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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

NOTES ON TIERRA DEL FUEGO.

AN ACCOUNT OF THE SWEDISH EXPEDITION OF 1895-97.

By Dr. OTTO NORDENSKJÖLD.

IN the year 1895, thanks mainly to the liberality of the late Baron Oscar Dickson and of some other private gentlemen, an expedition consisting of Mr. Dusén, botanist, Dr. Ohlin, zoologist, and of myself, geologist and leader of the party, was able to leave Sweden for South America. Our general object was to study the physical geography and natural history of Tierra del Fuego and of the southernmost part of the continent, and our special purpose to compare the natural features of those regions with the corresponding ones of Northern Europe, and to bring home collections of sub-Antarctic forms, the subsequent study of which might stimulate the interest in Antarctic exploration.¹ The members of the party arrived at Punta Arenas (Sandy Point), a small town on the north shore of the Straits of Magellan, and the principal political and commercial centre of those regions, at the beginning of the Antarctic summer of 1895-96. For that summer we worked chiefly in the Fuegian archipelago south of the Straits, where, mainly owing to the kindness of the Chilean and Argentine Governments in affording us the means of transport, we were able to visit the country far more extensively, both along the coast and up into the interior, than any previous scientific expedition had done. At the end of June 1896 we all left the region, but in the following summer I went back alone and explored Southern Patagonia especially, and in Tierra del Fuego the environs of Useless Bay, which had not been visited the previous year.

¹ A notice of the zoological work accomplished by our expedition appeared in *Natural Science* for September 1896.

In the following notes I intend to give a preliminary account of the physical geography, particularly of the large main island of the archipelago, pending a fuller report to appear in the special volume intended to comprehend all the scientific results of the expedition.

The island mentioned, Tierra del Fuego in a narrower sense, has an area of nearly 20,000 square miles (two-thirds that of Scotland), and consists topographically of two distinct zones, viz., a woodless tableland in the north, and a mountainous territory in the south, the latter being the extreme continuation of the South American cordilleras. Each of these zones consists of two elevated regions, divided by deep valleys, but, as described below, of very different characters. The boundary between the two zones is an almost straight line, that crosses the Western channels in lat. $53^{\circ} 40'$ S. and reaches the Atlantic in lat. $54^{\circ} 30'$ S. South of this line flat country is to be found practically only in the river valleys, that rarely reach a width of more than one or two miles. The rest of the land-surface is occupied by a mountain chain, formed mainly of folded schists. Massive rocks are very subsidiary, but where they are found they generally stand out conspicuously in the topography, as, for instance, Mount Sarmiento, the most striking and probably the highest summit in the archipelago. With such exceptions, however, the country has a peculiarly monotonous aspect, resembling, one might say, a high wall, with a few not very prominent rounded summits, and here and there a narrow cleft. It is only in the attempt to cross the mountain chain that the traveller finds how wrong such an impression in reality is. He climbs the mountains, first their lower parts, covered with luxuriant vegetation, then the more elevated slopes, from about 2500 feet upwards, bare or covered only with enormous masses of loose stones and with patches of eternal snow, until he reaches the highest parts and expects to find, as in most other countries, a comparatively level plain, where he can walk on for miles without either descending or ascending. But I have never come upon such plains in those regions. The usual thing is rather to find oneself on a narrow ridge, steeply descending into a deep, narrow valley of almost level surface, through which a deep river, whose waters are white with suspended glacier mud, slowly trickles in complicated windings. On the other side of the valley another steep wall ascends, covered lower down with forest. In a distance of ten miles it may often be necessary to go down and up in this way some 3000 feet three times or more; and, considering the difficulty of traversing the forests, whether it may be through the full-grown ones in the valleys, or the dense shrubs on the upper slopes, it is very evident that travelling in the Fuegian cordilleras is not an easy undertaking.

The enormous development of the river valleys is connected with the general tendency in the whole southern cordillera to form longitudinal valleys. Of such, the above-mentioned valley that divides the two chains forming the Fuegian cordillera from each other, is an excellent example. It is occupied partly by Admiralty Sound, a narrow bay about fifty miles in length, partly by the Fagnano lake, discovered in 1892, that runs east and west, and has a length of upwards of sixty miles, and an area of

more than 200 square miles. The height of the lake above the sea-level is about 200 feet, and it is connected with the Admiralty Sound by a broad river, called Rio Azopardo, with many rapids in its course, but no falls. The total length of the valley on the island itself is consequently at least 120 miles; but it is to be noticed that this valley is the immediate continuation of the western fjord-like section of the Straits of Magellan. As to its origin: it is undoubtedly a longitudinal valley, following, perhaps, an anticlinal line, and I think it most probably is a sculpture-valley formed by the action of running water, its peculiar shape—both the Admiralty Sound and the lake are very deep with steep sides—being due partly to the action of glaciers. The cliffs on both sides of the valley are formed of the same kind of slate, but farther north, different—probably younger—slates enter into the composition of the northern chain, as in some parts folded tertiary rocks also do, showing that the formation of the cordilleras was not completed at that last-named period.

Difficult as it is to cross the mountains, to pass along their axis is not much easier. A ridge of considerable extent may, perhaps, be found in the central parts, but nearer the coast the surface is diversified by numerous transverse valleys, sometimes deep and narrow fjords, in this district usually not very large, and sometimes river valleys, like the one described above, with but a slight inclination, and evidently forming supramarine continuations of the fjords. To the geography and the origin of those valleys I have devoted much attention, and I think it is still more difficult here than with the longitudinal valleys to suppose that they can have got their actual shape without the aid of ice-action, though their first beginning is probably much older than the glacial epoch. Nowadays, in the regions I visited in Tierra del Fuego, there are no very extensive glaciers, compared with those of Norway or Southern Patagonia, though numerous small ones descend as far as the level of the Beagle channel.

I have spoken above of the rather monotonous aspect of the Fuegian channels, and the *general* appearance is certainly not so fine as, for instance, that of the Norwegian coast, in spite of the more luxuriant vegetation here, and the proximity of the glaciers to the sea. There is, however, no lack of beautiful scenery, and some parts, such as Ushuaia, with its view over the fine Darwin mountains, and the curious pointed peak of Olivaia (or Olivia), or the Chasm reach in the Patagonian waters, are hardly surpassed in any other fjord-coast.

Topographically, there exists in Tierra del Fuego no real zone of transition between the cordillera and the northern table-land. The appearance of the last-named region is utterly different from what we have just described. In the whole country there is not a single trace of solid rock to be seen.¹ The ground consists mainly of tertiary rocks—of which, however, the erosion has left only inconsiderable, though in

¹ In this there is a very remarkable point of difference from the state of things in the South Patagonia, where basaltic lava beds exist to a large extent. I succeeded, however, in finding one very small volcanic crater in Tierra del Fuego, north of Useless Bay, the first known, and perhaps the only one existing on this side of the Straits.

places very prominent remnants—hillocks with rounded slopes, but with summits either pointed or cut off by a flat surface. Such hillocks, however, are to be seen only in a few parts of the island. Yet little level country exists. Of such there is, first, the broad, noticeable valley that runs from St. Sebastian Bay to Useless Bay, two very large gulfs of the Patagonian type, flanked by high perpendicular “barrancas.”¹ In the interior, the gulfs slowly pass over into a low, flat stretch of country, overgrown with grass and covered by extensive lagoons, mostly containing salt water. No part of it is higher than 150 to 200 feet, and the whole, at a not very distant date, has evidently been a strait of the same character as the eastern Straits of Magellan. But that such a strait has not existed very recently, or in the time of man, as some previous visitors of these regions have assumed, is shown by many signs. The land is not rising rapidly enough for this. A well-defined old shore line, at the height of about 200 feet from the present sea-level, with big stones on it, shows us that at the time when the sea covered the island to that height the climate was still cold enough for a far greater extension of glaciers than at present, and the sea was crowded with huge icebergs, that brought big masses of granitic rock with them from the western islands.

Further, we find level country in the highest parts of the region. Between the 53rd degree of latitude and Useless Bay, from the Straits to the Atlantic, there is a wide bit of high table-land, descending slowly towards the east from 1800 to 600 feet. This is a very barren tract of ground, the soil being composed of coarse gravel with rounded stones and overgrown with lichens, *Empetrum*, and the semi-spherical masses of a curious kind of *Azorella*. Herds of guanacos may be seen here sometimes in summer-time; but for the most part it is a realm of death, the terrible Patagonian south-west gales prevailing here in their full strength.

Land of the same character also occurs on the south side of the San Sebastian valley, but not to the same extent. The tertiary rocks are seen in greater abundance, but in most parts they are covered with low, rounded hills, chiefly consisting of morainic material. The land rises very gradually towards the cordillera, so that it is difficult for water from the interior to find an egress. The development of river valleys in this territory is consequently all the more remarkable. Between 53° and 54° 30' S. lat. there are on the east side only two really big rivers—the Rio Grande (also known as the Rio Popper, after the prominent Fuegian explorer) and the Rio Carmen Silva. Both those rivers derive most of their water from the cordillera, their chief sources lying near Nose Peak, so that they traverse almost the whole breadth of the island. The former, by far the most important river in this part of the island, has its outlet in a narrow estuary, to which steamers drawing ten to twelve feet of water can approach in spite of the bar blocking the entrance. It receives several big tributaries, of which one, explored by the Boundary Commission, comes from a small mountain lake on the Chilean side, while another, hitherto unknown, and to which I gave the name “Rio Candelaria,” was followed by us to its sources, which we discovered in some

¹ The Spanish name for walls in sedimentary rocks.

peat-mosses at the very foot of the cordilleras, not far from Lake Fagnano. The valley of this tributary is typical of all the river valleys in this region. Its width is nearly one mile, but often this is a level terrace on one side or another of the real river valley, which is very narrow. Through it the river winds in wonderfully tortuous bends, just as in the cordillera valleys, so that it is often impossible, when following the course of the river on horseback, to keep in the valley without repeatedly crossing the river or ascending the walls of the valley, which, being always high and steep, makes this also a difficult undertaking. The river receives many small tributaries, whose valleys are always of the same character as the above; the sides are of corresponding height and the fall is almost equally imperceptible. Still more curious, moreover, is the impression made by the valleys in the northern tableland, where these deep, narrow gorges remind one of the cañons of some other dry countries.

Before finishing this short review of the physical geography of Tierra del Fuego there is another feature we must consider: that is the hills of morainic material—a typical boulder-clay with angular stones, often with scratched surfaces, intercalated at times with beds of sedimentary origin. Those hills are often high and have very peculiar forms: conical, pyramidal, etc., with steep sides. They occur more particularly on both sides of the northern table-shaped ridge, and extend to the Atlantic; but they are never found higher up than 500 or 600 feet. Undoubtedly the island was once covered with ice at least to that height, and that this glacial epoch came to an end not very long ago is shown by the distribution of animals and plants, the narrow Straits of Magellan forming the southern limit for a number of species.

The climate of Tierra del Fuego is very different in different parts. The mean temperature certainly is more or less the same, about $+6^{\circ}$ C. (43° F.) in all parts; but in the north the climate has far more of a continental character than in the south. Yet in San Sebastian, in the north-east corner, the difference between the summer (December to February) and the winter (June to August) mean varies only from $+10^{\circ}$ to $+12^{\circ}$ (50° to 34° F.). In the south-west, however, the variation is much smaller, and in some parts of the archipelago we may really assert that summer and winter do not exist. Still more striking, however, is the difference in the rainfall in different parts. Thus in Punta Arenas 370 mm. (15 in.) fall annually, while in the environs of San Sebastian the figure certainly does not reach 300 mm. (12 in.). At Ushuaia it is about 650 mm. (26 in.). These figures are all much below what has been generally supposed; but from the last-mentioned place onwards the amount increases very rapidly, reaching in the south-western archipelago, a distance of only 80 to 100 miles from Ushuaia, almost 2000 mm. (80 in.).

By reason of the different topographical and climatic conditions the vegetation in the north is far from being similar to that in the south of the island, and, indeed, the two have almost no resemblance to each other. The northern part is an open *pampa*, without any trees, and only in certain sheltered places low bushes of *Berberis* or *Ribes magellanica* can

grow. The Antarctic forest begins south of Useless Bay and the 54th parallel, but it consists at first of one single species, a low-growing variety of the Antarctic beech (*Fagus Pumilio*) in close, dense clumps, more extensive farther south, and growing only on the hills and valley slopes. A zone of taller forest-trees (*Fagus antarctica*) begins at the same place as the cordillera, while along the shores of the Beagle channel we first meet with some fresh species of tree, viz., the evergreen beech (*Fagus betuloides*) and the magnolia (*Drimys winteri*). The forest grows denser and more impenetrable the farther west we go on the main island; and likewise in the southern archipelago, where it has the appearance so marvellously described by Darwin, Cunningham, and others. In the most humid parts *Fagus antarctica* does not occur at the sea-level, but a new tree, the cypress (*Libocedrus*), is here met with.

Summing up all the facts and points of view given above, we can fairly divide Tierra del Fuego into the following four zones:—

1. *The Northern Pampa Territory*, consisting of tertiary rocks, covered partly by gravel, forming a vast table-land, partly by morainic material, deposited mostly in curious-shaped hills. The quantity of rain is less than 350 mm. (14 in.) annually; trees never grow, and the characteristic plants are the *Berberis*, *Chilotrichum*, and in the driest parts the thick-leaved *Lepidophyllum*. The lower parts are overgrown with rich grass, but at 500 feet and above the land is mostly very barren.

2. *The Central or Fagus Pumilio Zone* has an average height of from 150 to 500 feet. As the hills rise slowly with rounded contours it is difficult to find a point for a good view over the country, especially as they are generally covered with trees. But, taken as a whole, the country is for the most part open, or at least without any continuous covering of forest, and is overgrown with grass, replaced only in the most southerly parts by peat. Herds of guanacos are very common, and the general appearance of the country, with its fine glens and soft vegetation, is very pleasing. The rainfall amounts to from 350 to 500 mm. (14 to 20 in.).

3. *The Mountain or Fagus antarctica Zone*, with a rainfall of up to 800 mm. (32 ins.), is occupied by the central cordillera, the lower slopes of which are overgrown to a height of 1500 to 2000 feet with dense, uninterrupted forest of Antarctic beech. Of this there occasionally occur trunks with a diameter of six or seven feet. The mountain chain is cut up into numerous narrow ridges by river valleys, the bottom-surface of them covered with peat.

4. *The Outer or Fagus betuloides Zone*, with an annual average rainfall of more than 800 mm. (32 ins.), lies principally on the outer archipelago. The rocks, in great part eruptive, are more variable than in the central cordillera, the mountain summits lower and generally more rounded. The vegetation also is far more luxuriant, except on the bare rock, or in such places as are very much exposed to the wind, where only low, stunted bushes can exist.

The first three zones are inhabited by Indians of the Ona tribe, a tall, broad-shouldered, strong-limbed race, resembling the Patagonian Tehuelches, with whom they probably once formed a single tribe, but not very

recently, as the differences in their languages, which are now pretty considerable, show. The dwellers on the shores of the Beagle channel and of the southern archipelago, the Yaghans, are smaller, and their language, as well as their mode of life, is very different from those of the Onas.

Before concluding these notes it is worth while to add a remark or two on the new inhabitants of the island, the white settlers. Until quite recently they kept exclusively to the shore, but their mode of living is very different in the two principal zones of the territory. For many years the only white people living in the island were the missionaries sent out by the South American Missionary Society, who worked amongst the Yaghans in Ushuaia on the Beagle channel. Not until near the end of the Seventies, after the discovery of traces of gold, did settlers begin to frequent these regions. When the island was appropriated by Chile and the Argentine Republic in 1881, the former secured the coasts of the Straits, with the capital Punta Arenas, so it was necessary for the Argentines to found some centre for their trade in the territory. They chose Ushuaia for this purpose, where a small colony already existed, and from that time the southern shores, though far more inhospitable than the northern region, have as a matter of fact been more resorted to by people than the latter. Numbers of people still get a living by gold-digging, others again by killing seals, though that is now prohibited; but most of them also keep some sheep or cattle.

In contrast to the state of things in the south, almost all the land in the north is occupied by a few big companies, all founded for sheep-farming; but some gold digging is also carried on. The first farmers landed here in 1885, but down to the present day they have had great difficulties to encounter in their relations with the Indians; but as the land seems very well adapted for sheep-farming, and it is calculated that it can feed three millions of them, this industry ought to have a grand future. The biggest farm, at Useless Bay, now has about 100,000 sheep. It belongs to an Anglo-Chilean company. Most of the people, however, both in this region and in the whole territory bordering the Straits of Magellan, whether they be owners, managers, or shepherds, are English-speaking, many of them Scotsmen, who in many cases have come hither from the Falkland Islands.¹

For the traveller who is not desirous of exploring the most inaccessible or quite unknown parts of the country, a visit to Tierra del Fuego does not offer any *very* great difficulties. Moreover, leaving aside the numerous scientific questions that still demand a solution, such as the glacial geology of the district and the language and the mode of life of the aboriginal inhabitants, whose number seems likely soon to become a vanishing quantity, there is plenty of beautiful scenery of an interesting character, perhaps more varied than in any other part of the world; and there is abundance, too, of wild life alone with nature, so that a visit to this district, that approaches the Antarctic circle nearer than any other, cannot fail to repay the traveller who undertakes it.

¹ All the most suitable land for farming purposes in Tierra del Fuego is already occupied, and the only part of the Magellanic territory where good, unappropriated ground, adapted for sheep-farming, can yet be had at reasonable prices seems to be in South Patagonia, in the valleys of the rivers Gallegos and Coile.