TROMHOLT'S UNDER THE RAYS OF THE AURORA BOREALIS.

'WENN jemand eine reise thuht, so kann er was erzählen,'—it must have been with this text that Tromholt sat down to write the story of his life in Lapland. He was there to study the aurora borealis; but not content with doing a goodly amount of work, and doubtless setting the results down in awe-inspiring columns of figures, he devoted a part of his time to trips to Lapp encampments near his observing station at Koutokaeino, a more extended one to the Finnish station at Sorlankyla, and another along the north coast to Boris Glebe on the Russian boundary.

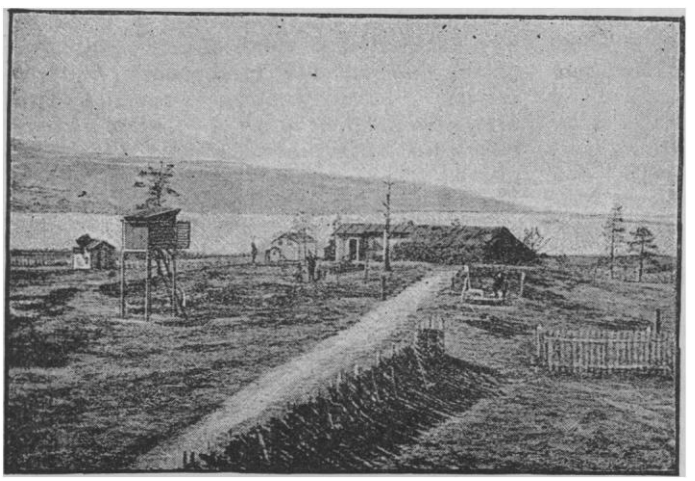

FIG. 1.—NORWEGIAN CIRCUMPOLAR STATION AT BOSSEKOP.

As a Scandinavian, he may well be proud of the scenery of southern Norway, which he refers to in the opening chapter. He says, "Dig a canal right through Switzerland, and steam down it: that would give some idea of the voyage along the coast of Helgeland, Lofodden, and Finnemarken." It may be even unjust to refer to Norwegian waters as canals, but still most will catch the author's meaning.

Bossekop was the name of the place where Tromholt and his party finally left the steamer which had brought him from Bergen. This hamlet is north of the arctic circle, and lies at the head of the Alten Fiord. We are somewhat surprised at our author's statement that Bossekop is surrounded by green hills with soft outlines, as most northern landscapes remind one strongly of the top of Mount Washington; and we are not much re-assured by the picture given of the place, which shows the usual assortment of barren boat-houses, and the trader's house and stores. One frame-house and its adjuncts constitute a hamlet in Norway.

It was in June, 1882, the party landed, and began the preparations for their series of observations, which were to be continued from Aug. 1, 1882, for one year. The description given of the routine at the station is not of such a character as to lead one to be anxious to emulate the work of such explorers. To sit blinking by the fire, waiting for the appointed hour, and then to venture out with a cup of hot water for the wet-bulb thermometer, in one hand, and an oil-lamp in the other, to spend a few minutes reading the thermometer and barometer, and sketching the aurora, and roughly measuring its position; and to return to the fireside, at last, with nearly frost-bitten fingers and a frozen lamp no longer burning,—this surely is not an alluring existence. But hour after hour the operation was gone through with, first by one, and then by another, of the party.

Tromholt himself left the main party at Bossekop, and travelled south about 63 miles to Koutokaeino. His reason for doing this was, that, by observations at the two stations

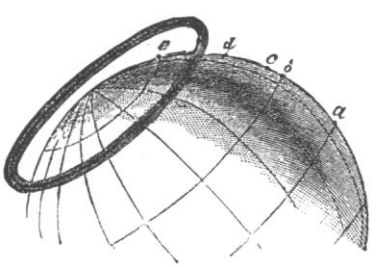

FIG. 2.—TROMHOLT'S THEORY OF AN AURORAL RING.

of the same auroral arch, some estimate might be formed of the height at which the auroral light is formed.

In a chapter of ninety odd pages, Tromholt reviews the theories of the aurora, classifies as best he can the different phenomena connected with them, and gives his own ideas in regard to what is actually going on when we see a

Under the rays of the aurora borealis: In the land of the Lapps and Kvaens. By SOPHUS TROMHOLT. 2 vols. London, *Low*, 1885.

display of northern lights. A number of illustrations are given; but in all cases they are reproduced from drawings, as, even with the most sensitive plates, he utterly failed in getting any impression on a negative. He holds the opinion that the fundamental phenomenon is a ring of light encircling the earth, as shown in fig. 2, and that all the various forms observed are due to modifications and imperfections in this ring. To the streamers he gives the position which a dipping-needle would take, and explains their apparent coming-together at the magnetic zenith, as they do occasionally, as due to perspective. He believes in such cases that the observer is looking into a tube of rays.

The geographical distribution of the aurora is described, and the results of the various estimates of the height given, Tromholt's own measurements making the average height of the lower edge of a number of auroral arches 70.2 miles. The connection of the aurora with the sun-spot periods is referred to, and a bi-yearly variation in the phenomenon is made probable. The crackling sound sometimes said to have been heard, Tromholt was led to consider imaginary. As regards the strength of the light emitted, he says that at times he was able to read print of the following size: —

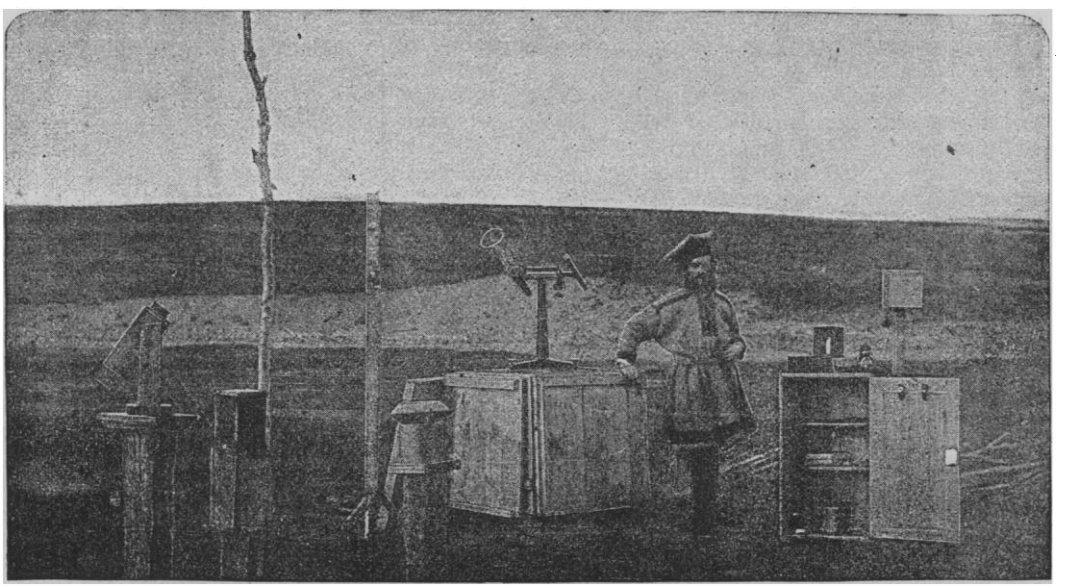

Fig. 3. — Tromholt's auroral station at Koutokaeino.

Aurora borealis.

In the account of his journey in the spring of 1883 to the Finnish polar station, Tromholt takes occasion to criticise the artificial aurora which Professor Lemström succeeded in getting on the top of a hill. He thinks the light more of the nature of St. Elmo's fire than a true aurora. He also takes exception to Lemström's determinations of the height.

Koutokaeino was the seat of a religious excitement among the Lapps, which finally culminated in 1852 in the murder of the trader and sheriff of the place, the pastor's life being saved only by the timely advent of a few armed and sane Lapps from a neighboring village. A somewhat similar excitement was in 1883 brewing at Hätta to the east of Koutokaeino.

The most of Tromholt's trips over the country were made in reindeer-sleds, when the snow was hard, and were accomplished with few more than the usual mishaps of such travelling, although his St. Bernard dog, Rolf, did not prove a congenial companion for the deer. But the final journey, to Sodankyla, was made when the sun had already begun to melt the snow; and, on his return, Tromholt pictures himself as dragged through from one to two feet of water for a great part of the way. In the spring the land must resemble one vast mud-puddle. Finally Tromholt returned to civilization, and took his voyage along the north coast of Scandinavia.

Thanks to the cheap photo-engraving pro-

cesses employed, the book is well supplied with authentic illustrations, although some of them are not very clear, — a fault doubtless due to imperfections in the original photographs.

SOME STATE GEOLOGICAL REPORTS.

MINNESOTA is not only the centre, but it is also the summit of the continent, in the sense of being the starting-point of the three most important systems of drainage in North America. But, notwithstanding its geographic position, the mean altitude of the state is less than thirteen hundred feet, and its surface configuration presents the simplicity and monotony of a level and thoroughly glaciated region; while the geological structure of the greater portion of the state is hopelessly buried under a thick and almost unbroken mantle of drift. These circumstances greatly diminish the labors of the geologist; and it is at first a matter of surprise that ten years should have elapsed between the inception of the survey and the completion of this first volume of the final report. But this is readily explained by the very economical administration of the survey, the geological corps consisting of the director and one assistant, and, during a considerable part of the time represented by this volume, of the director alone.

The introductory chapter is an extended and admirable historical sketch of explorations and surveys in Minnesota and the adjacent states, from the times of Champlain, Duluth, Hennepin, and La Salle, to the present survey. This historical introduction is, in its extent and general interest, unique among American geological reports. It is illustrated by several good reductions of the earlier maps of the north-west, and must prove a valuable compilation to students of history and geography as well as of geology. The account of the general physical features of the state in this volume is brief, and yet adequate, considering the topographic uniformity. But we look in vain for any generalized statement of the geological formations of the state below the drift. It is probable, however, that this chapter is reserved for a later volume; for, as stated in the preface, this volume is intended to be mainly descriptive, — a repository of facts, with only such generalizations as are self-evident or generally admitted.

The geology of Minnesota. Vol. i. of the final report. By N. H. WINCHELL, assisted by WARREN UPHAM. Minneapolis, *State*, 1884. 13+697 p., 1+31 pl. 4°.

Indiana. Department of geology and natural history. Twelfth and thirteenth annual reports. JOHN COLLETT, state geologist. Indianapolis, *State*, 1883, 1884. 400 p., 38 pl. (4) maps; 16+186 p., 39 pl., map. 8°.

The popular demand for early practical results is well met in the excellent chapter on the building-stones, which constitute, at present, the most important field of the economic geologist. The descriptions are plain and simple, with the condensed statements of the microscopic characters in fine print. The use of 'syenite' as a name for hornblendic granite is, however, antiquated, and without the sanction of the leading lithologists of this country and Europe. The table in which the descriptions of forty-one of the most important building-stones are condensed and compared would be a model of its kind, if the mineralogical composition of the stones were included. It shows at a glance, that, in crushing-strength and durability, the building-stones of Minnesota are probably not surpassed by those of any state in the Union.

The main part of this volume (about five hundred pages) is devoted to detailed accounts of the geology of the state by counties. Of the eighty counties in the state, twenty-eight, including nearly all that part of the state south of the Minnesota River, are here mapped and described, two-thirds of this work being credited to Mr. Upham. In some instances the descriptions of several counties have been combined; and, if this plan had been more generally adopted, much needless repetition might have been avoided, and the monotony of this part of the volume greatly relieved.

The two annual reports of the state geologist of Indiana contain comparatively little in the way of original contributions to the geology or natural history of the state. The most important sections of the reports are those on the paleozoic corals, and the subcarboniferous fossils of Spergen Hill, by Professor James Hall; the paleozoic flora, by Professor Lesquereux; and the fauna of the Indiana coal-measures, by Dr. C. A. White. These papers consist of short specific descriptions, with seventy-one plates of figures. Very few of the species are new to science, or peculiar to Indiana, while a considerable number are not found in that state. These articles are really compilations from the reports of other states and more general sources; and, although doubtless of some value as reference-manuals of the paleozoic fauna and flora, it is a question to what extent such publications are really germane to the purposes of a geological survey. Each volume contains several short county reports, and in these and other chapters the economic features have special prominence. But the treatment is not always impartial, for there is a manifest tendency in some parts to