



## The bacteriological work of the German South Polar expedition

Dr. Hans Gazert

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6. The office of the Seventh International Geographical Congress at Berlin will provide all co-operating stations with a sample of the observation formula, and recommends its universal adoption.

#### IV. PROGRAMME FOR THE INTERNATIONAL CO-OPERATION IN METEOROLOGICAL OBSERVATIONS.

1. The object of this is the construction of a synoptical weather chart of the as yet little-known southern latitudes for every day in the periods of time agreed upon, an object of particular importance from a theoretical as well as a practical standpoint.

2. All co-operating stations south of  $30^{\circ}$  S., all states with permanent or temporary meteorological observatories south of  $30^{\circ}$  S., all states and commercial bodies whose ships will be at sea south of  $30^{\circ}$  S. during the period fixed upon are requested to see that meteorological observations be taken from 1st October 1901 to 31st March 1903, every day at mid-day by Greenwich time.

3. The observations to be confined to precise records: (1) of the time of observation (local time); (2) place of observation; (3) atmospheric pressure; (4) air temperature; (5) strength and direction of wind; (6) the clouds, kind, amount, and arrangement. With regard to the latter point, the higher clouds (Cirri) are particularly to be noted.

4. The office of the Seventh International Geographical Congress should provide all the states co-operating with a sample of the observation formulæ and the notation to be employed, and recommend its general adoption.—*Petermann's Mitteilungen*, July 1901.

#### THE BACTERIOLOGICAL WORK OF THE GERMAN SOUTH POLAR EXPEDITION.

By DR. HANS GAZERT.

THE extraordinary important rôle which micro-organisms play in the economy of nature makes it desirable, that these minute though vastly important creatures should not be overlooked among the biological investigations of the German South Polar Expedition. The most important function they perform is the destruction of decaying organic material, and the conversion of it into that form which best serves to nourish plant life, and thus indirectly all organic life. To what extent this destructive process goes on in the Frigid zone is the chief object of investigation of the bacteriologist of the expedition. The notion that the low temperature of the Polar regions hinders the growth of bacteria is only partly correct. Ships have many a time come on the dead and highly decomposed bodies of whales, and have noticed the presence of skeletons in Polar regions. The decomposition of the flesh of animals that have been slaughtered has been noted by many expeditions, and goes to prove the presence of microbes. It is quite inconceivable that they could be absent in a region with a rich growth of vegetation as in the north of Greenland and in Spitzbergen, where, indeed, large carnivores,

reindeer, and musk oxen have their habitat. Nordenskjöld observed in 1870 the decomposition process going on, which made itself manifest by an unpleasant odour, away in the eternal ice of the interior of Greenland, where the dust and the snow-alga had collected, especially in places where large heaps were swept together. These observations agree with the results of Forster and B. Fischer in their researches on the growth of bacteria in low temperatures. They found numerous species which could thrive at  $0^{\circ}\text{C}$ ., and the growth of which was limited only by the freezing of the medium. Levin, who accompanied Nathorst on the summer expedition to Spitzbergen and King Charles Land in 1898, found bacteria in sea water of  $-2^{\circ}\text{C}$ ., and there is no doubt that these bacteria were not in a transitional latent condition, but performed all their functions, although quantitatively much weaker than in warmer surroundings. The only bacteriological investigations of any value in the Polar regions were undertaken by Levin and Blessing, if I may except the work of Nyström on board the *Sofia* in 1869, which was done with the usual inaccurate methods of his time. Blessing, the medical officer of Nansen's staff, appears to have devoted himself latterly to the germ contents of the air only, whereas Levin extended his observations to the ice and sea water. The air<sup>1</sup> was found to be practically free from germs, and the sea water and pools on the ice had but few. Every expedition has observed how pure the air is; and from the fact that men seldom or never catch cold there, Nordenskjöld has suggested that the Polar regions ought to be made use of, as a suitable place for the erection of sanatoria for invalids.

The presence of bacteria has been observed during the Polar summer, and it is more reasonable to suppose that they have survived the winter in spite of its length and its severity, than that a new crop should turn up every year, carried by the wind. Our water bacteria can remain a long time in ice and retain their vitality; and, in fact, Schmelck found bacteria in the ice of a Norwegian glacier. According to Pictet, many bacteria can endure extreme cold up to  $-200^{\circ}\text{C}$ . without any harmful results.

Bacteriological investigations of the kind initiated by Levin must be extended. With the help of Koch's methods, the germ life of sea water of different depths, of bottom samples, of the air, of the ice, of the pools on the ice, of the soil, and of the fresh water on land, must be studied as far as possible in the same locality in the different seasons of the year. The examination of anaërobic bacteria must not be neglected, since they do not appear to have been investigated, especially in sea water and in

<sup>1</sup> Rawitz, during the German Fishery Expedition to Bear Island in 1899 (vide *Deutsch. med. Wochenschr.* 1900, Nr. 13), observed that, as long as the air was clear and dry, fish did not become putrid and had no smell; so also for faecal matter. In misty weather both became putrid. He concluded from this that in the first case the air was free of germs, and in the second that the air was charged with germs. According to my opinion, this conclusion is not correct. For the dry air gradually prevented the growth of the bacteria present, through the rapid superficial drying up of the medium. As soon as the fish, etc., became moist owing to the foggy weather, the conditions were again favourable for the increase of the bacteria, and hence putrefaction arose.

bottom samples. Observations on the sea water can be made on the voyage to the Antarctic in the different seas, wherever hydrographical work will be taken up. The results will furnish a desirable contribution to the bacteriology of the sea, which has been worked up by Russel, San Felice, and above all by B. Fischer during the German Plankton Expedition. Their observations lead to the following results:—That germ life is more abundant in fresh water than in the sea; that it diminishes in quantity from the coast towards the high seas, and from the surface downwards through the layers of water to the depths. That the sea bottom at inconsiderable depths is rich in germ life, and that water and bottom samples from great depths are either very poor or entirely free of germ life. Through Bachmann's researches, as Chun has pointed out in his account of the German Deep Sea Expedition, bacteria have been recorded from the greatest depths, and it is greatly to be regretted that Bachmann's sad fate should have terminated his investigations on this subject.

We will not attempt the investigation of the morphological relationships of the micro-organisms to the different media they are found in. The difficulties would be too great to permit of results sufficiently accurate. Such investigations will be carried out in the laboratory, after the return of the expedition, as far as it is possible, with pure cultures made for the purpose. On the voyage, it will be sufficient to take note of what strikes the eye of the observer when the microbe is isolated, *i.e.* to find out to what group it belongs, and whether it forms colouring matter, or acts on gelatine, or whether it forms colonies, or if luminous in the dark, etc.

Perhaps observations will be set on foot on the physiological activity of bacteria. We owe much of our knowledge of the nitrous and nitric bacteria to the researches of Winogradsky, Hueppe, and others. Ersterer found them in the soil of all parts of the world; and Müntz has recorded them from the naked rock surface of the Faulhorn. In Polar regions and in the sea, observations on their activity are still unrecorded.

Brandt, in his paper "Ueber den Stoffwechsel des Meeres," has pointed out the activity of the nitrification bacteria, and in particular the important rôle played by denitrification bacteria in sea water. To them must be attributed the important task of setting free again the great mass of nitrogen which is brought into the sea by rivers in the form of ammonium salts, nitrates and nitrites. Brandt has calculated that without their activity, in the space of a thousand years, a concentration in the sea water of those above-named salts would take place sufficiently strong to be harmful to the life of organisms.

Owing to the striking fact "that the Arctic regions in summer are very rich in plankton, and the tropical regions, on the contrary, very poor the whole year round," Brandt comes to the conclusion that the activity of denitrification bacteria is far greater in warm seas. In consequence of this activity, the quantity of the above-mentioned salts in the sea water is smaller and makes the Tropics less suitable for the growth of plankton. With the growth of plankton in the Arctic regions, the forms of animal life, which directly or indirectly are indebted to it for food, naturally keep pace; and thus we see that the activity of the nitrification and the slight and dwindling, if not absolutely absent,

activity of the denitrification bacteria, virtually brings it about that mankind may make a livelihood in the Polar seas which would otherwise be quite worthless. Through the cultivation of such bacteria on suitable media, perhaps this theory of Brandt's may be substantiated.

I must not omit to mention a number of observations made by Levin on the contents of the intestines of different animals belonging to the Polar regions. He found the intestines of several birds and seals absolutely sterile, nor could he detect bacteria by cultivation under the microscope. He correctly attached importance to his discovery, since the necessity for the presence of bacteria in the intestine has not been clearly demonstrated. Experiments have been attempted with animals taken out of the mother, sterile, and placed in sterilized dishes, provided with sterilized food to try and settle this question. It is therefore particularly interesting to find out whether there really exist in nature animals with no bacteria in their intestines. Observations of this kind on Antarctic animals, as well as deep-sea animals where similar temperature conditions prevail, will be part of the bacteriological work done by the expedition.

I have attempted to give an outline of the kind of problems to be solved in the frigid zone in the realm of micro-organic investigation. How far these are practicable on the voyage is certainly not easy to say; for the limited room at disposal, the stormy seas of the Antarctic, and many accidental circumstances will interfere with the progress of the investigations. The greatest enemy of the bacteriologist is mould, which has caused many a one great trouble, especially Dr. Bachmann during the Deep Sea Expedition. It very commonly destroyed his observations, for, in spite of careful work, the spores of the fungus everywhere present all over the ship, found their way into his cultures and made further investigation impossible by their growth.—*Petermann's Mitteilungen*, July 1901.

### ANTARCTIC CLIMATE.<sup>1</sup>

THOSE who would undertake researches into the climate of the Antarctic regions must not expect to fulfil the strict demands of scientific method. The Argentine Staaten Island, which is the most southerly station in which observations have been prosecuted for several years, is situated in  $54^{\circ} 23' S.$ , that is, approximately, in the latitude of Kiel; and in the eastern hemisphere, in New Zealand, the outpost of observation lies in a latitude corresponding to that of Trieste. Kerguelen ( $49^{\circ} S.$ ) and Auckland ( $50\frac{1}{2}^{\circ} S.$ ) afford only interrupted records, extending over a few months at a time, from which it is only possible to infer, indirectly, approximate estimations of the mean annual temperature. Conditions are somewhat more favourable on the American side; for here observations extending over a whole year have been carried out at Cape Horn and in South Georgia; and the records from these two stations gain

<sup>1</sup> Translated from an article by Professor A. Supan; *Petermann's Mitteilungen*: pp. 128 ff, 1901.