DET KONGELIGE DEPARTEMENT
FOR HANDEL, SJØFART, INDUSTRI, HÅNDVERK OG FISKERI

NORGES SVALBARD- OG ISHAVS-UNDERSØKELSER
LEDER: ADOLF HOEL

SKRIFTER OM SVALBARD OG ISHAVET

Nr. 74

SOME INVESTIGATIONS INTO THE PHYSIOLOGY AND NOSOLOGY OF ESKIMOS FROM ANGMAGSSALIK IN GREENLAND

A PRELIMINARY STATEMENT

BY

ARNE HØYGAARD

WITH 1 MAP AND 3 TEXT-FIGURES

OSLO
I KOMMISJON HOS JACOB DYBWAD
1937

RESULTS OF THE NORWEGIAN EXPEDITIONS TO SVALBARD 1906—1926 PUBLISHED IN OTHER SERIES

(See Nr. 1 of this series.)

The results of the Prince of Monaco's expeditions (Mission Isachsen) in 1906 and 1907 were published under the title of 'Exploration du Nord-Ouest du Spitsberg entreprise sous les auspices de S. A. S. le Prince de Monaco par la Mission Isachsen', in Résultats des Campagnes scientifiques, Albert Ier, Prince de Monaco, Fasc. XL—XLIV. Monaco.

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With map: Spitsberg (Côte Nord-Ouest). Scale 1 : 100 000. (2 sheets.) Charts: De la Partie Nord du Foreland à la Baie Magdalena, and Mouillages de la Côte Ouest du Spitsberg.

ISACHSEN, GUNNAR et ADOLF HOEL, Deuxième Partie. Description du champ d'opération. Fasc. XLI. 1913. Fr. 80.00.

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RESVOLL HOLMSEN, HANNA, Cinquième Partie. Observations botaniques. Fasc. XLIV, 1913. Fr. 40.00.

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GOLDSCHMIDT, V. M., Petrographische Untersuchung einiger Eruptivgesteine von Nordwestspitzbergen. 1911, No. 9. Kr. 0,80.

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HOLTEDAHL, OLAF, Zur Kenntnis der Karbonablagerungen des westlichen Spitzbergens. I. Eine Fauna der Moskauer Stufe. 1911, No. 10. Kr. 3,00. II. Allgemeine stratigraphische und tektonische Beobachtungen. 1912, No. 23. Kr. 5,00.

HOEL, ADOLF, Observations sur la vitesse d'écoulement et sur l'ablation du Glacier Lilliehöök au Spitsberg 1907—1912. 1916, No. 4. Kr. 2,20.

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GUNNAR ISACHSEN has also published: Green Harbour, in *Norsk Geogr. Selsk. Aarb.*, Kristiania, 1912—13, Green Harbour, Spitsbergen, in *Scot. geogr. Mag.*, Edinburgh, 1915, and, Spitsbergen: Notes to accompany map, in *Geogr. Journ.*, London, 1915.

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Maps:

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East Greenland. Eirik Raudes Land from Sofiasund to Youngsund. 1 : 200 000. 1932. Kr. 5,00.

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A. W. BRØGGERS BOKTRYKKERI A/S

In the matter of diet the Eskimos occupy a somewhat peculiar position among human beings, in so far as they live mainly on an animal diet and are unable to procure milk. Such a diet, it has been assumed, would be insufficient for a European, as it contains too few carbohydrates, vitamins, and too little calcium.

In this connection the following questions arise:

1. Is animal food sufficient, after all, or is it supplemented in the case of the Eskimos by a vegetable diet to such an extent as to render it sufficient?
2. Does metabolism in Eskimos differ from that in Europeans in such a manner that a possible deficiency in diet is thereby compensated?
3. Or do the Eskimos, in fact, suffer from disorders arising from diet caused by a lack of carbohydrates, vitamins, and calcium?
4. Are several of the possibilities mentioned under 1., 2., and 3. present at one and the same time?

In collaboration with Professor Sophus Torup, M. D., the late head of the Institute of Physiology, University of Oslo, who has for many years been deeply interested in the physiology of Arctic races, a scheme of work was drawn up which he considered would contribute to the solution of the questions referred to. The scheme received the support of Professor Einar Langfeldt, M. D., the present head of the Institute and donations from a number of scientific funds enabled the plan to be realised.

Briefly, the scheme aimed at the establishment of a chemical-physiological laboratory at some place in the Arctic regions where there were sufficient Eskimos and possibilities of residence, and to which access was fairly easy. The previous investigations into the physiology of the Eskimos has been carried out during the summer months, and the time which could be devoted to them was too short to enable them to be sufficiently thorough. In the case of our own work it was, therefore, deemed necessary to winter for a year, or even two. On the advice of Mr. Daugaard-Jensen, director of the Greenland Board, Angmagssalik in East Greenland (lat. 65 1/2° N) was chosen as the most suitable locality. This place was discovered by Gustav Holm as recently as 1884,

and the drift-ice barrier of the coast of East Greenland has always proved an obstacle to regular navigation. In 1894 the primitive inhabitants, who were beginning to emigrate to the west Greenland coast with its tempting shops, were placed under European administration, and since that time they have continued their life at Angmagssalik in the same manner as their forefathers, living mainly by hunting and fishing. They live in huts built of stone and earth, widely scattered over a long coast-line, but during the summer months they congregate in three large communities and live in tents, a circumstance which facilitates investigations of all kinds. In all, there are now 830 individuals living at Angmagssalik. One minister and two teachers, all of them with families have arrived from the West Coast of Greenland. One girl, 16 years old and a 1 year old child are halfblooded. As far as can be ascertained there is no other European strain in the population.

During the course of one year, (1936—37), the following investigations were to be made:

1. Dietetic Investigations.

As far as possible all foodstuffs received into the homes of selected good and bad hunters were to be weighed, as were also all remains. Preserved samples were to be brought home for the chemical determination of nutritive substances. All species of animals and plants used for food were to be determined zoologically and botanically, and if necessary brought home. The preparation of the food was to be studied.

All foodstuffs were to be examined for vitamin C by Emmerie's method.

2. Examination of Inhabitants.

A schedule for the examinations was drawn up in advance. According to this repeated examinations were to be performed during the year, particularly with regard to vitamin (A, B_1, C, D, P-P factor) deficiency diseases, such as scurvy, beri-beri, rickets, spasmophilia, pellagra, and the like.

The following special examinations were to be made:

Measurements of the height in standing and sitting positions, as well as the body weight.

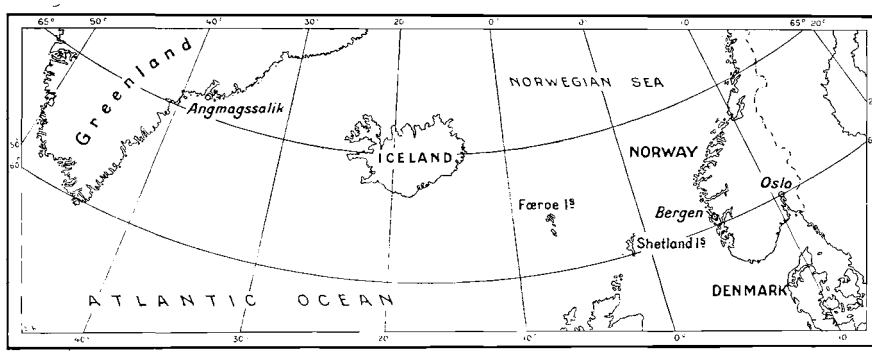
Examinations of the teeth (for caries, gingivitis, irregularities). X-ray examinations, especially with a view to discover the presence of denticles.

The presence of tori.

Gøthlin's test.

Determination of vitamin C in blood and urine.

Hemeralopi investigations.



The Pirquet reaction.
The blood pressure.
Examination of spasmophilia with a chronaximetre.
Haemoglobin in the blood.
Counting of red and white corpuscles.
Examination of blood smears.
Calcium and phosphorus in the blood.
Determinations of the blood sugar.
Examination of syphilis by Meinecke's reaction.
The basal metabolism.
The alkali reserve.

In addition, examinations with a view to other conditions such as anomalies, the special female functions, venereal diseases, etc.

3. Experimental Laboratory Tests.

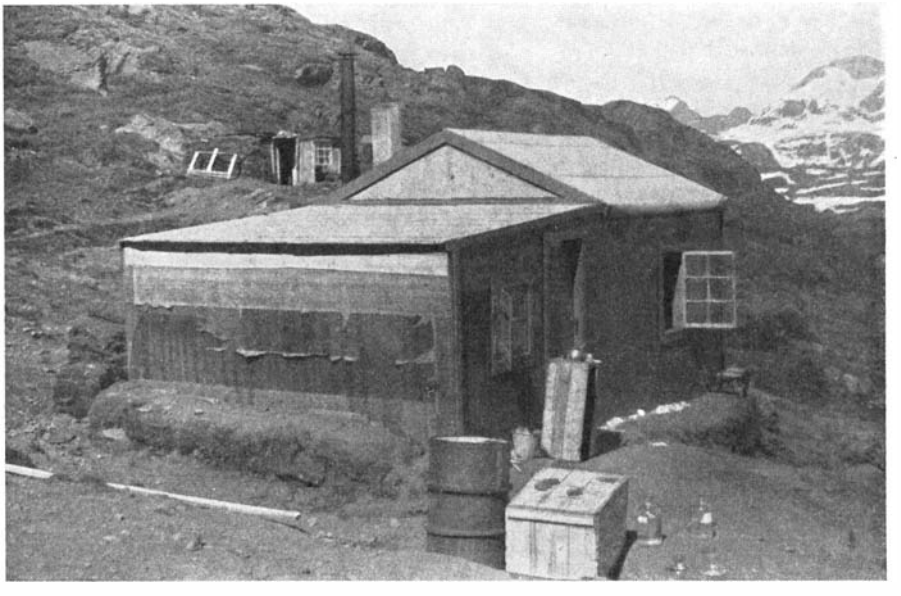
It was proposed to perform experiments with different types of diet (starvation, diet rich in fat, diet rich in proteins and diet rich in carbohydrates).

In these experiments the following analyses were to be performed:

A. Measurement of the gaseous metabolism (O_2-uptake, CO_2-output),
B. Examination of the urine (volume, specific gravity, titratable acidity, pH, urea, nitrogen, ammonia, acetone bodies).
C. Estimation of the alkali reserve of the blood.
D. Ingestion of glucose and simultaneous registration of the respiratory quotient.

It was further on proprosed to provoke scurvy and to study the effect of ingestion of ascorbic acid.

On 12th of February 1936 the Danish authorities informed me that my *permis de sejour* had been granted, and on August 8th I left Copenhagen by S/S "Gertrud Rask" belonging to the Greenland Trading Company.

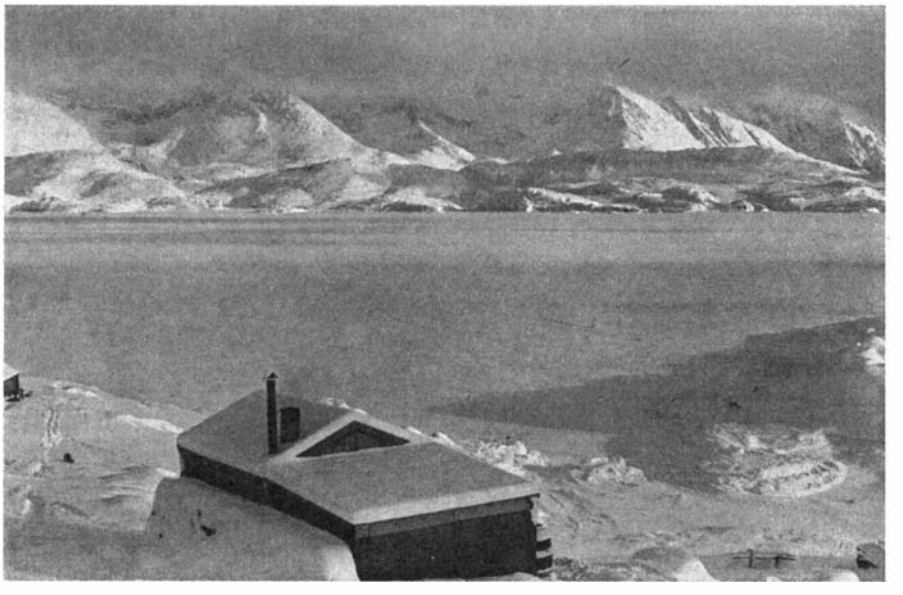


Our Laboratory in the Summer.

My wife travelled with me and we were accompanied by Mr. Falsen Krohn, a medical student, and Mr. Harald Waage Rasmussen, a student of chemistry, who where to act as my assistants. We made a quick passage and on August 17th we arrived in ice-free water to Angmagssalik and anchored in the harbour at Tasîssaq, where the Danish colony is situated.

On the arrival of the ship many Eskimos had come down to Tasîssaq and there was, therefore, no lack of help for the erection of the laboratory and the engine house. In the course of a fortnight the buildings were ready for use. The main building, the laboratory, consisted of two rooms of 3×3 metres and $3\,1/2 \times 3$ metres. The walls had a double panelling with a layer of pulp-board between. On account of the extraordinarily stormy weather prevailing during the winter it was necessary to bolt the house securely to a foundation of cement, and on the side exposed to the land ice a wall of cement and peat had to be built of a thickness of about one metre. The engine house was carefully bolted to a cast foundation on which our small electric plant, a Delco engine, was placed. This small plant produced about 800 watt, sufficient to supply lighting and power for our motors.

There was, in Angmagssalik, a Danish nurse by name of Miss Signe West, who managed the small hospital there. The Danish authorities placed this hospital at our disposal for our investigations, and at the same time Miss West was informed by the Greenland Board that I was to act as the local doctor during my stay there. Throughout the winter



Our Laboratory in the Winter.

the nurse proved an excellent assistant, and I also received help from Miss Sara Tønnesen, another Danish lady. Both were familiarised with a few of the methods employed. The native midwife Sofie proved capable of carrying out the work of weighing up diet in the houses.

A well-built wooden house erected by a ship's crew about the year 1900 was placed at our disposal free of charge by the Danish authorities. The house contained two good rooms and a small kitchen. In Tasîssaq there were, in addition to our party, seven other Europeans. There was a wireless station which circulated news every day through the medium of a radio newspaper. Of the 830 natives 113 lived at Tasîssaq, while the remainder lived in large and small communities on the coast from Kangerdlugsuatsiak in the north to Umivik in the south.

A motorboat was placed at my disposal by the Danish authorities on condition that, in the course of my journeys, I would undertake general medical work. This, thanks to the good state of health of the population, occupied less time than expected.

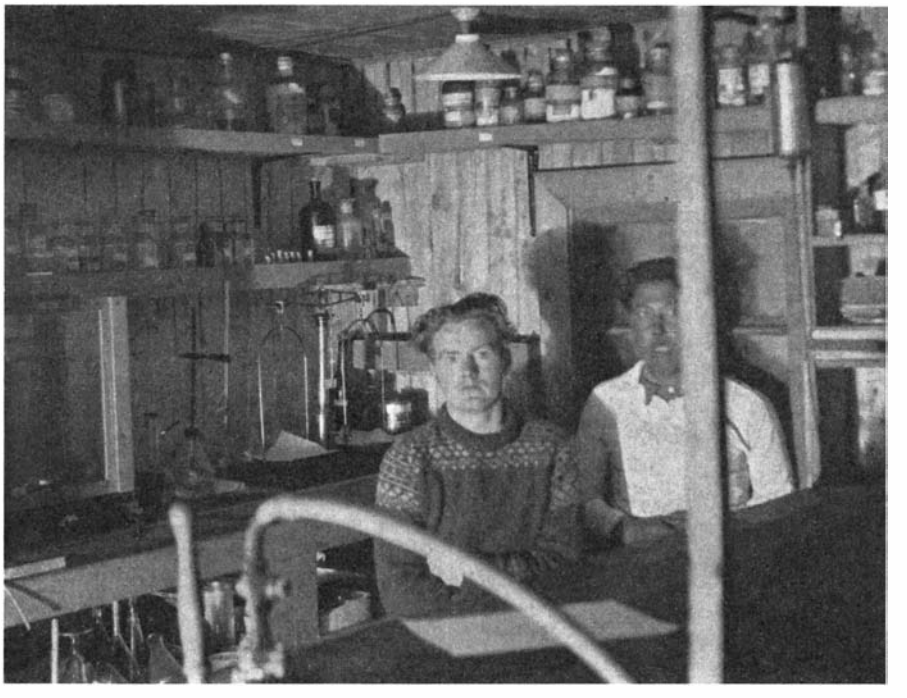
Sea journeys can only be made, as a rule, during the period July—October. The ice conditions are so difficult in November, December, and January, and the weather so stormy that journeys generally are impossible both on land and water. From February until June the district can be covered with the aid of dog sledges. In the autumn of 1936 ice conditions were so good that we were able to use the motor boat for journeys until late November. This enabled us to undertake haemoglobin and dietetic investigations for a much longer

period in the autumn than we had anticipated. From December until February we were obliged to remain at the colony and we employed our time in metabolic investigations in the laboratory. Fortunately, we had arranged with an Eskimo at Ikagteq to weigh up the diet in his own house (Adolf). He was probably the only man in the district capable of undertaking such a task.

The Eskimo inhabitants were exceedingly easy to co-operate with, and nakorsaq, the doctor, was held in great respect and regarded with awe. In the dietetic investigations, however, the majority of the families proved very unreliable, and it was necessary to be present in the houses to guard against cheating. In the beginning also the language caused us great difficulty and during the first six months we were compelled to employ Miss Tønnesen, the nurse, or Sofie as an interpreter.

In spite of these difficulties we were able to carry out our dietetic investigations according to the plan. The inhabitants of the surrounding district lived, in the main, as did their forefathers, by hunting the seal, the bear, and the narwhale, and on fish caught in the sea and rivers. The natives permanently domiciled in the colony subsisted to a great extent on rye and wheaten bread, rye biscuits, margarine, sugar, and tea. The preparation and storage of food by the Eskimos living in a primitive state would at first seem to be quite simple, but a closer study revealed quite a member of variations. The foodstuffs were eaten in a raw condition, or in a cooked, dried, semi-rotten or frozen state, or they were stored in skin bags together with oil from seal blubber for winter consumption. The preparation of a blubber bag of this kind was, in reality, a great art with which only the old people were completely familiar. And in a good blubber bag plants preserved their green colouring the whole winter and a great proportion of their vitamin C. Customs in the matter of eating food were, in reality, more complicated than would at first be supposed.

The vitamin C content of all the food was examined by the Emmerie's method, like that of all the mammals, birds, and fishes, as well as of all plants which formed part of the diet. It appeared that a great part of vitamin C was extracted by cooking. Thus, in uncooked muscle of *Phoca phoetida* there was 2.8 mg of ascorbic acid per 100 g, in boiled meat 0.5 mg per 100 g. On examination the water used for the boiling proved to contain a large part of the vitamin. In general, the water is thrown away after boiling (given to the dogs), a proceeding which, in an environment so deficient in vitamin C as that in question, is extremely irrational. Seal meat is preferably boiled with the other organs, and thus these are also deprived of a large part of their vitamin C. It may be mentioned that a number of the organs of seals, fish, and birds contained an abundance of vitamin C, first and foremost the suprarenal glands, and also the eyes, nerve systems, liver, thymus, and spleen.



A Corner in the Laboratory. Waage Rasmussen and a Native.

Thus, the blood of the *Phoca phoetida* was remarkably rich in vitamin C, namely, 2.8 mg per 100 g. Altogether it may be said that fresh animal food prepared in the Eskimo manner yielded approximately 50 mg ascorbic acid per individual. If the soup in which it was boiled was drunk, then considerably more. It was observed that the epidermis of the narwhale (*Monodon monocerus*) was very rich in vitamin C (17 mg per 100 g). The skin of the narwhale (mâtâk) is, as a matter of fact, and old well-known anti-scurvy remedy.

The food of the Eskimos may consist for long periods of dried meat, frozen seals, blubber, dried blood, and dried ammasat-fish.[1] As these foods do not contain any appreciable quantities of vitamin C, there would undoubtedly be a scarcity of this substance if the diet were not supplemented with large quantities of seaweed which is rich in vitamin C. During the autumn of 1936 studies of the presence of vitamin C by the Emmerie method were undertaken. The following figures are of interest:

Alaria Pylaii ("kipilasat")	47	mg per 100 g
Fucus spec. ("misarkat")	13	—„—
Rhodymenia palmata ("emertikat") .	17	—„—
Ascophyllum nodosum ("miserarnat")	11	—„—

[1] *Mallotus villosus*, or caplin (capelan).

As a rule the seaweed was consumed raw and in a fresh condition, at other times it was dipped into boiling water or soup (until it became green) shortly before being eaten. During a visit to Iceland and the Faroe Islands I was told that there also seaweed used to be eaten, and that even at the present day the children had "the bad habit" of going to the beach to eat seaweed. In Japan alga is a very much-prized dish and is served in restaurants in the shape of salads. It has later been told me that also the Chinese and the natives on the Polynesian islands have the habit of eating seaweed.

In the summer the Angmagssalik Eskimos eat the roots, stalks, leaves and flowers of a number of plants. The most important of these are:

Dandelion — Taraxacum officinale
Rosewort — Sedum roseum L.
— Oxyria digyna
Thyme — Thymus serpyllum
Hare Rue — Polygonum viviparum L.
— Salix herbacea L.
Angelia — Angelica
Some species of Saxifraga.
In addition:
Whortleberry — Vaccinium uliginosum, and for a long time throughout the winter:
Crakeberries — Empetrum hermaphroditum.

The eight first mentioned species are rich in vitamin C. The whortleberries and the crakeberries contain small amounts only.

During the summer the food of the primitive Eskimos is undoubtedly sufficient as regards vitamin C, while in the late autumn and winter seaweed is a capital source of supply of this substance and, for a long period, practically the only one. At certain times, and in certain places, it is practically impossible to obtain seaweed during the winter, and where this is the case the diet of the Eskimos must be deficient in vitamin C. It is true that at certain places mussels are eaten all the year round, but not regularly or in considerable quantities. Examinations of this class of food revealed a more moderate content of vitamin C, (3 mg. pr. 100 g). The same may be said of a certain species of crustacean which is occasionally eaten (5 mg pr. 100 g).

Whereas among those members of the community who lived in the outlying districts and subsisted on the primitive Eskimo diet, caries was practically unknown, it was fairly frequent in the case of the Eskimos who lived in the vicinity of the shop. Blood samples were therefore taken in order to estimate calcium and phosphorus in the blood of both groups.

On July 26 the first ship, the "Gertrud Rask" brought Dr. P. O. Pedersen, a dentist, and his wife. They were accompanied by

his assistant, Dr. Einar Hinsch, also a dentist. All three were from Copenhagen. As I wished to make careful investigations with regard to the teeth of the Eskimos in conjunction with my dietetic studies, particularly in relation to gingivitis and the occurrence of denticles, I had made an agreement with Dr. Ingjald Reichborn-Kjennerud, a Norwegian dentist, to come to Angmagssalik, if possible in the spring of 1937. The Danish dentist referred to, however, had sent in his application for a *permis de sejour* before Dr. Reichborn-Kjennerud, and was given the preference by the Greenland Board. He had planned his own investigations in such a manner that we were able to work together in the most perfect harmony. Professor K. E. Schreiner of the University Anatomical Institute in Oslo has found the simultaneous and frequent occurrence of arthroses and tori (*torus mandibularis*, *torus palatinus* and *torus alveolaris*) and has advanced the theory that both the arthroses and the torus have a common cause, possibly one or another avitaminosis. As I — sharing the view of Professor Torup — always have considered it reasonable to assume that all the circumpolar races live on the border-line of an avitaminosis C it was essential for me to study the teeth and gingiva with special reference to this. Dr. Pedersen showed that inflammations of the gums, both active and those which had run their course, were very frequent among the Angmagssalik Eskimos, as were also tori of all kinds, and it was particularly interesting to find quite young persons, not more than 14 years of age, with *torus mandibularis*, and also very young people with pronounced changes in the gingiva. A number of blood tests were taken (during fasting) from individuals with pronounced changes in the gingiva and the vitamin-C content was determined. As might be expected at this time of the year, when everyone had used vegetable food (flowers and leaves) for a considerable period, no particularly low content of vitamin C was found in the blood.

In addition, in the month of May a number of determinations of the capillary resistance were made by the Gøthlin method, but this method did not yield synonymous results. In one case (that of the French etnographer Paul Emil Victor) with manifest scurvy the result obtained after a quarter of an hour was 0 petechiaes with 35 mm pressure and 7 petechiaes with 65 mm.

The seasonal examination of the natives was not attended with any special difficulties apart from the miserable weather conditions which prevailed. Thus, one journey which was estimated to take two to three days stretched over as many weeks. The obstacles in this respect were storms, impassable drift-ice, and open fjords which could not be crossed either by boat or sledge. The people were easy to get on with, partly as a result of gifts. Thanks to the policy of the Danish Monopoly Board

the people were only acquainted with the good qualities of the white man and we were therefore received with confidence.

The mentality of the Angmagssalik Eskimo is very interesting, and it would undoubtedly be a congenial task for the psychologist or the socialogist to study the individual on the spot. A knowledge of the language would be necessary and the investigator would require to devote a couple of winters to the task. The Angmagssalik Eskimo is by nature friendly, intelligent, lively, and merry, and as a rule he is considerate to his fellow-men. His feelings do not always go very deep and he quickly forgets sorrows, joys, devotion, gratitude, and anger. An angry disposition is regarded by the Eskimo as a very bad quality, and if we had exhibited signs of bad temper we should have run the risk of "finding the waiting room empty" when the time came for medical examinations. When weights and measurements were to be taken we experienced no great difficulty in prevailing on our subjects to undress, but they were remarkably shy before one another.

We discovered only two cases of definite avitaminoses among the Greenlanders during the whole year. There was possibly slight rickets in the case of three small children in the colony, but none in the outlying district. I did not find any manifest cases of scurvy, beri-beri, pellagra, or sprue among the natives. Systematic examinations for haemeralopia with the Tscherning's glasses yielded an abnormally low figure in two cases and the ability to distinguish was improved by dosing with vitamin A. In the early part of the year there were a number of cases of glare blindness. This complaint has frequently been placed in conjunction with a lack of vitamin A, but in none of the cases which I examined with the aid of the Tscherning's glasses was there any reduction in distinguishing power.

In the spring in particular, bleeding from the nose was very common. This did not appear to have any connection with C hypo-vitaminosis.

With the aid of a chronaximeter investigations were carried out during the whole year into the irritability of muscles and nerves, but it was not possible to diagnose a single case of spasmophilia.

The blood pressure of the majority of the individuals was taken and no hyper-tensions were found. Arteriosclerosis, on the other hand, was by no means an uncommon occurrence.

At the various seasons of the year blood colour determinations were made with the Sahli apparatus. Furthermore, some countings were made of the red and white corpuscles, while a number of blood smears were taken for the closer study of the white corpuscles.

In no case was there any reason to proceed to Meinecke's reaction in the blood, and no cases of gonorrhæa were found.

Among other special investigations which were carried out mention may be made of the following:

Determination of blood sugar in individuals in a fasting state, determination of the alkali reserve, made during fasting in the case of individuals living on a genuine Eskimo diet, on a diet rich in carbohydrates and after 3—4 days fasting. Furthermore, a number of determinations of basal metabolism were undertaken according to Knipping's method, and metabolic tests with varying diet, e. g., with fat ingestion, and hunger. In addition a number of determinations of R. Q. were made after doses of glucose administered to individuals who for some time previously had been on a diet rich in proteins, a hunger diet, and diets rich in carbo-hydrates or fat. Nothing definite can be reported in regard to this material at the present time, but it seems as if conditions in this respect are not different in Eskimos from those prevailing in Europeans.

Particular attention was paid to tuberculosis, and a very thorough investigation was made of the chronic hæmoptysis conditions which had been described by previous workers as a disease which could not be due to Koch's bacilli, but to a mycosis. My investigations indicate that the disease is tuberculosis and nothing else. The frequency of positive Pirquet reactions amounted for the entire population to about 15%, in 40% of which there were manifestations of tuberculosis, particularly hæmoptyses with and without demonstrable physicalia. A fact worth mentioning is that at a remote village there were 38 inhabitants who all yielded a negative Pirquet reaction (the examination was made twice). There were signs which showed that in the outlying district the prognosis of tuberculosis was different from that in the colony. Thus, several cases were observed in the colony of acute consumption (4 being miliary tuberculosis, 3 of which occurred almost simultaneously in the same household. In these 3 cases the disease first showed itself in the form of erythema nodosum in three children with a negative Pirquet, and all three died within a few days of one another). I am inclined to ascribe to dietetic conditions the more malign course taken by tuberculosis in the colony than out in the outlying district, but the material is too limited to permit extensive conclusions to be drawn.

The hygienic conditions were also investigated. All the houses were measured and all conditions of sanitary significance were noted. It is a favourable circumstance that in the summer the Eskimos leave their houses and move about, living in tents. It may also, perhaps, be considered particularly fortunate that the roofs of the houses are so poor that they are taken off in the summer and the interiors left exposed to sun, air, and rain.

As pains in the joints frequently occur among the Angmagssalik Eskimos I made a number of X-ray examinations of the bone system

of some individuals. As far as I can judge from the material available arthroses were comparatively rarely the cause of these pains, whereas osteochondritis was found in a number of even young individuals. Among the women there were some cases of Kienbøcks Diesase in os lunatum. In older individuals there were distinct arteriosclerotic arteries.

Our return was made by the sealer "Quest", which called for the party at Angmagssalik on August 17th this year. Ice conditions were very bad during the summer and a number of ships were imprisoned for several weeks in the drift ice. The "Quest" was fortunate in this respect, and we travelled to Bergen via Iceland and the Faroe Islands.

I avail myself of this opportunity to express my gratitude to the founders and trustees of the following funds. Dr. Alexander Malthe's legat, Nansenfondet, Nordisk Insulinfond, Dr. L. Smit's legat, Bergens Medicinske Høiskole's Videnskabelige Reisefond, Det Videnskabelige Forskningsfond av 1919, Olaf Wright's legat, Roll's legat, Armauer og Klaus Hansen's fond, Freiafondet and A/S Norsk Varekrigsforsikrings Fond.

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