

two days of the month that rain began to fall, and even then in small amounts. . . .

(Signed) "W. L. DALLAS,  
Assistant Meteorological Reporter  
to the Government of India"

The above extracts speak for themselves. The results do not accord precisely with the terms of the prediction, inasmuch as the rains, instead of being simply retarded, penetrated for about a fortnight to the Upper Provinces, and then gave place to the dry north-west winds, which are characteristic of periods of drought. But there is no reason to regard the snows as inactive during this rainy interval. At Simla this rainy period was one of frequent thunderstorms and on more than one occasion of hail,<sup>1</sup> and in fine intervals the existence overhead of the ominous north-west wind was established by the steady drift of the higher clouds (*cirro-cumulus*, &c.). The outflow of dense air from the snow-fields was therefore active, although it was only at a later period that it descended to the level of the lower hills; and then, chiefly as the result of diurnal convection, to the plains of North-Western India.

The full discussion of the evidence for the dependence of dry winds on the snowfall will be undertaken elsewhere. It must not, however, be supposed that the Himalayan snows are to be regarded as the *sole* cause of drought. Causes of wider incidence are sometimes in operation. Thus, in 1876 and 1877, an unusually high atmospheric pressure prevailed over nearly the whole of Asia and Australia. Whether there was any unusual accumulation of snow on the vast mountain tracts of Central Asia or over the northern plains in those years would be an interesting subject of inquiry were the means of information forthcoming. H. F. B.

### NORDENSKJÖLD'S GREENLAND EXPEDITION<sup>2</sup>

#### III.

WE give a few extracts from Baron Nordenskjöld's concluding letters on his journey down the west coast of Greenland and his visit to the east coast:—

At Ivigtut a visit was made to a valley which, on account of its copious flora, has been named Grönnedal (Green valley), and another to the spot where the inland ice falls into the Arsukfjord. In the former place Dr. Nathorst found, in a kind of syenite, a blue mineral which seems to be sodalite. This discovery is chiefly remarkable from the circumstance that this mineral is also found in the vicinity of the small kryolite deposit at the Ilmen mountain in the Ural, which seems to indicate that a kind of relation exists between these two minerals, both strong in natron, which circumstance may be of service to the geologist in search of kryolite. From the excursion to Grönnedal Herr Kolthoff brought with him some rare butterflies and other insects, while of the botanical finds there were splendid specimens in bloom of *Linnaea borealis*, which is quite plentiful about Ivigtut. It has not before been known to exist in Greenland. The zoologists found only three kinds of land mollusks, viz. a physa, a vitrina, and a helix, which were all few in number. The entomological harvest consisted of a few beetles, butterflies, and insects of other kinds.

On their way to Julianehaab, as they steamed down the narrow fjord in pitch darkness and a perfect calm, "we saw suddenly behind the vessel on the surface of the sea a broad but clearly defined band of light. It shone with a steady, yellowish light, somewhat like that of phosphorescent elements, while, in spite of the speed maintained, viz. four to six knots, the band came nearer and nearer. When it reached the ship it seemed as if we

were steaming through a sea of fire or molten metal. After a while the light travelled beyond the vessel, and we saw it at last disappear on the horizon. Unfortunately I had not an opportunity of examining it with the spectroscope. It was beyond doubt of a different nature to the bluish-white phosphorescent light, which throughout its appearance was seen distinctly in our wake, and as the light was perfectly steady it cannot have been caused by the phosphorescence from a passing shoal of fish. A shoal of fish would have occasioned some stir in the sea, but in this case the surface was calm throughout, while phosphorescence from the same would have been bluish in character, not yellow as this was. The Esquimaux stated that a glacier river in the vicinity shed a thin layer of brackish clay-water over the surface of the fjord, and fancied that this circumstance was in some way or another connected with this grand phenomenon, which they themselves had never before witnessed. There was at the time no aurora visible, the sky being covered with clouds. The cause of this remarkable phenomenon, which made the *Sophia* seem to steam through a sea of fire for fully fifteen minutes, I have been unable to ascertain; maybe it was a phenomenon such as this which made Lig-Lodin, of the Greenland Saga, relate to King Harald Sigurdson that he had once sailed over a spot where the sea was on fire."

At Fredriksdal Nordenskjöld engaged two Esquimaux to act as pilots in the sounds on the east coast, north of Cape Farewell. One of them stated that remains of buildings, which were not built by the Esquimaux, are to be found in nearly every great fjord on the east coast, particularly in the large ones of Umanak, Ekaleumiut, and Igdluarsiut. Entire walls do not remain standing, but though low they are extensive. The largest ruin is said to exist at Igdluarsiut. A fine kind of soft stone is to be found on an island south of Umanak, from which pots were made to three feet in diameter. This mineral deposit is of special interest in reference to the ethnography of Greenland, as the Umanak fjord is situated in lat. 63°. This name is, however, a common one for places among the natives. Ivar Baardsen, in his famous description of Greenland, states that a soft stone was found on Renö, outside the Einafjord, from which the largest vessels were made. Cannot the mineral deposit at Umanak be identical with this? These statements, as well as others received from the "Eastlanders," and the remarkable Norse characteristics possessed by the same, which the missionary Hans Egede pointed out long ago, seem to Baron Nordenskjöld to refute the theory now mostly advanced as to the Norse colonies, viz. that they were situated on the south-west coast of Greenland.

In spite of predictions of failure and even disaster before he left Europe, Nordenskjöld decided to attempt to land on the east coast, south of the Arctic circle. After some difficulty they succeeded in anchoring in the Kangerlutsiok Bay, but on account of the state of the ice they had to stand to sea again, and steamed along the ice-belt lining the coast, in order to find an opening by which the shore might be reached. The fauna of the sea here was very poor, and they only saw in two days one whale, a few seals, and a very small number of sea birds. The abundant fauna of the coasts of Spitzbergen and Novaya Zemlya is thus entirely wanting on the east coast of Greenland. The cause of this may be the great depth of the sea right up to the shore, which prevents the animals from fetching their food from the bottom; perhaps also the war of extirpation which the natives seem to have carried on for years has also contributed thereto. The auk and the *Uria grylle* are, however, said to breed in large numbers on the rocks off Cape Farewell. The Esquimaux pilot stated that he had been told by old people that they could remember the *Alca impennis* having been found here. The natives called it Isaro-

<sup>1</sup> These accompaniments are characteristic of the spring rainfall both on the hills and the plains, not of the monsoon rains, and indicate demonstrably in most cases the existence of a dry upper current.

<sup>2</sup> Continued from p. 42.

kitsok. Only a little distance out to sea they found a warm current—rising to 6° C.—coming from the south. The drift-ice was what Arctic skippers call “knatteris,” *i.e.* little bits, *viz.* remains of large floes after the influence of the summer heat and the Gulf Stream. Very few icebergs were seen, and they appear to be far more numerous on the west coast. As it was now late in the season, and the coals were nearly done, Nordenskjöld had reluctantly to renounce the plan of reaching the fjords where the greatest ruins are said to exist, and, instead, attempt to reach the south shore by Cape Dan, a promontory which, if the Einafjord was situated at Umanak or Ekaleumiut, should be the Herjolf’s Naze of the Sagas. “On the 4th, when off the Cape, we met the ice twenty miles from the coast, which was, however, passable, as it consisted mostly of large, loose floes only a few feet above water, while nearer the shore it again became heavier. Beyond this we saw an ice-free channel three to four miles wide. The sea was as smooth as a pond, and a boat could easily reach the shore. The mountains ran mostly into the sea with almost perpendicular declivities, without any grass-covered underland. Opposite us we saw a small bay, into which I steamed, in order to take the sun; but finding both the depth and the bottom unsuitable for anchoring, we only landed for a few hours, while some of the crew went on the hills above to look for a better harbour. The staff returned on board with a rich harvest from the steep slopes, the flora of which was copious beyond expectation. The sailors reporting a harbour near, I steamed thereto and cast anchor. It was a beautiful fjord, with several arms, which was only connected with the sea through a small opening, and was well sheltered. It was the first harbour on the east coast south of the Polar circle, in which a vessel had anchored for several centuries.<sup>1</sup> It was named ‘King Oscar’s Harbour.’ If Cape Dan is the old Herjolf’s Naze, this harbour is the “Sand” described by Ivar Baardsen, ‘much frequented by the Norwegians and traders.’ That the Norwegians had once been here was demonstrated by walls of loose stones erected on the mountains above the harbour, which had, no doubt, served as landmarks for finding the almost hidden opening of the fjord. We found, besides, some stone ruins of a smaller house, identical with those found on the west coast. These ruins are, of course, not extensive enough to demonstrate that here was situated one of the ‘Bygder’ (parishes) of Greenland, but they may certainly serve as sign posts for future explorers of the east coast. As soon as at anchor we went on shore, and spread in all directions in order to examine the neighbourhood. King Oscar’s Harbour is surrounded by soft, close, grass slopes and flourishing shrubs. The fauna appeared to me more copious and the grass less mixed with moss than on the west coast in the same latitude. In one of the valleys a river flowed, the shores of which consisted of loose sand without any covering of grass. Here were found traces of the Esquimaux. Some of the footprints were days old, but others were so fresh that the moist sand had not had time to dry. Most probably they had taken flight on seeing the steamer forcing the barrier which had hitherto formed their shelter. We found plenty of remains of them in the shape of huts, graves, fox-pits, &c. The naturalists gathered here a quantity of fresh materials of the fauna and flora of East Greenland, among which I may specially mention the well-known *Potentilla anserina*, which is found so often near the Norse ruins in West Greenland, and which may, for that reason, be a sign of the Norse colonisation of East Greenland. We found traces of reindeer, but none of the musk-ox; neither did we see any bears or walruses, and only a few seals. Our whole bag was two ptarmigans.

<sup>1</sup> North of the Polar circle the east coast of Greenland is in many places easily accessible.

That the Esquimaux had decamped was very annoying, as they could no doubt have given some valuable information relating to this part of Greenland and the tribes which inhabit it.”

After reconnoitring the coast still further, Baron Nordenskjöld decided that his best course was to return at once to Reikjavik. Before doing so, however, some hours were spent in dredging and in hydrographical research, as well as in photographing some of the coast scenery.

“Having thus given an account of the work of my expedition, I have to point out that we have been the first to penetrate into the heart of Greenland, and that our journey has resulted in learning something about this continent, the natural conditions of which may probably give us a clue to the true condition of Scandinavia during the Glacial period, the study of which is therefore of such great importance to the geology of North Europe. Besides this, valuable scientific data have been collected during my voyage along the east coast of the composition of the ice-belt which bars the way *from the east* to the southern part of Greenland, while many errors as to the state of the east coast of Greenland have been corrected. In addition to these objects one more has been attained, *viz.* the anchoring of a vessel by the shore of East Greenland, an achievement attempted in vain for centuries. If thus the work of the numerous expeditions despatched since the sixteenth century by sea to the part of Greenland lying opposite or south of Iceland to the part where the Norse Österbygd was or was not situated, it will be found that not one of them succeeded in reaching the coast.

“A few words more in conclusion as to the purely scientific results of the expedition. During the voyage of the *Sophia* along the coast of Greenland from Cape Dan past Cape Farewell to Cape York, and further from Cape York around Cape Farewell to Ingolf’s Mountain, hydrographical researches and dredgings were effected whenever time and weather would permit. These labours were conducted by Herr Hamberg and Dr. Forsstrand. In addition, Herr Hamberg effected a number of analyses of sea water, and the gases contained therein, from various depths, while he brings home a series of the most carefully effected measurements of the temperature of the sea, which demonstrate that the *cold current* running along the east coast is, both in width and depth, very insignificant, and rests *even near the shore* upon one of warm water produced by the Gulf Stream. Davis Sound and Baffin’s Bay, on the other hand, are filled with cold or very slightly warmed water *to the bottom*. Contrary, therefore, to the general belief, *the west coast of Greenland is washed by cold water, while a greatly heated current coming from the south runs along the east coast a distance of 40’ to 50’ only from the shore*. This current must exercise a great influence on the climate of the east coast, which may be more moist, but, I believe, not colder than that of the west coast.

“The dredgings have yielded Dr. Forsstrand a fine harvest of marine animals, &c., of which I may mention gigantic sponges from great depths in Denmark Sound (between Iceland and Greenland). The dredgings on the east coast were, however, greatly impeded through causes detailed above, and by the circumstance that the bottom consists mainly of huge boulders, which tore the net. Of the animal species existing on land or in fresh water, Herr Kolthoff has collected rich fresh materials of the Greenland fauna. Especially will the variety of insects collected be of great instructive value to science. On account of the limited accommodation on board, and from the circumstance that the flora of Greenland is well known through Danish and Swedish specialists, I took no botanist with me. But even in this field new materials have been gathered through the zeal given to such researches by Dr. Nathorst and Dr. Berlin whenever time permitted. The collections of microscopical plants

which have been made, the true place of existence of which is the ice and the snow, must particularly be of great value. They are besides of additional interest to the expedition, as they belong to a new branch of science which has in the first instance been created by Swedish savants. The collections, perhaps, of most value to science have, however, been made by Dr. Nathorst from the North-West Greenland so-called basalt formation, which is remarkable for the quantity of fossil plants contained in the clay, sand, and tuff strata there. Of course some very fine palæontological collections have been brought from these parts before, especially by the Swedish expedition of 1870, and by some Danish ones under Dr. K. Steenstrup; but it is the first time that a palæontologist has visited this spot, and I am, in consequence, convinced that the objects gathered by Dr. Nathorst, when scientifically treated, will yield many new data on the copious flora which once covered the ice-laden regions round the Pole.

"Finally, the expedition has brought home some splendid specimens of the remarkable minerals found at the well known deposits at Kangerdluarsuk and Ivigtut, while I have on the inland ice collected, as previously stated, a great many samples of the dust found on the ice, and which I have named kryokonite. I hope, when this has been exhaustively analysed, to be able to furnish fresh proofs in support of the theory that this deposit is, at all events partly, of cosmic origin, and thereby contribute further materials to the theory of the formation of the earth. Dr. Nathorst was, as previously stated, prevented by the ice from reaching Cape York and examining the blocks of ironstone lying there, but their existence has been corroborated beyond doubt by the Esquimaux in the neighbourhood. Here the expedition obtained some valuable ethnographical objects, and it learnt a fact from the natives which may be of considerable importance as to the question of the wanderings of the tribes around the Pole, viz. that four 'Russian Esquimaux' had come to Wolstenholme Sound. They said they were the last survivors of a tribe which had left their place of habitation by the Behring Strait (or the northern shore of Asia?) in search of a new place of settlement, and who had at last reached Smith's Sound. These are the results of my expedition to Greenland in the *Sophia*. The scientific collections made will be distributed among the museums of my country."

A. E. NORDENSKJÖLD

#### THE ROTHAMSTED GRASS EXPERIMENTS<sup>1</sup>

THERE is at Rothamsted nothing which will more impress the visitor than the seven acres of meadow land in the Park, the many years' experiments upon which with different manures constitute the subject of the above-named memoir. The twenty parallel plots into which the area is divided appeal at once and forcibly to the eye by the obvious differences in their herbage. A plot here with rich green grasses waving luxuriantly upon it; another, on which the yellow meadow vetchling apparently constitutes the leading feature; a third, irregular, patchy, and much afflicted with the sorrel-dock; and yet another, on which, at the time of our visit (August), the white-flowered umbels of the earth-nut put everything else in the shade,—these and the like appearances convince with an eloquence which the pen is powerless to imitate.

The land in Rothamsted Park has probably been laid down with grass for some centuries. No fresh seed has been artificially sown within the last fifty years certainly, nor is there record of any having been sown since the grass was first laid down. The experiments commenced

<sup>1</sup> "Agricultural, Botanical, and Chemical Results of Experiments on the Mixed Herbage of Permanent Meadow, conducted for more than twenty years in succession on the same land." Part II., the Botanical Results. By Sir J. B. Lawes, Bart., F.R.S., Dr. J. H. Gilbert, F.R.S., and Dr. M. T. Masters, F.R.S. *Phil. Trans.*, Part iv., 1882. Pp. about 250.

in 1856, at which time the herbage appeared to be of uniform character. With few exceptions the same description of manure has been applied year after year to the same plot; and two plots, the third and twelfth, have been continuously unmanured. For the first nineteen years the first crop only was cut and carried away, and the second crop was usually fed off by sheep who were receiving at the time no other food. Of recent years it has been more and more the practice to make the second crop also into hay, and it is intended to adhere to this plan in future, weather permitting.

The produce of every plot is weighed as hay, and the result calculated per acre. Taking the average of the first twenty years, the unmanured plots, 3 and 12, gave the lowest yields of all, 21¼ and 24 cwt. respectively. Next above these is plot 5, manured with ammonia salts<sup>1</sup> at the rate of 400 lbs. per acre per annum, the yield giving an annual average of 26¼ cwt. per acre. The highest average recorded, 62½ cwt. per acre, resulted from a mixed manure, containing 500 lbs. sulphate of potash, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, 3½ cwt. superphosphate of lime, 600 lbs. ammonia salts, and 400 lbs. silicate of soda,—a tremendous dressing, by the way. The average yields on the other plots, each one of which received different manurial treatment from that of the others, range themselves between these extremes.

But the mere quantitative estimation of the results was a comparatively simple task to that of making a qualitative examination of each crop. The proximate analysis was into the three classes of gramineous herbage, leguminous herbage, and miscellaneous herbage, the last-named containing all plants not referable to the Gramineæ or the Leguminosæ; and even this task would not be a very difficult one. But when it is stated that in certain seasons a complete botanical analysis was made, whereby each species of plant was separated from all the others, then the irksomeness of the work will be appreciated. For the details of these analyses we must refer to the memoir itself, but the following is worth reproducing. "To quote an extreme case in illustration of the difference in the character of the herbage, and of the difference in the degree of difficulty of separation accordingly, it may be mentioned that whilst a sample of 20 lbs. from one plot in 1872 only occupied from four to five days in botanical analysis, a sample of equal weight from another plot in the same year occupied thirty days."

The total number of different species of plants that have been detected on the plots is 89; of these, 20 are grasses, 10 are leguminous, and the remaining 59 belong to miscellaneous orders. The 89 species comprise 59 dicotyledons, 26 monocotyledons, and 4 cryptogams, 3 of which are mosses (Hypnum); they are arranged under 63 genera and 22 orders. Of the miscellaneous plants there are 13 species of Compositæ, 6 of Rosaceæ, 5 each of Ranunculaceæ and Umbelliferae, 3 each of Labiatae, Polygonaceæ, Liliaceæ, Caryophyllæ, Scrophulariaceæ, and Musci, 2 each of Rubiaceæ and Plantagineæ, and 1 each of Cruciferae, Hypericinea, Dipsacæ, Primulaceæ, Orchidaceæ, Juncaceæ, Cyperaceæ, and Filices. Six genera only were represented by more than one species; these were Ranunculus, 5 species, Rumex 3, and Potentilla, Galium, Leontodon, and Veronica, 2 each. The 20 species of grass comprise 14 genera; Festuca is represented by 4 species, Avena by 3, Poa by 2, and Anthoxanthum, *Alopecurus*, Phleum, *Agrostis*, Aira, *Holcus*, Briza, Dactylis, Cynosurus, *Bromus*, and Lolium by 1 each. The fact that the four genera whose names we have italicised were only represented by one species each serves to indicate somewhat the nature of the land. Had it been wet or marshy in parts, *Alopecurus geniculatus* might have been looked for as well as *A. pratensis*. Had not the plots

<sup>1</sup> "Ammonia salts"—in all cases equal parts sulphate and muriate of ammonia of commerce.