

work will confirm them ; and when this is done, students of spectrum analysis will find a new region of the highest importance open to their inquiries.

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(To be continued.)

THE VARANGERFJORD REGION AND THE FORTHCOMING SOLAR ECLIPSE.

WE expect to have during this summer a good many visitors to the far north of Norway under the 70th parallel of north latitude, and close to the frontier of Russia. The total eclipse of the sun on August 9 (a few minutes before 5 a.m.) will attract many astronomers to these high latitudes. The sun will rise only 14° above the horizon during the eclipse, but the mountains here are not so high as to prevent the selection (though with some little difficulty even on the fjords) of places where their height will not prove an obstacle to the observers. In case one is in doubt, our official almanac gives the time when the sun will be visible on May 3 ; add nine minutes to that time, and it will be the time when the sun will rise over the mountains at the particular place.

It will be more difficult for astronomers to get a clear sky. The neighbourhood of Vardö, which otherwise would be very suitable, is plagued with fogs in the summer. Vadsö has more advantages, but still better are such inland places as Polmag, Utsjoki, Karasjok, Kautokeino, and Karasundo (in Sweden).

I shall give here some information for the guidance of those who intend to visit this remote corner of the earth.

The Varangerfjord ("ng" pronounced as in singer, not as in anger) runs inland west-north-west ; the land lying north of it is called the Varanger Peninsula, and that to the south of it South Varanger. All the land is fjeld (mountainous land, highlands), but it rises nowhere to any great height. There are no good maps of this region, except of the eastern part of South Varanger, of which the Government recently published a map on the scale of 1 in 100,000 ; it is the best map. There is also the ethnographical map of Finmark, by Friis, scale 1 in 200,000 (Christiania, 1888). On this remarkable map every family is indicated by a separate mark ; it indicates also the language they speak, and gives other details. It is, naturally, only in such a very sparsely populated region that such minute details can be represented on a map.

The Varanger Peninsula is a plateau which on its western border attains a height of 2200 feet, and on its southern about 1500 feet. The plateau is, however, not quite level, but presents such long, gentle undulations as are seen on the open ocean in calm weather. The permanent population, which keeps to the sea-coast, has here and there some outlying fields in the open parts of the valleys near the sea.

With the exception of these and the immediate neighbourhood of the settled places, the whole region consists of rolling mountain-tops practically unknown to the civilised world. It can, according to all that we know of it, be described as a wilderness of rocks, a stony desert covered here and there with reindeer moss (*Cladonia rangiferina*), and some swampy places where there thrives a scanty vegetation of green plants. Towards the inner part of the Varangerfjord there are some stretches of damp ground, overgrown with dwarf willows. About the centre of the peninsula are some large lakes full of fish, which only a few Norwegians have visited. However, access to them (apart from the question of distance) is not difficult from the south, for although there is no road, one can be driven there in a little cart. In winter, a few clever snow-shoe skaters have crossed this com-

pletely desolate, uninhabited land from north to south, a distance of forty English miles.

The western side of the Varanger Peninsula has a steep coast-line, but between Vardö and Vadsö the slope of the land seawards is very gentle ; to those who sail along the coast the country seems quite level.

The appearance of the coast at Vardö is seen in the illustration on p. 418, desolate and dreary, truly an Arctic desert land ; to the right is a bay of the sea, and the flat land in the foreground, consisting of gravel, exhibits some characteristic curved lines ; they are raised sea-beaches. Probably one must go to the great lakes of America to find equally brilliant examples of former water-levels. The uplifting of the land has not been uniform. On the north side of Varanger Peninsula the old beaches are 70 feet above tide, but on the south, at Vadsö, they have been raised to between 260 feet and 295 feet. Probably the land is rising at the present time. In Vardö, old people point out quays which have risen several feet during their lifetime. The Austrian astronomer, Pater Hall, who came to Vardö in 1769 to observe the transit of Venus, was so much interested in this question, that he caused a little pillar to be erected, the height of which above the then existing tide-level was accurately determined. He inserted in the parish register of Vardö a description of the position of this pillar ; but, alas ! though the register is still in existence, the pillar has disappeared. The land on the south side of Varangerfjord, South Varanger, is not quite so bleak and bare as Varanger Peninsula ; it has some pine forest in the valleys. It also can be considered a plateau ; but it is furrowed by valleys and fjords, and is thereby broken up into a multitude of small, flattish, dome-topped mountain masses. The plateau character is shown by the fact that all the mountains rise to about the same height ; in the eastern part, near the sea, to about 1300 feet.

These differences in the landscape and in the character of the country are connected with the fact that there are not the same kinds of rocks on the south side of the fjord as on the north side ; probably there is a line of faulting along the fjord. On the south side there are Archæan gneiss and granitic rocks ; on the north side younger rocks (conglomerates, sandstones, and slates), probably of Cambro-Silurian age ; but fossils have not as yet been discovered in them. A remarkable conglomerate occurs in the inner part of the Varangerfjord ; it may have been formed during a very remote Glacial period, probably Cambro-Silurian. It contains striated boulders, and rests partly on an underlying bed which shows glacial striations.

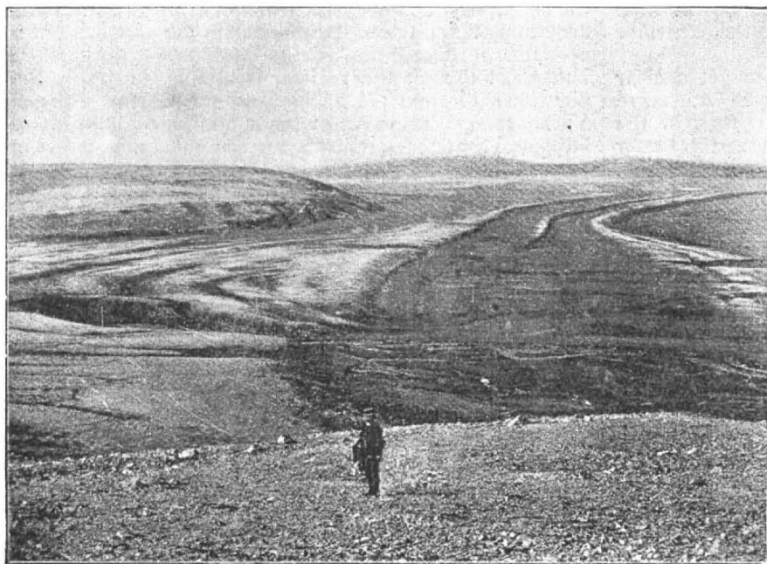
We shall now take a glance at the inhabitants of this province, Finmark, which touches the Russian frontier. The Norwegians gradually migrated into it during the last few centuries, but the Laps were already there. Many of the Laps wander as nomads with their reindeer, and dwell in tents, but the greater part of them live on the sea-shore, poor fishermen and farmers (like the crofters in the isles of Scotland), who grow a little hay for their cattle, and a few potatoes for themselves. There are no cereals in this northerly province.

Many of the inhabitants live in wretched earth-huts, which they share with their cattle. The Fins, who came from the grand-duchy of Finland, were the last to migrate into this district. The immigration commenced more than a century ago ; it attained its maximum between twenty and ten years ago, and it is now decreasing. The language of the Laps differs about as much from that of the Fins as English differs from German ; the Norsk language, as is well known, belongs to another group, the Germanic. All the three races are Lutherans. Finmark is very thinly peopled ; the whole population in 1891 was 23,000 on an area of 47,000 square kilometres, or about two square kilometres to each individual. Finmark

has three small towns, Hammerfest, Vardö, and Vadsö, each with about 2000 inhabitants; the last two are spoken of as astronomical stations; in both there are small second-class hotels, at which the charges are about five shillings to six shillings a day. In Vardö, Hansen's hotel, and rooms may be had from Herr Holte, the baker, and Herr Ness. In Vadsö, Krog's hotel, and rooms from Herr Lindseth. The charges for labour and assistance, such as men to row a boat or to carry things, are rather high in the summer-time in the whole of Finmark, because work is plentiful and labourers are scarce.

Vardö lies on a little island in the Arctic Sea, but quite close to the mainland; it has a more rigorous climate than any other town in Norway; not the smallest tree will thrive upon the island. Sea-fogs in summer, and the tremendous storms of winter, that never cease for a single day, are not at all cheering. It is not surprising that business people there live with their families in Christiania in the winter, and in summer follow the birds of passage to the north.

Vardö's sole source of income is derived from fishery,



View of the coast at Vardö, East Finmark.

and fish is cheap; haddock in the season sell at 6 lb. for a penny. A manufactory was started here to make dried fish meal from the flesh of this fish, but the people did not succeed in trying to remove the peculiar odour of dried fish from the material, so they were obliged to convert their works into one for the manufacture of damped fish-balls.

The only entertainment that I can recommend is the Russian vapour bath; it is a primitive installation. The vapour is produced by throwing water on heated stones, and the two women attendants whip the bathers with a bunch of quick-beam rods (*Pyrus aucuparia*). After the bath they offer, gratis, the Russian national drink, kvas, which tastes like ale mixed with water. However, Vardö has made progress in some respects within the last half-century. It was at that time, owing to the slowness and irregularity of the means of communication, so thoroughly out of touch with the world, and even with Christiania, the capital, that the commandant of the miniature fortress, who gave instructions to his orderly that the news from the capital should be laid before him every day, duly received them, but, alas, they were a year old!

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Vadsö lies on the mainland on the northern shore of the Varangerfjord. The neighbourhood is a quite treeless pasture. The houses, like those in Vardö, are of wood, small and plain. On a little island opposite the town lies a now abandoned whaling station. Whale fishing began in the Varangerfjord; but reckless over-fishing has driven the whales from this locality, and one can foresee the time when whale fishing will be a thing of the past in the whole of Norway. From Vadsö there is a good driving road to the west, past the little town of Nessby, as far as Seida on the river Tana.

Other places which may be mentioned as stations for observing the eclipse are Polmag, Utsjoki, Karasjok, Kautokeino, and Karasuando. The first three may be reached by the steamer, which enters the Tanafjord between sixty and seventy miles east of the North Cape, and sails in a southerly direction and touches at Vagge, thirty-five miles from the mouth of the fjord. Vagge lies near the mouth of the Tana River, and close by is Guldholm, near Tana Kirke, where boats may be hired for rowing up the river to Polmag, Utsjoki, and Karasjok. At Tana Kirke (church), as well as at Vardö and Vadsö, there are telegraph stations, where astronomical time may be received from Christiania Observatory, but not at Polmag, Utsjoki, Kautokeino, nor Karasuando.

Prof. Dr. H. Mohr and Mr. Schroeter, from Christiania University, will probably take their stations at Vadsö and Bugönes, close by. In Polmag the inhabitants are the most civilised of the Laps; they live in wooden houses, and are comparatively cleanly. A party of observers may live here for some time if they bring provisions with them.¹

In Karasjok, and, so far as I know, in Utsjoki also, one will get a friendly reception and good food from the shopkeepers. In Karasjok there are about 250 inhabitants, including a clergyman; in Polmag, not so many; but how many in Utsjoki (which belongs to Finland), I do not know. The way to Kautokeino, where living can be had at the Norwegian shopkeeper's, is by steamer to Alten, then forty miles on horseback, and seventy miles on the river by boat, which must be ordered in advance. From Kautokeino one

may proceed to the village of Karasuando in Sweden, which also is within the boundary of totality, by taking a boat on the river for fifteen miles, and then on horseback or by walking for thirty-five miles more.

Another less generally known way of reaching Karasuando, because it is newer, is by steamer twice a week from Tromsö to Skibotten on Lyngenfjord, where comfortable accommodation can be had, thence by road thirty-six miles to Lake Kilpisjärvi (half-way to which is the not very comfortable stopping-place Helligskogen), then by rowing-boat to Muotkavuoma in Sweden, and then by road to Karasuando. The return journey from here may be made either by Vitangi to Gellivara railway station, about 100 miles, or by the much-frequented route down the river Tornea to Haparanda on the Gulf of Bothnia.

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¹ As the brown (rye) bread in general use in Norway is badly baked and most unpalatable to those unaccustomed to it, and as white (wheat) bread can rarely be had, especially in such places, a supply of biscuits should be taken