out by the consulting engineering firm NIRAS for five towns and one settlement. The project was funded by Dancea. Some of the measurements were taken at a consumer's water tap. The aggressiveness of the water was also tested. Water is called aggressive if it contains carbon dioxide (CO_2). Carbon dioxide dissolves ions in copper pipes and thus raises the copper content of the water – possibly beyond the limit value. The individual analyses indicate that this may not be a problem. However, to arrive at a final decision, samples will have to be taken from several towns. If the samples show that the aggressive water does not result in a measurable increase in, for example, copper content, there will be no reason to ban the use of copper pipes.

A ban could make it necessary to change the building regulations on this point. There are no problems with aggressive water in Denmark, and in Greenland it looks as though the water containing CO_2 – the aggressive water – is not a problem for people but only for water mains.

WASTE WATER OR SAVE IT

Water consumption varies between 130 and 180 litres per person per day in towns with a mains

Thomas Bjørneboe Gomez Berg

The water main in Qaqertarsuaq (Godhavn) is above ground so it is easy to detect any leaks.

supply – e.g. Nuuk. In Copenhagen, water consumption is 120 litres per person per day.

In Upernavik, consumption is 55 litres. This is because there are no flushing toilets and no water mains.

In some towns, the daily water consumption per person used to be as much as 400 litres. Therefore, in 1991, a water-saving campaign was carried out and the mains were examined for leaks.

The campaign resulted in a reduction of consumption in the towns in question to less than 200 litres. The biggest sinner was leaks in the mains.

WATER METERS?

All one-family houses in Greenland have their own water meter, but in blocks of flats and multi-family houses, the water meter is shared by a group of flats.

The fishery industry has no incentive to save water and energy.

Do water meters affect consumption? In three to four towns, Nukissiorfiit investigated how much people could be persuaded to save in electricity, water and heat. The results showed a big potential for heat savings, but almost no effect on electricity and water consumption. Magni Niclasen from Nukissiorfiit says that he himself saw a big fall in the water bill in the Copenhagen apartment building he used to live in simply from reducing the water pressure. Magni Niclasen thinks that is financially more viable than installing water meters in the individual flats.

WHAT ABOUT INDUSTRY?

At Nukissiorfiit I am told that the Home Rule Government sets the tariffs for water, heat and electricity. Since Nukissiorfiit is an operating company directly under the Home Rule Government, it has to abide by the rules laid down by the Home Rule Government.

In practice, that means that appropriations for new plant or renovation work within the company's operating areas (water, heat and electricity) must be decided at the political level. The fishery industry is of great importance to Greenland so applications for investment grants for this industry are often political

Mads Fægteborg

matters. The tariffs paid by the fishery industry for electricity, water and heat are also a political question.

In 1993 companies in the fishery industry complained loudly that their costs were so high that they could not compete on the world market. The Home Rule Government therefore intervened and brought in special industrial tariffs for electricity and water for the industry.

Initially, under the scheme for water, if a company's water consumption exceeded 30,000 m^3 a year, the price it paid for its water fell to about one third. However, this scheme led to over-consumption and has been changed: the favourable industrial price now applies only to an agreed annual water quota. Once that has been used up, a company has to pay the full price for the rest of its water consumption.

"We thought we could discern a rise in water consumption at fishery companies," says my contact at Nukissiorfiit. "There was simply no incentive to save water."

SWITCH OFF THE LIGHT

In Denmark, successive energy ministers have not managed to tame the rise in electricity consumption. The same pattern applies in Greenland, although to a lesser extent because the price of electricity there is almost twice the Danish price. From 1990 to 1999 total electricity production for light and power for private households and industry in Nuuk rose by 1.7 per cent per inhabitant.

Both energy saving and energy supply come under Nukissiorfiit, but my contact there says that the company is not doing much at present to inform people about energy savings. He continues: "We could save on street lighting, responsibility for which lies with the public authorities. It is difficult to influence private consumers' behaviour, but the high unit prices for electricity have an entirely natural reducing effect on consumption. In Nuuk, which is supplied with clean energy from the hydroelectric power station in Buksefjord, there is no environmental incentive to put on energy-saving campaigns as long as the power station has sufficient capacity."

In the case of electricity production based on gas oil, less than half of the energy supplied is used for electricity; the other half becomes heat. In 11 of Greenland's 18 towns, part of this residual heat goes to the district heating network. A lot of attention is being paid to getting financially viable district heating networks established because there is still a residual heat potential that could be used instead of being lost.

Negotiations are going on at present with the hospital in Aasiaat (Egedesminde) about supplying the hospital with residual heat from electricity production.

Christian Oxenvad

This balloon holds just as much CO_2 as two Danish single-family houses emit each year. If people switched off the light every time they left a room here in Hillerød, there would be 3,000 fewer balloonfuls of CO_2 a year. What about Sisimiut, Aasiaat, Ilulissat?

Aqqalu Rosing-Asvid

In Greenland, saving water and energy is an unknown concept.

Finn Pedersen

SPECIALISING IN EVERYTHING

The vocational education and training system is ready to train people to refurbish housing and institutional buildings. All that is needed now is the starting signal – the release of the money granted for the refurbishment programme.

It is an ambitious goal to have a fully developed training and education system for a population about the size of that of Esbjerg but spread over 18 municipalities around the coast of Greenland.

For many reasons, Greenland has decided to train its own building tradesmen.

It already has a longstanding tradition for training carpenters, plumbers, painters and other trades needed in the building and construction sector in Greenland.

The Building and Construction School in Sisimiut is the home of the vocational training schemes, all of which have been designed for the special Greenlandic conditions. You can read about the schemes below, but I can already reveal that one of the main things the school tries to teach the coming building tradesmen is to act on their own initiative.

WAITING TIME

A start must soon be made on the refurbishment of nursing homes, hospitals, kindergartens, public infrastructure, housing, etc., but the question is, whether there are enough qualified people for this gigantic task. I put that question to Torben Jürgensen, the Principal of the Building and Construction School in Sisimiut.

He tells me: "In Greenland we have a large number of qualified people for the different jobs that are needed within building and construction. We already have qualified manpower in most building trades and are only waiting for the politicians to release the money for the refurbishment work.

In cooperation with an Adult Vocational Training Centre in Denmark, the Building and Construction School is training people for work with concrete, but the refurbishment project has not really got going yet, so there are quite a few that have dropped out of the course."

Torben Jürgensen points out that a long wait is dangerous if one wants to keep qualified manpower. With the politicians dragging their feet and nobody knowing where it is all going to end, some people find other jobs, and one can hardly blame them for that!

The school has pressed for a specification of the refurbishment work so that it can offer the right courses.

JACK OF ALL TRADES

Nowadays, timber is the most widely used material in house building in Greenland, so the main training courses are in carpentry and joinery.

However, there is actually a wide range of work in Greenland, including construction and maintenance of roads, airports and harbours, and blasting work for new urban developments. These projects have led to the introduction of a special course for blasting contractors that has been designed specifically for Arctic conditions. This course is only offered in Greenland.

Most people are trained within the traditional building trades: carpentry, joinery, painting, and plumbing. There are no courses in Greenland at present for bricklayers and masons because there are very few brick built and masonry houses. However, many of the concrete buildings from the 1960s and 1970s need refurbishment. The trouble here is that buildings from that period in both Denmark and Greenland were built using industrialised building methods, whereas refurbishment calls more for good, old-fashioned craftsmanship. In principle, it takes more skill to repair a

Finn Pedersen

Construction projects in Greenland change the landscape dramatically. Here, part of Upernavik's highest point, called "The Top of Life", is blasted off to make room for the airport.

Only into the cities of Greenland you will find roads. That is the reason why some of the greatest projects are airstrips for aeroplanes close to the biggest cities. Here the construction of the airport in Upernavik.

The Building and Construction School in Sisimiut (Holsteinsborg) runs a special course in the use of dynamite to move mountains.

building than to build a new one.

In response to this, the vocational training courses are being changed. A new vocational training and education system is being developed in which all the people that are not on a carpentry, joinery, painting or plumbing course are gathered together for combined basic training. This means that they are trained to participate in many different kinds of work.

The difference between vocational training in Greenland and Denmark is that, in Greenland, a student starts off training as a kind of "jack of all trades" and can then go on to a course in a specific trade. It is initiative that is needed, particularly on jobs in settlements.

Training Greenlandic manpower means that the knowledge and experience gained stays in Greenland instead of flying off back to Denmark or to other countries when the jobs come to an end.

BUILDING GANGS

There are conspicuous differences between a Greenlandic building gang and a foreign one. When a foreign gang comes to Greenland to carry out a job, the gang's members usually want to put in as many hours a day as possible. They take the view that since they are here, they can just as well earn as much money as possible as quickly as possible during a short, hectic summer.

Greenlandic workers have a fundamentally different attitude. They want work for as long as possible and preferably right through the winter, and they want an ordinary working day, weekends off, etc.

Greenlandic workers have their families on the spot. The foreign workers are either single or have their families in Denmark, Norway or Iceland.

I ask whether that means that mixed gangs are a really bad idea.

Torben Jürgensen replies: "Not necessarily, provided things are properly planned, but it is difficult. It is often the politicians that get in the way of proper planning. The Finance Act will be passed in the autumn, and the money released at the beginning of the New Year when the budget planning is in order. A start will then be made on analyses, design work, etc. That work will be finished sometime in the summer. Tenders will then be invited for the project, so the actual work cannot start until possibly the late summer. In other words, it will be outdoor, winter work, which is obviously more costly and rushed. At the same time, the building project must largely be completed before it has begun."

REGIONAL VOCATIONAL SCHOOLS

With the revision of the training and education system that is now being implemented, the role of the local vocational schools that used to be an important element of the vocational training schemes has come to an end. Instead, training in building and construction is now concentrated in four regional vocational schools located in Sisimiut (Holsteinborg),

Torben Jürgensen

Training Greenlandic manpower means that knowledge and experience stay in Greenland.

Egil Borchersen

Solar heat is used to heat utility water at the student hostel in Sisimiut (Holsteinsborg).

Finn Pedersen

With prefabrication, building has become almost assembly-line work, but repair work calls for real building tradesmen.

Torben Jürgensen

Torben Jürgensen

Modern times in the laboratory

Aasiaat (Egedesminde), Nuuk (Godthåb) and Narssaq.

At all four schools, students start with a combined basic training course in building and construction. No specialisation from the start. Directly into the combined system.

Another innovation is that specialised courses can now be held in other towns. A blasting and contracting course has just been held in Nanortalik for road renovation.

If there is an urgent task we can obtain instructors from our business partners for almost any kind of work. This also upgrades the qualifications of local instructors.

It is not difficult to get the message about a new course out. The schools use TV – everyone watches TV in the wintertime. They also use the newspapers, and lastly, there is "kamikposten" – the grapevine – passing on the message about good courses from mouth to mouth.

Denmark went from the apprenticeship system to basic vocational education and then back to what can be called semi-apprenticeship, which is almost what vocational training and education in Greenland can be called. A trainee period at companies is a very important element of the training. A lot of attention is paid to ensuring that young people gain plenty of practical experience.

DROPPING OUT AND BOTTLENECKS

Torben Jürgensen describes what has usually happened in a typical year: "What has happened up to the present time is that about 160 suitable young people register for the vocational training schemes in the building and construction trades – that is almost 20 per cent of potential students in a school year. Only 90 of them are accepted – in other words, a large proportion of the applicants is rejected. One of the bottlenecks is that there has to be an agreement on a practical training place before the course starts. It is relatively cheap for an employer to have a young person for the first year because his or her wages are refunded by an employers' contribution fund. During that year, one can see whether the young person can cope with the job.

"Up to 40 young persons drop out of the courses in the first two months. This means that the regional vocational school receives around 45 students after one year, i.e. half the number that started one year earlier at the local vocational school. Of those 45, more than 30 become qualified tradesmen. So the drop-out rate on the vocational training courses in the final three years is relatively low."

A pilot training scheme for adult apprentices is in progress in Sisimiut (Holsteinborg) and Nuuk (Godthåb). This scheme was started in Sisimiut in1999. At that time, nine people joined the scheme, and of those, five passed their exams and received their certificates in plumbing and painting.

ARCTIC ENGINEER

At the entrance to the Building and Construction School in Sisimiut stands a sign bearing the words "Centre for Arctic Technology". This is where building engineers specialise in Arctic technology.

It is obvious that Greenland is going to need many building engineers with this speciality – engineers who can plan, design and supervise building projects. It is planners and building technicians that receive this training at the centre, i.e. supervisors and site supervisors. It was hoped that half the people on the Arctic engineering course that started in September 2001 would be Danes, and half would be Greenlanders. However, only a

Building engineer in Greenland

The first two years of the course are held at the Centre for Arctic Technology in Sisimiut. The students then go on to six months' practical training on a building site in Greenland.
The last two years of the course for building engineers are spent at the Technical University of Denmark (DTU) in Lyngby near Copenhagen. The students specialise in the last part of this period. Students wanting to specialise in Arctic engineering, can do this part of the course in Sisimiut.

It may seem strange that this course of education is not turned around, with the students taking the basic course at DTU in Lyngby and the specialised course in Sisimiut.
The reason for choosing the model actually used is the immense difficulty in getting young Greenlanders to study for an engineering degree in Denmark. The people behind the course thought it would be more likely to attract Greenlandic students if the basic course and practical training took place in Greenland, and the students thus had a better chance of finding out whether this course of education was right for them. In this way, at least the possible trauma of finding themselves in a totally different environment does not decide whether they complete the course. If they have found out during their first two years of study in Greenland that a building engineer is what they want to be, they will certainly cope with the last two years in Denmark. This applies particularly to those wanting to specialise in Arctic engineering because they go back to Sisimiut for the last six months of the course.

Permafrost, extreme climatic conditions and the development of Arctic technology are among the challenges facing building engineers in Greenland.

single Dane was interested in this extra specialisation in Arctic engineering. The remaining eight on the course are Greenlanders.

There is only one permanent teacher at the centre - Egil Borchersen. He is an associate professor at the Technical University of Denmark but is stationed in Sisimiut. The education is very much based on teachers from Denmark holding intensive two-week courses in Sisimiut. Mathematics is taught by the centre's own teaching staff.

Nine people are hardly enough to create a university milieu, but Egil Borchersen hopes that there will be more students next year.

Sisimiut University does not offer IT engineering or heavy current engineering courses. For these courses, people have to go to Denmark or somewhere else. However, there are, for example, no more theology students at Nuuk University than engineering students at Sisimiut University.

In fact, in Greenland only the course of education for administrators has relatively many students – 30 at present.

ARCTIC RESEARCH

What should preferably happen next is for funds to be made available for some project staff that would be attached to the centre for a number of years and thus be able to help create a real research and university milieu.

Research should focus mainly on the special impacts to which buildings and public works are subjected in the Arctic. That means the permafrost, which pushes foundations, and the extreme Arctic climate, which affects the rest of buildings. The harsh Arctic climate has a devastating effect on many building materials because of their moisture content. This applies particularly to concrete structures.

Most of the housing built in Greenland in the last 40 years has been built in accordance with Danish/Norwegian building traditions. It would be exciting to explore how a house perfectly adapted to conditions in Greenland

How would a house that has been perfectly adapted to the Greenland climate look? The sustainable Arctic house.

Finn Pedersen

would look. The ecological Arctic house, or, using the same recipe, the fully sustainable urban district in Greenland.

There is a wide range of other exciting, urgently needed research projects that would be perfect for such an educational institution – for example, transport routes, communication, refurbishment technology, waste management, water supply, environmental protection, surveying, position-fixing and solar energy.

Full-scale tests of solar energy have already been carried out with three experimental installations on the roofs of some of the hostels for students at the Building and Construction School. The results show that the sun gives off more energy in Greenland than in Denmark. It has therefore been suggested that it be made mandatory, in connection with refurbishment, for all hot water tanks to be prepared for solar heat and that in future the use of solar heat be made mandatory in all public buildings.

It is said that in many of these fields and particularly within education, Greenland has achieved so much that it could act as a model for other parts of the Arctic.

A modern airport building under construction in Upernavik.

Finn Pedersen

Airports for fixed-wing aircraft have resulted in far more stable service of towns in Greenland.

Finn Pedersen

HOUSING CONDITIONS AND TUBERCULOSIS

The critical factors for the development of tuberculosis is how close together people live, the hygiene. But Tb cannot be, it cannot be eradicated.

At the end of the Second World War, tuberculosis was a gigantic problem. At that time, the disease accounted for one third of all deaths in Greenland. Around 1950 it was therefore decided that a massive operation was needed. The action taken included the construction of a sanatorium, Dr. Ingrid's Sanatorium, in Nuuk in 1954 and use of a special shipvessel, "Misigssut" to trace new cases of TB.

The operation succeeded – fewer patients died! In 1955, the incidence of tuberculosis was 23 per 1,000 inhabitants. By 1965, it was down at 2.9. The big fall was due to a combination of vaccination and early tracing of new cases. In the same period, more effective treatment became available in the form of antibiotics, including streptomycin. In just 10 years the disease was brought down to approximately the same level as in Europe.

The figures fluctuate due to micro-epidemics. The first epidemic occurred in the district of Nanortalik in 1990-91, the next in Upernavik in 1994-98 and the most recent one in South Greenland, concentrated mainly in Nanortalik.

MORE AND BETTER HOMES

In the last few years, however, there have been outbreaks of tuberculosis in Kullorsuaq in Upernavik district, in Uummannaq district, and in Nanortalik, Narsaq and Qagortoq.

I asked Gunnar Pallisgaard, a specialist in pulmonary diseases in Nuuk, whether it was impossible to eradicate tuberculosis.

Gunnar Pallisgaard replied, "The TB epidemic in Kullorsuaq appeared in 1994 – 20 cases among 300 people. With an incidence like that, there is every likelihood of the epidemic spreading – mainly perhaps because of the number of people living in each houses. There could be 18 people crowded together in a house no bigger than 70 $m^{2.}$ We pulled out all the stops to educate people and held meetings on hygiene. Ove Rosing Olsen carried out a project that included improving the general standard of hygiene, repairing the local dump, building more houses and, first and foremost, building a service centre, which was called "Prins Henrik". In 2001, there were four new cases of TB, so the disease is clearly still smouldering."

In both Denmark and Greenland, the fall in TB came with better housing conditions, better institutions and better social conditions. Cases of TB fell still further with the advent of effective medicine against the disease around the time of the Second World War. All these factors helped to improve the population's general resistance to tuberculosis.

In the last few years, the incidence of TB in both Greenland and Denmark has been rising - in Greenland because of micro-epidemics and in Denmark because of athe relatively high incidence of TB among immigrants.

A HEALTHY IMMUNE SYSTEM IN A HEALTHY BODY

When a person is infected with the tuberculosis bacterium, the disease spreads to the whole of the body within six weeks. At that point, the person begins to form antibodies and can fight the disease. One can have an inactive form of the disease, which means that, although infected, there are no symptoms. If a person later becomes weakened for other reasons, the disease can break out as pulmonary tuberculosis or tuberculosis in other parts of the body.

One can be counteracted by diseases by having as good an immune system as possible, i.e. by avoiding smoking and other strains onburdening of the immune system.

The public health service in Greenland has not had the best of conditions in the past 10-15

TB in Greenland in the 1990s
The numbers fluctuates because of micro-epidemics. The first epidemic took place in Nanortalik district 1990-91, the next one in Upernavik 1994-98 and the last one in the southern part of Greenland, latest most severely in Nanortalik.

years. Some health personnel have been employed on short-term contracts. They have not had sufficient reserves of energy to worry about TB. It is therefore very important for the Medical Officer of Health to be notified of all new cases of TB. A team that includes a specially trained TB nurse has been created and is ready to go out in the event of new epidemics.

Gunnar Pallisgaard likens TB to a vicious cur, saying, "You have to keep a close eye on it. If you turn your back, it will bite you!"

TUBERCULOSIS WILL CONTINUE

Whereas outbreaks of influenza and measles last for weeks, outbreaks of TB can go on for years. Looking at TB in the last hundred years, one can conclude that the fall in the disease in theat period was due to TB's own dynamic. There is some form of interaction between the TB bacterium and vaccine and antibiotics. The protection provided by vaccination varies greatly (from 0-80%). A very worrying development is the growing incidence of multidrug-resistant tuberculosis. There is therefore a long way to go before the disease is eradicated. Looking at the next hundred years, TB, malaria, leprosy and measles will continue to dominate the global pathological picture. TB has not been eradicated and will only be eradicated when the disease has run its own course, but it can be reduced considerably with healthy housing and a healthy lifestyle

Îsâvaraq Petrussen

MYTHS AND OPINIONS ON PUBLIC HEALTH IN GREENLAND

Looking at the overall picture, we find a higher incidence of cardiovascular diseases among Inuits than in Western Europe and the USA. There is a high incidence of both cerebral thrombosis and of "other cardiovascular diseases". However, there seems to be a low incidence of cardiac thrombosis among Greenlanders.
In the 1990s, Greenlanders – and especially the women – put on weight. One consequence of this is an increased incidence of diabetes.

"No health problems that can be attributed to environmental impacts have been recorded in Greenland," says Peter Bjerregaard. "There are naturally a lot of suppositions about how such impacts affect people, but, firstly, they are only suppositions and, secondly, it is on the marginals that they affect people. It is possible, for example, that the high Persistent Organic Pollutants (POPs) impacts have some effect or other on the immune system so that people more easily acquire infectious diseases. However, it is also well-known, of course, that living in overcrowded conditions in poor housing has an enormous effect on the incidence of infectious diseases."

Peter Bjerregaard stresses that there have been no signs so far that the environmental impact with heavy metals and POPs has led to more cases of illness among the population of Greenland.

Peter Bjerregaard is a professor in arctic health working at Denmark's National Institute of Public Health (SIF).

"Then what," I ask, "about the fact that right now the population is putting on weight, guaranteeing that, within just a few years, Greenlanders will suffer from some of the diseases that we in the Western world are being warned against?" "It is reasonably well proven that the population is gaining in weight", replies Peter Bjerregaard. He has compared a survey carried out by SIF in 1993-1994 with a similar survey from 1999. The comparison showed that men had not gained in weight, but that women had put on an average of one kilo in two years. The reason is probably that people are abandoning their traditional diet and are instead eating poor quality food and drinking fizzy drinks. Moreover, they are not getting as much exercise as they used to.

Although it is clear that women are gaining in weight, there are different trends for men and women. Most of the men that are overweight are in the highest social group, whereas most of the women are in the lowest social group. The same situation has been found among Inuits in Canada. In Denmark, both men and women are generally most overweight in the lowest social group that.

OMENS FROM ALASKA

The number of hunters has fallen in recent years. Hunting is probably the most physically demanding occupation there is – and, in a cold climate, is undoubtedly one that calls for the highest calorie intake.

At the same time, it is the hunters and people out in the settlements that complain most of rheumatic pains and aching joints. That is the price paid for living in a settlement instead of a town.

The changes in lifestyle show the same trend all the way round the Ice Cap.

"The changes are not yet as pronounced in Greenland as in Alaska," says Peter Bjerregaard. "The Eskimos in Alaska are more Americanised in their lifestyle, so they spend more time in front of the television and ride round on snow scooters and all-terrain vehicles, even when they are only going into town. Incredibly, in a small settlement, people will even use a snow scooter to go a hundred metres down the road. Greenlanders walk much more, and there is also a healthier attitude to physical exercise."

However, the public health situation in Alaska can be used as a forewarning of the

Diabetes, cardiovascular diseases and other "lifestyle diseases" will make an unwelcome appearance in coming generations in Greenland.

direction the trend can take in Greenland.

In Alaska, cases of diabetes have quadrupled in 20 years. There has also been an increase in Greenland, but not as big as in Alaska.

"In the 1960s, one saw almost no cases of diabetes in Greenland," says Peter Bjerregaard. "In the last couple of years we have been measuring the blood sugar level, which is the best way of diagnosing diabetes. We have tested about 1,000 Greenlanders and have found a high incidence of diabetes."

The tests have shown that 10% of the tested Greenlanders over the age of 35 have diabetes. This is at the same level, or higher, than in Denmark.

THROMBOSIS

"It is said that Greenlanders and Inuits do not suffer from cardiovascular diseases, but that is simply not so," says Peter Bjerregaard, surprisingly.

Looking at a list of cardiovascular diseases,

there appears to be a very low incidence of cardiac thrombosis, but it is a different story altogether with the other forms of cardiovascular disease.

It is a bit complicated and becomes no less complicated when one looks at the historical picture.

Going slightly back in time, it seems to have been traditionally held in Canada and Greenland – all based anecdotally – that the incidence of cardiac thrombosis among Inuits is the same as in the rest of the population.

In Alaska, there used to be a different medical tradition, according to which almost no Inuits suffered from cardiac thrombosis. It is difficult at the present time to decide whether there is any real basis for either tradition. However, in the 1960s, the American tradition took over, and since then it has been said that there is a very low incidence of cardiac thrombosis. All the same, there is still nothing that substantiates this assertion.

Nowadays, few death certificates in Greenland give cardiac thrombosis as the cause of death. However, with the tradition of "knowing" that the incidence of cardiac thrombosis in Greenlanders is not very high, few doctors want to put that cause of death on a death certificate. There is a self-reducing effect at work.

The uncertainty concerning death certificates in Greenland probably has just as much to do with the fact that a post-mortem examination is not normally carried out, even in the large towns. Only in cases of murder or manslaughter is one carried out for forensic reasons. All in all, a post-mortem examination is only performed in a few per cent of cases, so the main cause of death is more or less a guess.

In short, we do not know with any certainty the extent to which cardiovascular diseases have been the cause of death.

Taking all cardiovascular diseases – in other words, not just cardiac thrombosis - we find a higher incidence among Inuits than among the populations of western Europe and the USA. There is a high incidence of cerebral thrombosis or cerebral haemorrhage, which display largely the same symptoms. There is also a

In 1997 there were 482 deaths in Greenland, 48 resulting from accidents and 59 from suicide. Predominantly young men commit suicide. There were 111 deaths from cancer, including 32 from lung cancer, and a further 20 from chronic obstructive pulmonary disease ("smoker's lung"). 38 people died from cerebral haemorrhage. According to Chief District Medical Officer Ove Rosing Olsen, Sisimiut (Holsteinborg), these 149 deaths, i.e. suicides, lung cancer, chronic obstructive pulmonary disease and cerebral haemorrhage, representing 31% of all deaths in the year in question, could have been avoided or delayed.

Finn Pedersen

A newborn child in Greenland will have a far greater risk of dying from cerebral thrombosis but a lower risk of cardiac thrombosis than a Danish baby.

high incidence of what are together called "other cardiac diseases". However, it does seem that there is a low incidence of cardiac thrombosis among Greenlanders, even though that has not been definitively proven.

LIFESTYLE AND HEALTH

In the lifestyle studies in which Peter Bjerregaard has participated, people were asked for their own evaluation of their state of health. They were asked about illnesses and symptoms within the last 14 days, about tobacco, alcohol and cannabis, about the indoor climate, work, and occupational health and safety problems. In fact, they were asked about every conceivable thing.

Peter Bjerregaard says, "One of the most remarkable results was that hunters and people living in the settlements, who, with our rose-coloured glasses, we might imagine had a good life, actually described their own lives as worse than those of the town dwellers. They said that their health was poor and that they suffered from rheumatism and other problems with their arms, legs and back."

One sees the same picture in Denmark when comparing life in rural areas with urban life.

In stark figures, the study shows that there are an unreasonably high number of smokers in Greenland, but that smokers in Greenland smoke less than smokers in Denmark. There are fewer heavy smokers in Greenland, but a larger proportion of the population smokes. In the 1990s, around 80% of the population smoked. There are no social differences between smokers and non-smokers.

According to the statistics, people in Greenland used to drink, on average, twice as much as people in Denmark, but alcohol consumption has now fallen considerably and is now

Finn Pedersen

only slightly higher than the average consumption in Denmark.

Peter Bjerregaard offers this explanation for the reduction: "It was always Danes that drank most in Greenland. So one of the reasons why alcohol consumption has fallen in Greenland is that fewer Danes are stationed there now. However, more important still is the fact that attitudes are changing in the population."

There are social differences in the pattern of drinking in Greenland. However, it is a little difficult to describe the pattern because the drinking is so spasmodic – perhaps every fortnight in the case of those paid fortnightly and perhaps every month in the case of those paid monthly. The usual methods of recording alcohol consumption in Denmark and other countries are of no use because it is not so much the average consumption over a year that is interesting, but the extremely episodic drinking.

Besides that, the answers given are very unreliable.

Another myth well and truly holed by Peter Bjerregaard is that the many alcohol problems and high alcohol consumption are caused by certain enzymatic factors and are thus genetically determined. In other words, it is supposed that Greenlanders become inebriated more quickly because they do not have the same alcohol-catabolising enzymes in the liver as, for example, Danes. There is no scientific support for this.

QUALITY OF LIFE

In comparisons of public health around the world, the main indicators are infant mortality and life expectancy.

Infant mortality in Greenland is high. The trend lies parallel with the corresponding Danish trend 30 years ago, displaying a handsome fall. So, infant mortality in Greenland corresponds to that in Denmark 30 years ago. In Greenland 30 years ago, it corresponded to the situation in Denmark 60 years ago.

Average life expectancy in Greenland has always been lower than in Denmark. That is because there has always been a higher proportion of accidents in Greenland than in Denmark – and in the last 30-40 years also a higher suicide rate, particularly among young people in the 15-24 year age group.

The average life expectancy of a baby Greenlander is 62 years if it is a boy and 68 years if it is a girl.

Finn Pedersen

It might be thought that there would be more suicides in the wintertime, but that is not the case. Researchers have been very much on the lookout for a correlation between winter darkness and the number of suicides, but nothing at all indicates that there is one.

There is, on the other hand, a clear relationship between winter darkness and the number of hours spent in front of the television. In Greenland, people spend an incredible amount of time watching television in the wintertime, but watch it hardly at all in the summertime.

Average life expectancy in Greenland is 62 years for men and 68 years for women. For comparison, the corresponding figures for the

There is some inherent uncertainty about what "self-assessed state of health" measures. The fact that the questions and answers are given in Greenlandic and that other factors than health are included in the assessment of quality of life does not make things any easier.
As Peter Bjerregaard wryly points out, "These difficulties go some way to explaining why the preventive function in Greenland is nothing to write home about."

Finn Pedersen

Faroe Islands are 73 years and 80 years, respectively.

One can also record "lost good years of life", i.e. how many good years of life a 50-year-old can expect, but that easily becomes so refined that the message is difficult to understand.

There is some inherent uncertainty about what "self-assessed state of health" measures. The fact that the questions and answers are given in Greenlandic and that other factors than health are included in the assessment of quality of life does not make things any easier. As Peter Bjerregaard wryly points out, "These difficulties go some way to explaining why the preventive function in Greenland is nothing to write home about."


Jens Carl Hansen

Outreach work along the vast coast of Greenland is the only way of anticipating coming health problems. Here, Dr. Henning Sloth Pedersen from the medical centre in Nuuk.

PUBLIC HEALTH THROUGH HALF A CENTURY

Until 50 years ago, the threats to health were: tuberculosis, polio, typhoid and other infectious diseases. There were also many accidents.

Then came the first period of modernisation. In the course of the 1950s, tuberculosis disappeared and the incidence of infectious diseases fell considerably (although it was in this period that the measles epidemic took hold). In this period, alcohol problems and suicides were rising.

Now – in the third period – it is lifestyle diseases that are appearing.

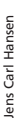
It is thus on these chronic diseases that researchers must concentrate in future. What does that mean in practice?

Peter Bjerregaard replies, "It means studying in detail why lifestyle diseases are beginning to appear. We know perfectly well, of course, that it is obesity, smoking and dietary habits that are triggering these diseases, but we want to try to go a step further back and look at why it is happening."

The best way of investigating this would be to seek out Greenlanders that have moved to Denmark and compare them with Greenlanders living in towns and settlements in Greenland. If one went back to the same people after 10-15 years, one would be able to describe causes for an unfortunate trend.

However, going back to the beginning, I ask whether it is not the National Institute of Public Health, rather than any other body, that must take on the role of watchdog, ready to raise the alarm when environmental impacts threaten public health in the Arctic.

"Yes, it is indeed," says Peter Bjerregaard. "The high level of heavy metals and POPs alone is a danger signal. Although that cannot be related to any specific disease, it is an undesirable situation. It cannot be healthy."


Jens Carl Hansen

A big turnover of health personnel makes it difficult to keep a close eye on the state of public health in Greenland.

PUBLIC HEALTH IN SISIMIUT

Every year, the health centre in Sisimiut (Holsteinborg) puts on a one-week campaign to improve the population's health habits. The purpose is the same every time: to get people to understand that a healthy lifestyle protects against disease.

Week 46 of the year is a special week in Sisimiut. The local community centre is seething with activity. This year's health theme is being debated. The hospital's personnel, together with personnel from other institutions, have spent the preceding six weeks preparing the theme, which this year is Self Care. Stalls have been set up in the community centre at which people can discuss food and nutrition, weight problems, hygiene, etc.

They can also have their Body Mass Index (BMI) calculated; BMI is a simple measure of whether one is overweight. People can also find out how they themselves can avoid many diseases by changing their lifestyle. Communal meals are laid on at the community centre all week, and recipes are given out.

"We have a tradition for this method of activation," says Ove Rosing Olsen, who is the Chief District Medical Officer in Sisimiut. "Good preparation is essential for getting the health message across and encouraging the right attitude."

The health week is a very popular event. About half the population participate in it. It has become a well-established tradition, and a template has been made for the method, so that it can be used elsewhere in Greenland. The method has two elements: the first is the public information activities and activation of the population and the second is scientific studies of health problems in the area.

During the scientific follow-up, the health centre works together with a research team at the Department for Epidemiological Research at Statens Serum Insitut in Denmark. The problem could be the incidence of the bacterium Helicobacter pylorii, for example, which causes stomach ulcers, or various venereal diseases. Right now, hepatitis is being investigated. On previous occasions it has been human parasites, particularly those affecting children (pinworm, whipworm, roundworm and the different various tapeworms), and allergy. This last study was extended to other towns (Aasiaat and Ilulissat).

One recently completed project was called "Children and Disease". It revealed that children had exhibited symptoms of one or more bronchial infections for 40% of their lifetime.

To calculate your Body Mass Index you take your weight in kilos and divide it by the square of your height in metres. If your BMI is between 18.5 and 25, you are normal weight; if it is under 18.5, you are underweight; and if your BMI is 30 or more, you are seriously overweight.

A person who weighs 60 kg and has a height of 165 cm has a BMI of 60: (1.65x1.65) = 22.

Finn Pedersen

Mads Fægteborg

This is almost a world record. Surprisingly, these bronchial infections occur equally frequently in summer and winter.

The main reasons were found to be smoking in the family, being in a day-care centre, and sleeping together with others in one bedroom. Lastly, it looked as though children that were breast-fed until the age of at least six months had fewer bronchial infections than those breast-fed for a shorter time. In a previous Week 46, there was massive advertising of the project, and participation in the project was enormous – 88% of parents in the town decided to participate.

Everyone at the health centre works together on these projects. There is a campaign newspaper, "Peqqik Sisimiut", which is distributed to all households.

The scientific results are published in both "Ugeskrift for Læger" (the Danish Medical Journal) and international scientific journals. Equally important, the local population gets some feedback written in ordinary, everyday language – for example, the title of the article in the campaign newspaper: "Snotty noses and coughs in children in Sisimiut".

FOOD AND POLLUTION

"How do you inform people about the impact on their food from heavy metals and POPs in a reasonable way?" I ask Ove Rosing.

He replies: "We have not done much yet on the pollution of our food products. Just recently, a couple of us have looked into the eating habits of children and young people and carried out diet studies in the local schools to find out what the situation is and promote the use of traditional foods.

"However, the effect of toxic substances in the environment and our food on people's general health is not a subject of daily discussion among the local population. Nor has there been a week 46 project on the subject."

People are aware of pollution in food products but do not talk much about it. They are generally resigned to the fact that there is not much they can do about that aspect of their lives. They cannot stop eating seal meat. Being told that there are contaminants in seal liver does not stop them from eating seal liver, although they may eat less of it.

"But that must be very much your problem, as head of the health centre," I say, not wanting to leave matters there. "You know how high the impact is and also know that people are not keen on discussing what effect this has on their health."

"The question is, what it pays to do," replies Ove Rosing Olsen. "I quite literally look people deep in the eye. When I take people's blood pressure, I automatically take a look at the small blood vessels in the retina, and I have found almost no changes at the back of the eye. In other populations, e.g. the Danish population, very extensive changes are seen, so there must be a factor here in Greenland that protects blood vessels – perhaps it is the diet. It is unlikely to be anything genetic."

Ove Rosing Olsen also tells me that patients with hepatitis and people that drink a lot do not have the same degree of changes in the liver as in Denmark. In Greenland, practically no cases of cirrhosis of the liver have been seen. And patients with hepatitis B, which is common in Greenland, suffer almost no long-term effects. He does not see much in the way of cardiovascular changes in his patients. He seldom sees the kind of glaring cardiovascular changes that are seen in other countries.

Ove Rosing says, "This leads me to conclude that there are some important protective factors at work here, and I attach great importance to them. I think that part of the explanation lies in the diet." Ove Rosing Olsen uses this for treatment purposes. He almost never uses cholesterol-reducing drugs. They are used very extensively in Denmark. Greenlandic patients with high blood pressure – apart from those with familial hypercholesterolemia – receive dietary advice. They are told to eat seal blubber and beluga blubber. Beluga blubber is the most potent cholesterol-reducing agent he knows.

Îsâvaraq Petrussen

People in Greenland spend an incredible amount of time watching television in the wintertime – television is a source on information on diet policy!

Mads Fægteborg

Pollution of food products is not a topic of daily discussion among the local inhabitants.

THE DIET ALONG THE COAST

Why is Greenland not more self-sufficient with regard to meat, considering that the traditional Greenlandic diet in many ways is healthy, despite a certain level of environmental toxins?

In Denmark, one million meals are delivered to military bases, hospitals and other institutions as well as 'meals on wheels' for pensioners. What is the situation like in Greenland?

"Fifteen per cent of the population in Greenland eat at least one meal a day paid for by the State. No requirements are made as to the quality of the meal or whether it is made with domestic products. I find this very unfortunate," says Ulla Uhrskov from NUKA a/s. "This is something that I feel very strongly about: the people of this country should be able to eat Greenlandic food if they want to. And children should learn to eat Greenlandic food while they are little, otherwise the traditions will be lost. I think that the politicians should wake up and say what they want for their money. I would like to see an active diet-plan policy for provisioning throughout the entire public sector", says Ms. Uhrskov.

She teaches at the Centre for Healthcare Training in Nutrition, Dietetics, and Greenlandic Foods. Her students are primarily healthcare assistants and nursing students. She has previously taught nutrition students for 14 years. Ms. Uhrskov now works at NUKA a/s, a company which purchases and produces Greenlandic foods sold primarily to domestic shops, restaurants, hospitals, old-peoples' homes and childcare centres. NUKA has also exported salted cod and "uvak" (Greenlandic fjord cod), dried fish, musk ox and reindeer, mainly to the Faeroe Islands, Germany, Denmark, and southern Europe. NUKA a/s is owned by the Home Rule Government of Greenland and its main purpose is to supply Greenland with Greenlandic foods, while also maintaining employment levels in the small settlements.

Aqqalu Rosing-Asvid

COOKING IN GREENLAND

At present Greenland's level of self-sufficiency with regard to meat is 22 per cent. NUKA's target is that this should be increased to 50 per cent. As the level of self-sufficiency increases, imports of food will decrease correspondingly.

One way of ensuring this is to prepare a diet policy for the country's institutions. Another way is through general information about Greenlandic foods.

Ms. Uhrskov's own family is self-sufficient with regard to meat, fish, and poultry. Ms. Uhrskov wishes that professional chefs were more imaginative and experimented more with the wonderful Greenlandic products, as

The Greenlandic diet is a mixture of traditional and imported food. Here, a birthday party up in the mountains.

A girl eating mattaq – whale skin

The cultural factor

"People eat fish all over the world, however we are one of the only countries in the world where seal is eaten. Seal is a truly Greenlandic food.
"Ulla Uhrskov, NUKA a/s

The little auk is not a threatened species, but one of the world's most numerous birds. It is not shot, but caught with a kind of racquet. NUKA a/s sells 50,000 little auk a year.

they can play an important role in inspiring others to try out new dishes based on familiar foods.

THE OTHER SIDE OF THE COIN

It is well known that both heavy metals and POPs have been found in Greenlandic food. How are these scientific findings reflected in practical dietary advice given to the Greenlandic population? In 1997 Gert Mulvad, a doctor in Nuuk, Tine Pars, a Ph.D. in nutrition, and Ulla Uhrskov, who is a clinical dietician, joined forces and set up a working group that organised a seminar about Greenlandic foods. Fishermen, hunters, indigenous groups, and scientists from Denmark and Greenland discussed this matter. After the seminar, a Nutrition Council was set up providing a forum for debating Greenland's dietary policy in light of the many scientific findings from the surround-

Aqqalu Rosing-Asvid

ing world. The Nutrition Council has just published a pamphlet called "A debate about the contamination of Greenlandic foods" ("En diskussion om forurening af den grønlandske mad").

Defining a common position concerning pollutants in our foods has been a long process. The Nutrition Council wants to avoid alarmist campaigns, but at same time it wants to conduct a serious debate. Today the majority of the population's diet consists of both traditional Greenlandic foods and imported foods. A small part of the population depends on the resources from the sea, and at times this group's diet is very unvaried. "Pollution is an extremely sensitive topic to address," says Ms. Uhrskov, who bases her work on Jens C. Hansen's book about the Greenlandic diet, "The Greenlandic Diet – an eco-medical assessment" ("Grønlandsk kost – en miljømedicinsk vurdering"). The book is for doctors, nurses, and other health-care personnel. She also uses "The Arctic Dilemma" ("Det arktiske dilemma"), published by the Danish Environmental Protection Agency, which is the only book about nutrition and pollution written for laymen so far.

THIS DIETARY ADVICE IS GIVEN IN THE BOOK "FOOD FOR SMALL CHILDREN, AND WOMEN DURING PREGNANCY AND BREASTFEEDING"

- Continue to eat Greenlandic foods
- Eat fish often
- Vary your diet, alternate between meat from different animals
- Continue to breastfeed your infant child
- Pregnant women and women who are breastfeeding can maintain a varied Greenlandic diet
- Eat a lot of rice, potatoes, pasta and wholemeal bread, also with hot meals
- Eat fruit and vegetables every day, they contain a lot of vitamins
- Limit your sugar intake

Mads Fægteborg

Aqqalu Rosing-Asvid

All over the world, there is a marked unwillingness to discuss pollution of food products.

Ms. Uhrskov has written the book "Food for Small Children" ("Mad til små børn"), which contains a chapter about pollutants and diets for women during pregnancy and breastfeeding, as well as for small children.

"When I tell people how healthy Greenlandic foods are compared to many imported foods, I must also tell them about pollution," says Ms. Uhrskov about her everyday teaching. "It's important that the nursing students know about pollutants, as they will be some of the few who know anything about nutrition and pollution."

The students have heard about mercury and other heavy metals, but only a few of them know about POPs. "I've only met a few students who understand what POPs are and are familiar with the latest knowledge in this area", says Ms. Uhrskov.

Eat Greenlandic food in Greenland!

Aqqalu Rosing-Asvid

PRACTICAL ADVICE

The Nutrition Council has always maintained that the best advice is: vary your diet. Advice that can be difficult to follow in a little settlement where seal is the only available food for four to five months a year.

Wherever possible one should eat seal and whale meat, fish, poultry, and also some imported foods. In general the Council's position on environmental toxins is that:

- fish and shrimp from Greenland are clean and healthy,
- berries, lamb, reindeer and musk ox do not contain pollutants,
- whalebone whales contain less pollutants than toothed whales,
- older seals contain more pollutants than younger seals,
- POPs are mainly found in fatty tissue and heavy metals in organs.

FAT AND POLLUTION

"There is a tendency for us to adopt all the bad things from the eating habits of the western World. We import a lot of sugar and saturated fats," says Ms. Uhrskov when describing today's Greenlandic diet.

It is especially with regard to fat that Greenlandic foods distinguish themselves from imported foods, as they contain healthier fats, at least when it comes to sea mammals. Lamb, musk ox and reindeer contain the same type of fat as imported foods. This is an issue that is often discussed at the Centre for Healthcare Training. Other issues discussed are vitamins and minerals.

WHAT IS HEALTHY FOOD?

In general, people believe that Greenlandic food is healthy. However, it is extremely difficult to get an answer to the question "Why is Greenlandic food healthy?" Ms. Uhrskov spends a lot of time discussing this when she teaches nutrition. The main reason is that a large part of the Greenlandic population – just as many Danes – eats too much fat in general. Ms. Uhrskov also addresses the type of fat one should choose. And finally, she addresses the issue of the ideal omega-3 : omega-6 fatty acid ratio in different types of food.

Louise-Inger Kordon

The shops are bulging with imported meat products.

"People in Greenland don't worry as much about fat as people in Denmark," she explains. "In practice, we're talking about reducing the intake of saturated fat. But if you're overweight, the main thing is to reduce how much fat you eat. Today people here in Greenland are becoming fatter and fatter. And the fat primarily deposits itself at the waistline. This increases the risk of cardio-vascular diseases."

"What is important here is the difference between fat from sea mammals and terrestrial mammals," Ms. Uhrskov explains. "If your diet is based on foods from the sea, you will get a lot of unsaturated fats and omega-3 fatty acids."

"But you could have taught this in Brønderslev and Randers", I interject.

"Yes," Ms. Uhrskov answers, "but we have many more alternatives here in Greenland. We can eat fish, seal and whale, all of which contain types of fat that are healthier than those found in imported meat products. It's just too bad that the delicatessens at the supermarket don't have meals made with Greenlandic products. You can't get reindeer, lamb or Greenlandic fish in Denmark, you can only buy pork, beef and chicken," Ms. Uhrskov concludes.

"It's not because pork is bad, but it seems quite a paradox that you can't buy Greenlandic foods in the supermarkets in Greenland."

"Children must learn to eat Greenlandic food while they are small – otherwise, they will never eat it." Ulla Uhrskov, NUKA a/s.

FAT IN GREENLAND – TOO LITTLE AND TOO MUCH

Fat is essential in people's diet. Marine mammals contain the best mixture of fat. The traditional food in Greenland is generally far healthier – from a fat point of view – than many imported food products.

In West Greenland, beluga whales are hunted as they migrate along the coast. The kill is then brought up onto the beach. After flensing, the "mattaq", which consists of the skin and 1-2 cm of blubber, is peeled off and eaten, mainly raw, together with air-dried meat. The innards are also gathered, and the liver is regarded as particularly tasty. However, mainly full-time hunters and the elderly enjoy the liver raw. The mood is euphoric and the smiles go from ear to ear because now the freezer is full of "our food" again. The mattaq, which is also called "white gold" fetches a high price. It is sold in nearby towns and settlements, although only when the hunters have enough of the important "winter medicine" themselves.

The head of the beluga whale is kept for special, festive occasions, where it used as a decorative delicacy – first enjoy the sight of it, and then the taste of it.

When there is locally caught game, it is eaten with great gusto and in great quantities. If there is no catch, people have to supplement what they have with what the local shop can offer. The selection of Greenland game in the shop is extremely limited and sometimes non-existent, so then people turn to a more western diet. Particularly children and young people eat an astonishing amount of biscuits, cakes, and fast food.

That is how Per Møller describes the mixed diet he experienced in Saqqaq on the Nussuaq peninsula.

However, this chapter is about fat, which is the subject in which Per Møller has specialised. What is the difference between fat from seals and whales and fat from the biscuits and cakes etc. bought in a shop?

FAT IS ESSENTIAL

Our bodies need fat to grow and function properly. Fat is many things, and different types of fat have different and often vital functions.

Fatty tissue is a concentrated energy store, but at the same time it is a wonderful insulating material and shock absorber, protecting our internal organs against blows and dehydration. The main component is fatty acids, which are important in several ways – they keep the cell membrane supple, and transport and nutrients and waste products to and from the cell. They also participate in the production of hormones and signal substances. Our bodily functions, our sight, and all our other senses depend on them.

Aqqalu Rosing-Asvid

There is a vital difference between fat from marine mammals and fat from cakes and biscuits.

Aqqalu Rosing-Asvid

SEAL OR BISCUITS

"The fat in crisps, biscuits and cakes consists almost only of saturated fats," says Per Møller. "Industrially modified fat in the form of hardened vegetable fat – better known as trans fatty acids – is often added. Saturated fats are an excellent source of energy but play no essential role apart from that. As in the case of trans fatty acids, eating too much saturated fat increases the risk of cardiovascular diseases."

In seals and whales, up to 15% of the fat is saturated fat, while the remaining approx. 85% is unsaturated fat, with mono-unsaturated fat as the predominant form. Unsaturated fat is of great physiological importance, and some of it is even vital. Since we humans are not very good at making this type of fat ourselves – and are in fact in some cases completely unable to do so – it is very important that it be added through our diet. Polyunsaturated fat has the opposite effect to saturated fat – it reduces the risk of cardiovascular diseases.

Within the polyunsaturated fatty acids, the two groups omega-3 (n-3) and omega-6 (n-6) are often mentioned, and n-3 is of particular importance. The ratio between the two groups (n-6/n-3) is also believed to be important. The optimum ratio is thought to be 1:1. For comparison, the ratio in Denmark is 10:1 or even 20:1, while in Greenland it is around 1:1.

From a health point of view it is the unsaturated fatty acids we should focus on.

TOO MUCH AND TOO LITTLE

Fatty foods increase the risk of overweight. When our food contains more fat than we burn, the fat is transported directly from the intestine to the fat depots, where it accumulates. Obesity increases the risk of complications and can make it more difficult to become pregnant. Although fat is blamed for a lot of things, we cannot live without it, and it can be difficult to eat enough if fat constitutes less than 20% of the energy in our diet. The low-energy constituents simply take up too much room in the stomach. In these conditions it can also be difficult to get enough of the vital fatty acids and the fat-soluble vitamins (A, D, E and K) that the fat transports with it.

Louise-Inger Kordon

We can thus also eat too little fat. Too much unsaturated fat is not good for us either, since in extreme cases it is thought to cause spontaneous cerebral haemorrhage.

In brief, we have long looked at the negative effects of fat, but are now realising the positive functions fat has in our bodies.

Many crisps, cakes and biscuits contain industrially modified fat. Eating too much of them puts people at risk of cardiovascular diseases.

Important advice on fat is therefore:

1. 20-30% of your total energy intake should be in the form of fat.
2. Eat food from the sea often – and preferably different kinds.
3. Your total energy intake should not include more than 10% saturated fat.
4. Make sure that as much as possible of the fat you eat is unsaturated fat (5-10% polyunsaturated, 10-15% mono-unsaturated).
5. Eat less crisps, biscuits, and cakes containing "hardened vegetable fat" (max. 2%).

Aqqalu Rosing-Asvid

A MIXED DIET

The heavy metals mercury and cadmium accumulate mainly in the liver, whereas POPs accumulate in fatty tissue. No effects on people from heavy metals or POPs have been found in Greenland.

One of the very few thorough studies of Greenlanders' diet was carried out in Disco Bay in the mid-1990s. It showed a mixed diet – the Greenlandic diet supplemented by imported western food products. "We concentrated on the Greenlandic part of the diet, not the imported part," says Poul Johansen, who has spent many years researching the routes followed by heavy metals and POPs in living organisms. Some of the research, which is co-funded by Dancea, is carried out at Denmark's National Environmental Research Institute in Roskilde.

SEAL LIVER

Quantitatively, the diet of Greenlanders in Disco Bay consists mainly of fish and seal meat. The absolutely dominant source of the diet's content of the heavy metals mercury and cadmium is seal liver. Seal liver constitutes only a small part of the diet, but is the main source of the diet's content of heavy metal.

In terrestrial animals, the levels of heavy metals are generally low. There are exceptions, however. For example, ptarmigan have high concentrations of cadmium in the liver, the only explanation for which must be that ptarmigan have naturally developed an ability to accumulate cadmium in their bodies – and live happily with that.

In freshwater lakes, high levels of mercury are found in, for example, non-migratory trout. Figure p. 76 shows the mercury content of different types of food.

COMPARISONS

The content of heavy metals in animals varies from one region to another in Greenland, but not systematically as in the cases of POPs, the highest concentration of which is found in east Greenland and the lowest in west Greenland.

The same concentration of lead is found in people in both Denmark and Greenland. In the case of mercury, higher levels are found in the parts of Greenland where people eat a traditional Greenlandic diet. In the case of cadmium, there is no evidence that a high concentration of cadmium in the diet leads to a high concentration in the body. Most of the cadmium in the diet is presumably bound so tightly to proteins that it is not absorbed in the body. Smoking, on the other hand, greatly affects the body's content of cadmium. Cigarette smoke contains a lot of cadmium in an absorbable form.

SAFETY AND SELENIUM

The limit values for heavy metals in human diet have remained unchanged for many years. When the expression "limit value" is used, it sounds as though you will die if you exceed it. This is not so, but if you ingest heavy metals in quantities beyond the limit value, it may affect your health – for example, your nervous system – and have other invisible effects.

Poul Johansen says, "Many people who eat the Greenlandic diet ingest more cadmium and mercury than international limit values, and people who eat a lot of birds can reach lead concentrations around the limit value." However, there are no documented effects from heavy metals on human health in Greenland.

Selenium is interesting because there seems to be a relationship between selenium and mercury, with the selenium binding to the mercury so that it is not absorbed. Selenium binds to mercury in the ratio 1:1. So it is important where selenium is found and where mercury occurs. The main source of selenium is mattaq – whale skin – but selenium is also plentiful in

There are low levels of mercury in terrestrial animals and high levels in marine animals.
Dieticians in advice to Greenlanders on diet use such facts.

other marine food. How does selenium get into the mattaq? Nobody knows – all one can say is: "that's nature!" Specific substances are concentrated in specific places in food. The fact is that there is a sufficiently large content of selenium in the Greenlandic diet to eliminate the current content of mercury.

RISK AND GOOD ADVICE

Most of the cadmium and mercury load on the Arctic environment has probably always been there naturally. However, there is a contribution from the industrialised world, although the size of the contribution is not known. It is being investigated right now. It can be seen from analyses of marine deposits that there has been a rise in the content of mercury. Similarly, studies of peat bogs in different places in the North Atlantic region show a rise in the mercury load that peaked in around 1970.

There are considerable differences in the concentration of heavy metals found in marine animals. The very highest concentrations of mercury are found in the liver and kidneys of marine mammals, and the lowest in crustaceans, mussels and the flesh of fish and marine mammals. The same applies to cadmium. The higher we move up the food chain, the higher the concentrations. This applies particularly to cadmium – young birds contain almost no cadmium, whereas old birds can have a very high concentration of cadmium.

It is therefore advisable to eat as far down in the food chain as possible and to eat young animals rather than old ones.

LEAD – A LOCAL PROBLEM

"Our studies indicate that lead shot is the main source of lead in Greenlanders' blood," says Poul Johansen. More than 200,000 guillemots are shot each year in Greenland. Lead residue from the shot is deposited in the carcasses and ingested by people when they eat the birds. That is one of the reasons why the Home Rule Government of Greenland proposes banning the use of lead shot for shooting birds.

In the areas around the old Greenland mines at Mestersvig, Maarmorilik and Ivittuut, higher lead values are still found in the fjords as a consequence of pollution from mining activities, and in Ivittuut and Maarmorilik people are advised not to collect and eat common mussels because they are contaminated with lead. However, there is no risk from eating fish, birds, and marine mammals from the old mining areas.

Unlike mercury, cadmium, and POPs, lead does not occur in increasing concentrations up through the food chain. It might be thought that when an eider duck eats mussels containing lead, it gets a bigger concentration than the mussels (because it eats lots of mussels), but that is not the case. Some of the lead is eliminated from the eider's body. It is the liver that cleans the body of lead. There is no lead in meat from Greenlandic animals, except birds shot with lead shot. Apart from these, the lead content of the Greenlandic diet is very low and does not constitute any risk to human health.

THE DIRTY 16

DDT, PCB, HCH, toxaphene …Up to the present time, most effort has gone into getting the 12 worst environmental toxins – "the dirty dozen" banned. Attention is now turning to at least four others (and they will be followed by thousands more).

While heavy metals accumulate mainly in the liver, POPs accumulate partly in fat. Toxaphene is an insecticide that used to be widely used in the American cotton industry. High levels of toxaphene are found in Greenland, where cotton is not grown!

There are clear regional differences in the human PCB load in different places in the Arctic.

Whereas the PCB content of blood from people in southern Canada is relatively low, higher values are found in Nuuk, and even

The dirty dozen

aldrin
chlordane
DDT
dieldrin
endrin
heptachlor
HCB
mirex
PCBs
dioxins
furans
toxaphene

The most important local diet in the western part of Greenland

Marine mammals
Ringed seal
Harp seal
Hooded seal
Walrus
Narwhale
Minke whale
Common rorqual

Marine birds
Thick-billed murre
Common eider
King eider
Kittiwake

Fish
Atlantic Cod
Uvak
Capelin
Greenland Halibut
Atlantic Redfish
Spotted Catfish
Atlantic Catfish
Atlantic Salmon
Arctic Char

higher ones in Ilulissat; and the values in Ittorqortoormiit (Scoresbysund) set the world record. This geographical distribution accords well with the increasing importance of marine mammals in human diet as we move from Nuuk to Ittorqortoormiit, and with the fact that highest POP levels are found in east Greenland. There is concern that the high POP levels can affect people's health.

The content of another well-known spray agent, DDT, is very low in terrestrial animals. It is by and large in marine animals that the high concentrations of POPs are found.

Among birds, it is the kittiwake that sets the record. That is because the kittiwake spends the winter on the coasts of North America, where it receives a dose of POPs every year. Unlike the kittiwake, the black guillemot, which spends its whole life in the Arctic, has a lower load.

Eating the eggs of wild birds is particularly risky. The concentration of the pollutants in question is often high in such eggs. When the egg forms, the mother bird passes some of the pollutants that have accumulated in her body throughout her lifetime on to the egg. The mother bird thereby becomes a little "cleaner",

while the egg receives a dose of pollution.

A similar mechanism applies in the case of mammals, in which the POPs accumulate in fatty tissue. If a pregnant polar bear is exposed to POPs, the POPs will initially accumulate in the fat, but are carried round the body with the blood and thus delivered to the foetus. In both animals and humans it is in the foetuses rather than adult individuals that we can expect to see reproductive damage.

SUMMARY

It may seem paradoxical that heavy metals and POPs are an environmental problem in Greenland when Greenland lies far from the sources of pollution, which are to found in the southern latitudes. Furthermore, most of Greenland's fish and prawns, which are its main export products, are among the cleanest in the world. Greenlanders are only exposed to a high load of heavy metals and POPs from their diet, which, unlike that of Europeans and North Americans, includes a large proportion of marine mammals and marine birds. If a Dane lived in the same way as a hunter from Scoresbysund and ate seals, whales and birds from Danish waters, he or she would probably take over the world record for PCB content in the blood.

HORMONE-DISTURBING ENVIRONMENTAL CHEMICAL TOXINS

A NEW BIOCHEMICAL TEST METHOD SHOWS THE EFFECT ON HUMAN CELL FUNCTION OF HAVING SLOWLY DEGRADABLE ORGANIC ENVIRONMENTAL CHEMICAL TOXINS IN THE BLOOD. LABORATORY ANALYSES SHOW CLEAR DIOXIN-LIKE ACTIVITY AND EFFECTS ON THE HORMONE BALANCE IN BLOOD SPECIMENS FROM 140 GREENLANDERS.

It has been proven many times that the environmental chemical toxins dioxin, PCB, DDT and the nine other members of the so-called "dirty dozen" affect birds and mammals. Now, the effect of these organic dioxin-like and hormone-like substances has been tested in humans. The results show that these substances – which accumulate easily in animals and humans because they are fat-soluble – can affect the hormone balance and thus fertility, growth, the brain and the immune system. The risk of disturbances is thought to be greatest at the foetal stage.

The results have been obtained by researchers using the new method on a number of blood specimens from Greenland. What is new – and revolutionary – is that, with a relatively simple biochemical method, it is now possible to evaluate the effect on human cell functions of having problem environmental chemical toxins in the blood. The method is at the same time so sophisticated that the total effect of the accumulated toxins in a blood specimen can be measured directly through tests on human cells or mouse cells. By observing the cell culture we can see whether the toxins affect vital functions in the cells, such as the ability to receive hormonal influences.

INHIBITION OF THE FUNCTION OF NATURAL HORMONES

Researchers have used the new method to analyse 70 blood specimens for the effect of the dioxin-like substances in human blood directly on a cell culture system. The blood came from 70 people in six districts of Greenland (Upernavik, Ilulissat, Nuuk, Nanortalik, Ammassalik and Scoresbysund). The researchers describe the level of effect on the cell systems as worrying.

With the method for determining the hormonal effect of problem substances, the natural hormones have to be separated from the accumulated problem substance with hormone-like effect. This is the only way a blood specimen from a human being can be analysed for the effect of environmental chemical toxins on a human cell culture system.

70 other blood specimens, taken in the Ammassalik district, showed clear inhibition of the function of the natural hormones – in the cell cultures used, of course. The method thus gives only an indication of the damage the substances can cause in the body in the longer term.

The results are statistically significant, i.e. scientifically reliable.

THE RESULTS ARE A DANGER SIGNAL

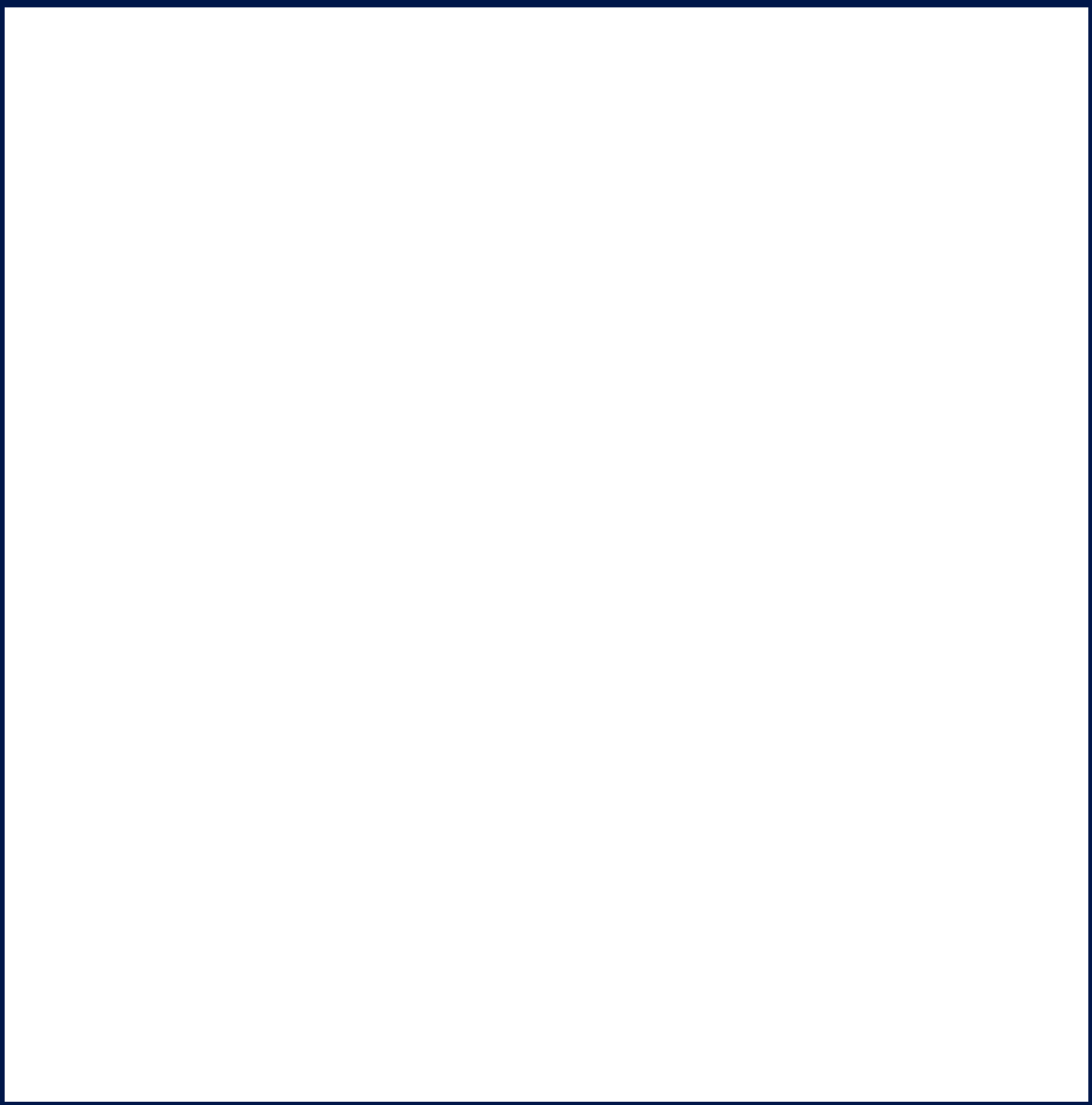
The method was developed at the Institutes of Environmental Medicine at the University of Southern Denmark and Aarhus University. One of the researchers behind the method, Eva Bonefeld-Jørgensen, Senior Lecturer at the Institute for Environment and Occupational Medicine at Aarhus University, says:

"It will take a whole generation before we know how the children of these people will be affected. The method gives a clear signal – in this case a danger signal – that can be transferred to other population groups with the same load levels."

Eva Bonefeld-Jørgensen presented the results at the AMAP 2 conference in Tromsø from 21 to 24 January 2002. At this conference 175 researchers from the eight Arctic countries gathered to discuss the impacts of heavy metals and "the dirty dozen" on Arctic environments.

With the signing of a new convention by 92 countries in Stockholm in May 2001, "the dirty dozen" were internationally banned. That was a pleasing and historic global event. However, it will take several generations for the impact from "the dirty dozen" to die away, and, on top of that, it emerged at the conference in Tromsø that there are not just 12, but at least 16 of these problem substances. Besides that, there are the relatively new brominated fire retardants, which are still being used in computers and elsewhere. Their impact is in many ways similar to that of "the dirty dozen".

A remarkably higher level of environmental chemical toxins is found in polar bears in east Greenland and on Svalbard than elsewhere in the Arctic. What is the level in humans that live in the same areas and have the same place in the food chain as polar bears?



Rasmus Ole Rasmussen

SHEEP FARMING AND SUSTAINABLE DEVELOPMENT

Sheep farming has been a subsidiary occupation in south Greenland since the beginning of the 20th century, and since 1924 it has also been a full-time occupation. In many ways, sheep farming fulfils the criteria for sustainable development set out in the Brundtland Report.

By Rasmus Ole Rasmussen

When people think about the Greenlandic landscape, they think of snow and ice, bare mountains and vast areas of tundra where reindeer and musk oxen roam as the only large mammals that can survive on the sparse vegetation. It therefore often comes as a surprise that south Greenland has verdant pastures, grass- and bush-clad hillsides and, in particularly sheltered valleys, even large trees. Similarly, sheep farming is seldom thought of as a traditional Greenlandic occupation.

However, besides the traditional chief occupations – hunting and fishing – sheep farming is one of the occupations that make a positive contribution to Greenland's economy. In 1989 an analysis showed that the contribution from sheep farming was more than DKK 4 million, after deduction of all production costs, interest payments, etc.

An important step in this development was a modernisation and development programme for the industry that saw the light of day in 1983. With this programme, the Federation of Greenlandic Sheep Farmers Associations, in cooperation with the Home Rule Government of Greenland, wanted to try to promote economic development that would help to achieve the Home Rule Government's vision of a society based mainly on the country's renewable resources. At that time, the basis for the development programme was around 60 years' sheep farming experience.

THE START

It all started in 1905/06, when Pastor Jens Chemnitz from Narsaq Kujalleq (Frederiksdal) drew attention to the possibilities for sheep farming in south Greenland. Until that time, colonists had taken sheep with them to supply the colony with food and milk, but no one had thought of sheep farming as a real occupation. Jens Chemnitz travelled to the Faroe Islands to learn about sheep management and returned to Qaqortoq (Julianehåb) in 1906 with the first flock of 11 animals – two rams and nine ewes. Later, another eight animals arrived, some Scottish sheep and 170 animals from Iceland. This led to the establishment of a sheep farm in Julianehåb in 1915.

At first, the area's hunters and fishermen kept sheep only to supplement their income, but that situation changed in 1924, when Otto Frederiksen settled in Qassiarsuk with 145 animals, thus becoming Greenland's first full-time sheep farmer. By 1935 Otto Frederiksen had increased his stock to 300 sheep, two cows and six horses, and – inspired by his success – another 14 sheep farms had been established. The settlements Qassiarsuk and Igaliko began functioning as centres for the new occupation.

DEPENDENCE ON NATURE

A very extensive form of sheep farming was practised, with the sheep out all year round, as in the Faroe Islands and on Iceland. That the sheep could be kept out in the somewhat colder and more snowy winter climate of south Greenland was due to the warm katabatic wind, which is called the föhn, and to the fact that the snow melts at regular intervals, making the vegetation available to the sheep.

However, in some years, the otherwise so

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In just over three generations, a completely modern, sustainable sheep farming industry has developed in south Greenland.

regular föhn does not occur, and then the sheep have difficulty in finding enough to eat. Or, worse still, the föhn only melts the surface snow, which then freezes into ice. When that happens, the sheep cannot get anything at all to eat. To remedy this problem, sheep farmers began experimenting with different forms of winter fodder made from local products, e.g. silage of grass and fish waste, and also began importing winter fodder. However, that had two drawbacks: firstly, it was costly and, secondly, it meant that the sheep gathered around the feeding place, treading down the vegetation and opening the landscape to increasing erosion.

Therefore, since the very start, sheep farmers in Greenland have had to learn to live with a wide range of uncertainties – firstly, uncertainty about how many sheep are going to survive the winter and thus uncertainty about income; secondly, the problem of obtaining and storing winter fodder in case there is no föhn; thirdly, growing attrition of vegetation and landscape; and lastly, the question of the yearly setting of the price for the farmers' products and thus the totally funda-

Rasmus Ole Rasmussen

mental problem of managing to live only from sheep farming.

THE HOME RULE GOVERNMENT'S DEVELOPMENT PROGRAMME

Those were the problems facing the Home Rule Government. They led to the decision to try a new development model that took account of some of the problems: the general uncertainty, the problem of winter feeding, and a change of sheep farming from a subsidiary occupation to principal occupation. Initially, the EU's Regional Fund promised support for the ideas, but with Greenland's withdrawal from the EU, the Home Rule Government intervened, guaranteeing the funding required by the development programme. The Federation of Greenlandic Sheep Farmers Associations), under the chairmanship of Kaj Egede, took care of the practical formulation. The seven main steps in the process were as follows:

Preparation of a general development programme, structured on the basis of such questions as principal occupation, securing winter fodder, better income conditions, better possibilities of communication, more social interaction, etc.

Mapping vegetation resources with a view to determining vegetation potential. As it was decided early on that the individual sheep farmer should be self-sufficient in winter fodder, the mapping work included indicating possible areas for intensive cultivation of winter fodder.

Development of the necessary technology for keeping and housing animals in the winter period. Keeping the animals in sheds makes it possible to minimise fodder consumption and reduce wear on vegetation around the feeding place.

Designing a programme for best possible use of the vegetation, which would also enable cooperation on machines and transport between the scattered sheep farms.

Clearance and cultivation of land to ensure the necessary winter fodder, construction of sheds and establishment of fences to ensure better utilisation of the vegetation and counteract overgrazing, and construction of roads and better harbour facilities.

Establishment of an advisory and training system that would live up to the overall aims, which included a vocational training course in sheep farming leading to qualification as a sheep farmer. This step also included specifying the aim of the individual sheep farming family being allowed to keep enough animals – typically 400 – to ensure the family a suitable income.

Implementation of the new system, a vital element of which was active participation by the sheep farmers themselves. This is helping to preserve the characteristic sheep farming culture that exists in south Greenland today and that has been developed over more than three generations.

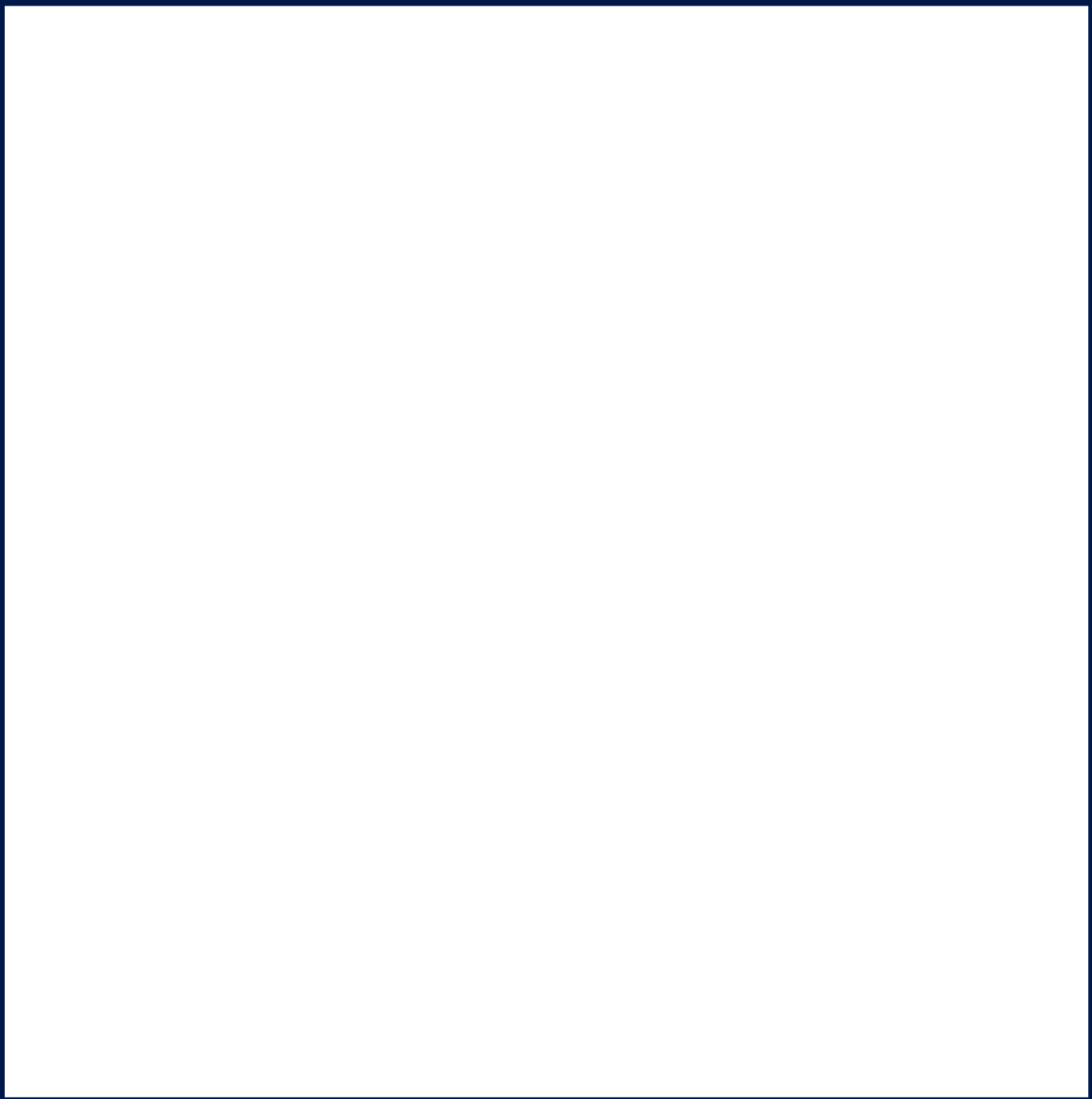
To give the industry an adequate economic basis, a tax was at the same time imposed on competing imported meat products with a view to making the relatively expensive home-produced products more attractive to consumers.

SUSTAINABLE DEVELOPMENT

For a very good reason, sustainability was not on the political agenda at the time the development of sheep farming took place. The development programme saw the light of day three years before the Brundtland Report. Despite this, there are many similarities between the goal defined for sustainable development and the way sheep farming in

It has been agreed that each sheep farming family shall be allowed to keep 400 sheep. That ensures a reasonable income without the farmer's land being worn down.

Rasmus Ole Rasmussen



Rasmus Ole Rasmussen

Greenland has actually been developed.

The principles of sustainable development have been summarised as follows: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

THIS NECESSITATES:

- a political system that ensures that the citizens are involved in the decision-making processes;
- an economic system that generates surplus and technological knowledge that ensures a self-generating system;
- a social system that guarantees solutions to problems resulting from unsustainable development;
- a production system that respects the need to maintain a sustainable basis for development;
- a technological system that develops or seeks new solutions;
- an international system that supports sustainable commercial and financial systems; and last, but not least,
- a flexible administrative system that is able to react to challenges.

The development programme has clearly helped to ensure suitable economic units, technological development with winter housing and methods of farming adapted to conditions in Greenland, a socio-cultural programme that ensures interaction between users, and a development process based on users' interests and active participation. Furthermore, an industry has been established that not only provides value today but also creates a basis for future generations.

However, that does not mean that the industry can just lay back and rest on its laurels. Sheep farming is not yet an industry that will always contribute to a sustainable development process. Poor management of resources, lack of reaction to overgrazing, an inadequate market price, etc. can all shift the balance. And today's market conditions and economic problems are already changing the picture. However, the important thing is that a basis has been created that can be built on!

Rasmus Ole Rasmussen

New and improved solutions must constantly be found within sheep farming.

ESSENTIAL COMMUNICATION IN A NEW AGE

Use of nature guides is a way of encouraging debate on Greenland's environment and resources.

"Seal hunting – that's something schoolchildren like to learn about," says Îsâvaraq Petrussen, who is the nature guide in Nuuk (Godthåb). He is a qualified primary and lower secondary school teacher. After teaching for 10 years, he underwent further training at the Danish University of Education. He then saw a job ad in "Grønlandsposten" for a nature guide, applied and got the job.

HUNTING TRIP

There are five schools in Nuuk. The nature guide works mainly with remedial classes, i.e. pupils that do not fit in in normal classes. He concentrates on remedial classes because they are small and there is not much room in the boats. On the hunting trip, he takes the children into Godthåbsfjord and south of Nuuk. It is mostly boys that take part. When a seal has been shot, the boat sails to an island and anchors up there. The seal is taken up onto the beach and cut up, the innards being thrown away. "While that is going on we talk about food chains, about whether there are hunting quotas for certain animals and about conservation." When the children come again they can continue working on the subject of the Greenland seal in school and cook food at school.

Îsâvaraq Petrussen says, "I began working as a nature guide in August 1999 and have been on a sealing trip like that every week in October and November. They have all been wonderful trips.

The sailing season largely ends in the middle of December. Then one can go ptarmigan hunting in the mountains behind here," says Îsâvaraq, pointing over his shoulder. "I am going to try that this year."

THE WATER CYCLE

This autumn the nature guide arranged trips to the local waterworks, where water is cleaned and checked. The waterworks staff tell the children about the substances they put in the water and how the water is piped to households and factories. "I usually take the children out to a vantage point from which we can see all the elements of the water cycle in the Nuuk district: the clouds, the lake, the waterworks, the town." At the same time, the nature guide tells the children about traces of the Ice Age in the landscape, about the gigantic rock in the middle of everything – where did that come from? The answer: the Ice Age brought it.

Îsâvaraq Petrussen

It is mostly boys who participate in the hunting trips arranged by the nature guide.

Isåvaraq Petrussen

Isåvaraq Petrussen

ENVIRONMENTAL DEBATE

The Danish Ornithological Society has established a local group in Nuuk. The Worldwide Wildlife Fund has gone out of it way to please by paying a visit to Greenland. The Danish Society for the Conservation of Nature, the Danish hunting associations, etc. are trying to gain a foothold in Greenland. What is the best way of promoting debate about the environment in Greenland?

There is already an association for amateur hunters. They are interested in hunting reindeer and musk oxen. They are involved in the debate about the number of reindeer and musk oxen that may be shot. They have also had their say about the beluga and narwhale quotas and intervened in the debate on hunting guillemot.

It used to be only the local professional fishermen's organisation KNAPP that held public debates in the community centres.

Îsâvaraq Petrussen says, "When I was a child, our family used to go char fishing for six weeks every summer. Salted char, dried char, smoked char. Nobody does that much any more. A time will probably come when ordinary folk want to discuss these topics."

In other words, an argument for nature guides in the growing towns around the coast. This message is being sent to the Greenlandic Cabinet right now.

The Danish Outdoor Council, the Home Rule Government and Nuuk Municipality are pay the salary of Greenland's first nature guide.

As the population gradually migrate to Greenland's large towns, there is a growing need for outdoor leisure activities. The nature guide discusses matters with people "on the spot".

"When I was a child, our family used to go char fishing for six weeks every summer. Nobody does that much any more." Îsâvaraq Petrussen says. A time will probably come when ordinary people want to discuss these topics in the growing towns around the coast.

Îsâvaraq Petrussen

It is the ice that has shaped the landscape – ice has transported this gigantic boulder, for example.

THE BIGGEST ISLAND IN THE WORLD

Greenland is the biggest island in the world. It stretches from Nunap Isua (Kap Farvel) in the south at 59°46' N lat to Odaap Qeqertaa (Odak Island) at 83°40' N lat. The polar circle crosses the country at 66°33' N lat, which means that north of it you can experience polar night and the midnight sun. The further north, the longer the periods of polar dark and polar light.

The country covers an area of 2,175,600 km^2. Only about fifteen percent of the country is free of ice; the rest is covered by the world's second-largest ice sheet: the inland ice. It contains nine percent of the world's fresh water, and is 3,500 m deep at its thickest. In some areas near the coast, mountaintops protrude above the ice, and form islands of land, known as nunatakker. In places where the glaciers reach all the way to the sea, icebergs break off and are carried away by the sea currents. The coast of Greenland, which is about 40,000 km long, consists mostly of skerries, with innumerable big and small islands and fjords.

CLIMATE

Greenland is located in the Arctic. That means that the average temperature in the summer is never over 10°C, that there is permafrost, so only the top layers of soil thaw in the summer, that the country has little rainfall, and no forests, only a little brush and bushes as tall as a man in south Greenland. The country can be divided into subarctic, low-Arctic and high-Arctic climate zones (see map). The lowest precipitation levels are in North Greenland, where there is arctic desert in some areas. South Greenland receives more precipitation, and is fertile enough for limited agriculture.

Several systems of sea currents meet in Greenlandic waters. They influence the temperature and salt content of the sea, and thus the occurrence of marine organisms. The sea currents also determine the spread of the sea ice. Because of the sea ice, the areas from Qeqertarsuup Tunua (Disko Bay) north, as well as the east coast can only be navigated for a few months in the summer. Off of West Greenland from Paamiut (Frederikshåb) to Sisimiut (Holsteinsborg), is what is known as the open water area, where the fjords and waters near the coast freeze only occasionally in the winter.

POPULATION

Greenland is divided into eighteen municipalities, each with a capital city and with fifty-nine villages in all. The population in 1996 was about 56,000, about eighty percent urban dwellers and twenty percent village dwellers. By far the largest part of the population lives in West Greenland, in Paamiut (Frederikshåb), Nuuk (Godthåb), Maniitsoq (Sukkertoppen), and Sisimiut (Holsteinsborg) municipalities. The southern municipalities, and the hunting regions, which include Uummannaq, Upernavik, Qaanaaq as well as Tasiilaq (Ammassalik) and Ittoqqortoormiit (Scoresbysund) municipalities, are the most sparsely populated.

OCCUPATION

Fishing is the main occupation, and is estimated to employ about 2,500 people directly, with about 3,000 employed in the fishing industry. Besides this, a number of people work in jobs related to fishing. Hunting is of direct or indirect significance for about twenty percent of the population, and is the principle occupation in Qaanaaq, Upernavik, Uummannaq, Tasiilaq (Ammassalik) and Ittoqqortoormiit (Scoresbysund) municipalities. Sheep and reindeer are raised in south Greenland. It is expected that tourism and the extraction of raw materials will become leading industries, and will supplement fishing in the future.

PROJECTS

Project title: AMAP Assessment-kontrakter
J.no. 123/000-0013
Project holder: Aarhus Universitet

Project title: AMAP implementering/ moniteringskontrakt 97-98
J.no. 123/000-0033
Project holder: Aarhus Universitet

Project title: Varetagelse af AMAP Lead country opgaver for Human Health.
J.no. 123/000-0090
Project holder: Aarhus Universitet

Project title: Bestemmelse af total dioxin aktivitet i humant blod: En stærk biomarkør.
J.no. 123/000-0193

Project holder: Aarhus Universitet

Project title: Miljøforurening og børns udvikling i Arktis.
J.no. 123/000-0194
Project holder: Statens Institut for Folkesundhed

Project title: Lead country function – Human Health
J.no. 123/000-0201
Project holder: Aarhus Universitet

Project title: National and international assessment on the human health programme in Greenland 2001-2002
J.no. 123/000-0202
Project holder: Aarhus Universitet

Project title: Biostatisk og epidemiologisk vurdering af den humane belastning af kontaminanter og levevis ifm. AMAP-projekt.
J.no. 123/001-0069
Project holder: Aarhus Universitet

Project title: Kontaminantanalyser i grønlandske fødevarer.
J.no. 123/001-0085
Project holder: Danmarks Miljøundersøgelser

Project title: Sundhedsmæssige virkninger af blyhagl i grønlandske fugle.
J.no. 123/001-0086
Project holder: Danmarks Miljøundersøgelser

Project title: AMAP Human Health Program fase 2 1998-1999.
J.no. 123/001-0091
Project holder: Aarhus Universitet

Project title: AMAP Human Health Program, 2nd. Phase.
J.no. 123/001-0186
Project holder: Aarhus Universitet

Project title: AMAP Lead country function – human health
J.no. 123001-0187
Project holder: Aarhus Universitet

Project title: Screening of contaminants in Greenland Human Diet.
J.no. 123/001-0283
Project holder: Danmarks Miljøundersøgelser

Project title: AMAP-implementering, human health
J.no. 123-0004
Project holder: Aarhus Universitet
Project title: Udvikling og etablering af energistatistik.
J.no. 123/001-0161
Project holder: Grønlands Statistik

Project title: Opdatering og udbygning af planlægningsgrundlaget for energiforsyningeni Grønland
J.no. 123/001-0168
Project holder: Grønlands Energiforsyning

Project title: Miljøforurening og børns udvikling i Arktis
J.no. 123/001-0035
Project holder: Statens Institut for Folkesundhed

Project title: Den grønlandske befolknings opfattelse af sammenhænge mellem kost og forurening.
J.no. 123/001-0105
Project holder: Statens Institut for Folkesundhed

Project title: Styring af græsningstrykket ved fjeldgræsning med får ved hjælp af indikatorplanter.
J.no. 123/001-0117
Project holder: Konsulenttjenesten for fåreavl

Project title: Naturskole i Grønland
J.no. 123/001-0124
Project holder: Nuuk Kommune

Project title: Olie- og benzinspild – en trussel for vandmiljøet?
J.no. 123/001-0220
Project holder: Danmarks Tekniske Universitet

Project title: Solvarmeanlæg i Sisimiut 2000
J.no. 123/001-0221
Project holder: Bygge- og anlægsskolen

Project title: Miljø og sygdom blandt Inuit i Grønland, Canada og Alaska.
J.no. 123/001-0264
Project holder: Statens Institut for Folkesundhed

Project title: Marint fedt – human ernæring og trofiske relationer belyst gennem fedtsyrer.
J.no. 123/001-0269
Project holder: Danmarks Miljøunder-

søgelser

Project title: Naturformidling Sisimiut
J.no. 123/001-0151
Project holder: Sisimiut Kommune

Project title: Opdatering og udbygning af planlægningsgrundlaget for drikkevandsforsyning i Grønland
J.no. 123/001-0192
Project holder: Grønlands Energiforsyning

Project title: Sektorprogram vedr. miljø- og energiforbedrende renovering i Grønland.
J.no. 123/001-0163
Project holder: Grønlands Hjemmestyre.