

## ON DIPHTHERIA IMMUNITY IN NORTH GREENLAND 1932–33

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### *Introduction*

FOR nearly two centuries Greenland has been a closed country, in that visitors were not admitted without the Administration's authorization, and unless they arrived by the administration's ships. This policy—coupled with the compulsory medical examination of every visitor before starting from Copenhagen on a sea journey lasting longer than the incubation period for epidemic diseases—resulted in Greenland being protected so long against the ravages of epidemics.

These conditions, in the course of the last years, have aroused the interest of epidemiologists both in Denmark and abroad, the general impression prevailing that a study of this population might throw light on certain problems of general interest and affecting Greenlanders.

During the last 15–20 years Greenland has become much less isolated. Whereas formerly but two journeys a year were made by ships between Denmark and Greenland, the number of journeys has now risen to four or five annually. Moreover, under favourable conditions, the voyage from Copenhagen to Greenland now lasts at most but 10 days. Visitors arriving by air are not uncommon, and many expeditions, which the Administration's ships cannot always transport, take up quarters in Greenland for a longer or shorter period. Salt-freighters, arriving from foreign ports, call at various settlements and motor-boat traffic in Greenland is rapidly growing. All this increased intercourse is breaking in upon the old, safe isolation. Even a highly vigilant control cannot under these changed conditions rule out the possibility of carriers of infectious diseases entering the country; and passengers may land within the incubation period of an epidemic illness acquired abroad.

Consequently, it can no longer be maintained that Greenland has a "virgin population" in the epidemiological sense. Earlier papers, mainly by district medical officers in Greenland, record the presence of the following infectious diseases: epidemic meningitis, poliomyelitis, whooping-cough, typhoid fever, diphtheria, etc.

### *Personal investigations*

My studies were carried out in north-west Greenland during 1932–33 as part of a series of bacteriological and epidemiological researches initiated at the bacteriological laboratory in Godhavn. I sought to obtain material from Disco

Bay and Umanaq Fiord, which could be utilized for comparative purposes conjointly with the material collected by Bay-Schmidt in South Greenland and Heinbecker and his collaborators in central and polar Eskimo regions of North America.

The main point of interest was this: is the immunity against diphtheria as indicated by the negative Schick reaction found in a number of Greenlanders the result of previous infection by diphtheria bacilli? Or is this immunity of spontaneous origin? Unfortunately, the results obtained were not so clearly cut as had been hoped, chiefly because the cultures from swabs were lost in transit to Copenhagen, and further testing of these thus rendered impossible. There remains, however, a series of Schick reactions made with standardized toxin and a series of examinations of swabs on Loeffler slants by means of direct microscopy. I used the standardized toxin XXI*b* prepared by S. Schmidt of the State Serum Institute. It was brought to Greenland in an undiluted condition, preserved at low temperature and diluted with the freshly prepared phosphate buffer solution (*pH* 7.3) proposed by Claus Jensen (1933), immediately before use. I injected 0.1 c.c. of toxin intracutaneously on the forearm and as control the same quantity of toxin after heating to 100° C. for 5 min. The unheated toxin was always injected on the right arm.

In most of the cases readings were made after 48 and 72 hr., in a few after 48 hr. only. As the new international investigations show that readings of Schick reactions should take place after 72–96 hr. at the earliest—preferably even as late as on the seventh day—if the control is positive, our own material only includes the positive cases with a negative control, all doubtful cases having been eliminated.

Schick tests were carried out on 304 Greenlanders: 76 in Godhavn, 173 in Umanaq, and 55 in Uvkusigssat and Agpat. Of these 304 reactions 63 were doubtful. As the table shows we found among 241 North Greenlanders, out of 75 children under 15 years, 61% Schick positive, and 39% Schick negative. Of 166 adults, 31% were Schick positive, and 69% Schick negative. The controls with heated toxin showed 51 positive reactions. Of these, 38 correspond with doubtful Schick reactions, and 8 with negative.

Opinions differ as to how positive controls or pseudo-reactions with negative Schick reactions should be interpreted. In the literature two views preponderate. One holds that the pseudo-reactions are not specific; similar reactions can be produced by proteins, which are not related to diphtheria bacilli. The other theory, which appears to have the largest number of supporters, explains the pseudo-reaction as an allergic reaction due to previous contact with diphtheria bacilli; the reaction is considered specific, and caused by bacterial proteins, not by the toxin.

We have 38 + 5 pseudo-reactors = 43 persons, who according to the second theory, have been in contact with diphtheria bacilli, and consequently may be added to the Schick-negative reactors. Swabs from 139 Greenlanders were inoculated on Loeffler slants, and examined on both Bie's and Gram's staining

after 24 hr. incubation at 37° C. in zinc-nitrate incubator (Martin Kristensen). In 11 persons we ascertained the presence of rods closely resembling diphtheria bacilli. The throat flora, as a whole, in all the persons examined did not materially differ from that of civilized populations.

*Table showing Schick investigations*

	Absolute numbers and percentages							
	Absolute number of persons investigated in each group				% of positive and negative Schick reactions in each group			
	0-15 years		Over 15 years		0-15 years		Over 15 years	
	S. pos.	S. neg.	S. pos.	S. neg.	S. pos.	S. neg.	S. pos.	S. neg.
Bay-Schmidt:								
Julianehaab	114	28	121	119	80	20	50	50
Kap-Farvel	94	17	75	116	85	15	39	61
Own investigation:								
North Greenland	46	29	52	114	61	39	31	69
Heinbecker:								
Pond-Inlet	Total 14		Total 29		64	36	52	48
Pangnurtung	Total 21		Total 15		33	67	27	73
					3-18 years		Over 18 years	
Central and Polar Eskimos			Total 110		38	62	39	61

S. pos. = Schick positive.    S. neg. = Schick negative.

We have compared our results with those of Bay-Schmidt (1929), partly from Julianehaab Colony and partly from the much more isolated Eskimos of Kap Farvel. To facilitate this comparison, we have divided Bay-Schmidt's material into two parts, viz. individuals above and below the age of 15 years, with this result: in Julianehaab 20% Schick-negative reactors under 15 years and 50% over 15 years. In Kap Farvel the corresponding figures were 15 and 61% respectively.

Judging from these figures the number of Schick-negative reactors appears to be larger in North Greenland than in the southern parts. The difference is greatest in the case of children, the number of Schick negatives in North Greenland being about twice as large as in the south. This phenomenon, and especially the large number of Schick negatives in Umanaq (115 out of 151, or 76%), may perhaps be connected with the numerous European expeditions to the Umanaq Fiord and colony.

The material of Heinbecker and his collaborators from various parts of arctic America is divided into persons under and over 18 years of age. At Pond Inlet they found, under 18 years, 14 (or 36%) Schick-negative reactors, and over 18 years 25 (or 48%). This agrees fairly well with our figures. At Pangnurtung Heinbecker records: under 18 years 6 (or 67%) and over 18 years 15 (or 73%) Schick negatives. Heinbecker does not state to what extent these regions are exposed to invasion by possible carriers. By adding the two lots of figures—which should be justifiable if one region is not more exposed to diphtheria invasion than the other—the percentages of Schick-negative reactors are: under 18 years of age 52, over 18 years 60. In our North Greenland

material of 91 individuals between 3 and 18 years we find 47% Schick-negative reactors, a figure not far below Heinbecker's 52%. If the results from Umanaq are taken separately we find 65% Schick-negative individuals, a figure which—based on a larger number of individuals—fairly corresponds with that obtained by Heinbecker at Pangnurtung.

We may add here, that Heinbecker found diphtheria antitoxin (more than 0.2 unit per c.c. serum) in the blood of 9 out of 19 Eskimos (age not stated) living in four different settlements.

### *Discussion*

Since both Bay-Schmidt, Heinbecker and ourselves have found a rather large number of Schick-negative reactors in Greenlanders and Eskimos, it may be asked whether these findings may not be due to an immunity in the sense of Hirschfeld (“serogenese”, “physiologische reifung”). A theory which Bay-Schmidt, based on his researches in the Kap Farvel district and his considerable knowledge of Greenland epidemiology, is inclined to support. Or is the immunity indicated by the negative Schick test a natural consequence of the presence of diphtheria bacilli in the throat flora of these Greenlanders and Eskimos (latent infections or not diagnosed, possibly atypical diphtheria cases)?

Bay-Schmidt observed in Julianehaab a diphtheria-like angina epidemic with paresis of the soft palate and extensive false membranes in the throat, and in which bacilli resembling the diphtheria bacillus were repeatedly found by direct microscopy.

Heinbecker found rods resembling the diphtheria bacillus in swabs, and he reports one strain (Bache 4) resembling the diphtheria bacillus in fermenting glucose and dextrin but not sucrose and mannitol. 1 c.c. of broth culture killed a guinea-pig in 10 days, but not a guinea-pig which had received 350 antitoxin units 2 hr. previously. The experiment was repeated after a period of 3 months with the same result.

We are inclined to agree with Wells & Heinbecker (1932*a, b*) that the cause of diphtheria immunity among Eskimos and Greenlanders is due to latent infection of the community with the diphtheria bacillus.

### *Summary*

1. 304 natives of North-west Greenland were examined with standardized Schick toxin, and 139 with direct smears stained by the methods of Gram and Bie.

2. Of these 98 gave positive, 143 negative, and 63 doubtful reactions to the Schick test. 51 showed a positive control reaction with heated toxin. The swabs from 11 persons showed rods resembling the diphtheria bacillus.

3. We incline to the belief, also held by Wells & Heinbecker, that the most natural explanation of the existence of this large number of Schick-negative

reactors in Eskimos and Greenlanders, is that diphtheria bacilli not infrequently occur in their throats, occasionally causing "angina" epidemics. Owing to the difficulty of bacteriological investigation in those latitudes, especially in performing fermentation and virulence tests upon the isolated strains, it has mostly been impossible to trace the aetiology of these epidemics to diphtheria bacilli.

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