The value of these plates would have been much greater if they could have been arranged in chronological order and properly labeled. Twelve of the plates have no date upon them and even an expert can not be sure to what period in the history some of them belong. Plate LXIV. is said to represent the source of the flow of 1880–81; but it was taken from near the head of the flow of 1887.

In utilizing the records of these volcanoes attention must be paid to the personal equation. Because the events happened so long since we hardly consider the relations of the two early explorers, Admiral Wilkes and Professor Dana. The former wished to write the history himself and hence directed that the latter should attend to business elsewhere, although he was the official geologist of the expedition. With a keen sense of the injustice done him, Dana would not fail to mention the weak points in the writing of his superior. Wilkes had Vesuvius in mind, evidently, when he spoke of the action as "a sea of molten lava, rolling to and fro its fiery surge and flaming billows." Dana saw only a feeble but constant agitation, like that of a caldron in ebullition, whence came his classification of volcanoes erupting violently and peacefully. The ascription of the Hawaiian volcanoes exclusively to the quiet class originated in his criticism of Wilkes; and he was himself forced to admit later that the eruption of 1790 was truly explosive, such as had not been observed since, and consequently that both styles of discharge may be manifested in the same volcano.

An apparent neglect of Dana's work appears in Captain Dutton's report. Naturally the former felt slighted and failed to acknowledge some important suggestions of the latter, such as the use of the term caldera for those volcanoes in which the quiet action predominates. I happen to know that this apparent neglect arose entirely from the inconvenience of obtaining for reference a copy of the geology of the exploring expedition.

Dr. Brigham illustrates the personal equation in his selection of observers whose statements meet his approval. Dutton is not quoted because the reader can consult his report. From Dr. Titus Coan much material is obtained, though he rightly rejects the theory that the lava streams from Kilauea and Mauna Loa united to cause the Kau earthquakes and the Kahuku eruption of 1868. Miss Bird's descriptions are accepted only because they agree with those of W. L. Green. He is indifferent to Miss Gordon Cumming who acknowledges her indebtedness to him in her "Fire Fountains." There are no allusions to H. B. Guppy, W. H. Pickering and A. B. Lyons.

Every one will approve of Dr. Brigham's recommendation that a permanent scientific observatory be established at Kilauea where notes may be taken with the best instruments, of earthquakes, the diurnal changes of level of the dome of Halemaumau, the temperatures of the molten lava and steam jets, the analysis of the ejecta and spectroscopic observations. No organization can more fittingly attempt such an establishment than the trustees of the Bishop Estate, who sustain the museum of which Dr. Brigham is director.

C. H. Hitchcock

Die Polarwelt und ihre Nachbarländer. Von Otto Nordenskjöld. Mit 77 Abbildungen im Text und einem Farbigen Titelbild. Leipzig und Berlin, Druck und Verlag von B. G. Teubner. 1909.

Most books about the polar regions are either accounts of explorations, histories of discoveries, or scientific monographs. This recent work of Dr. Nordenskjöld falls into neither of these categories. It is rather a physical geography, describing in a general way the chief characteristics of the polar and semi-polar regions, especial emphasis being laid on glacialogy and climatology. It has, however, a personal quality rare in such works, because Dr. Nordenskjöld has traveled and explored both in the Arctic and the Antarctic, and his comparisons and descriptions are therefore often those of an eye-witness of the phenomena he speaks of, and not merely facts culled from the works of other writers. "Die

Polarwelt" is a book which will well repay close study by all glaciologists and polar travelers, and it is to be hoped that Dr. Nordenskjöld will enlarge it in another edition, as it is full of fresh thoughts and valuable comparisons, in many cases only too briefly expressed.

Dr. Nordenskjöld begins with a study of Greenland, a portion of the eastern shores of which he has himself explored. Although little is known of the interior, yet this seems to be almost entirely covered with an inland ice cap, some two million square kilometers in extent. In the south the ice cap reaches the sea only in a few places, but where this takes place in the fiords, the ice advances with great velocity. In the north the ice cap, as along Melville Bay, extends along the shore as an ice wall. In former years the glaciation was much more extensive than now, as its traces are found on all exposed spots. On the eastern coast of Greenland north of Scoresby Sound is a district of about 5,000 square kilometers, called Jameson Land, which was explored by Nordenskjöld himself. It is a stony, sandy and mossy plateau, on which there is no ice cap nor any glaciers. And as a result, polar life is specially abundant, and troops of musk oxen, countless lemmings, and an occasional wolf were seen. A good part of Greenland seems to be formed of gneiss, and to-day there is no trace of volcanic activity. But in some places, especially in the east, basaltic lava has broken through and overflowed the gneiss, and it seems probable that these lavas belong to the same formation as those in Iceland, the Faroes, Scotland and Ireland and that at one time Greenland was joined to Europe. The most noteworthy attribute of the climate is that it changes with extreme rapidity, in accord with the winds, and when this blows from the land, the temperature rises on the coast. Of the Eskimos, Dr. Nordenskjöld has a high opinion, and he is inclined to think that their main original habitat was in the lands west of Hudson Bay and that they spread from there.

Iceland is the center of a great volcanic area, which extended from Greenland to Ireland, Scotland and the Faroes. This volcanic activity began in the early Tertiary, and has gradually died out, except in Iceland. Jan Mayen Island, for instance, is entirely volcanic and the craters of the mountains show the activity has only stopped recently. Iceland is much smaller than formerly. It may be looked on as a high plateau, contorted by volcanic forces and smoothed down by former glaciation, of which there are many traces. Possibly there were several glacial periods and to-day a portion of Iceland is still under an ice cap. At one time the climate was quite mild; now it is oceanic, relatively warm in winter and cold in summer, stormy, damp and foggy.

Spitzbergen in the main is mountainous, but in places it is almost a level plateau. The mountains are not very high and many fiords cut deeply into the islands. There is much ice and many glaciers, but nothing that can be considered a true ice cap. There is quite an abundant vegetation. And this is a point of difference with Franz Josef Land, an archipelago with many of the characteristics of Spitzbergen, but much more arctic, since while Spitzbergen has 125 varieties of plants, Franz Josef Land has only 14. Coal has been found in Spitzbergen, and mining is already well started, and taken in connection with an increasing summer tourist inroad, it seems as if Spitzbergen might become in time a semi-civilized region.

Bear Island is interesting as an example of a rather rare geological occurrence. It consists of 400 to 500 meters high land in the south, sloping off gently to the north. It is largely covered with masses of broken stones and dirt, which fall into long streaks or broad lines. While these formations are not definitely explained as yet, it would seem as though the frost and ice broke up the rock in the higher land, and that water and rains then washed it down to the lower levels.

About Antarctica, Dr. Nordenskjöld depends largely on his own observations. He is in doubt whether East Antarctica and West Antarctica form one mass or whether they are separate. He thinks that the coasts running from north to south are much less ice covered

than those stretching east and west. He is unable to explain satisfactorily why it is that at some places, like the South Shetlands, there are huge masses of ice, while at others, like Snow Hill, there are stretches of ground which are ice free. But this last condition may, in some way, be due to the storms. He is also quite unable to account for the various phenomena connected with the ice cap of East Antarctica, as we know nothing about it beyond the few facts obtained by the British expeditions in Victoria Land, and that von Drygalski observed the edge of the ice cap advancing very slowly in Kaiser-Wilhelm Land. Dr. Nordenskjöld considers the ice cap of East Antarctica the greatest geographical problem in the world, and that nothing will be really known about it, until some expedition pushes in some distance from some place on its sea front, such as Wilkes Land. The Great Ice Barrier he looks on as remarkable but not unique, as he himself discovered a similar, if smaller, formation, which he calls "shelf-ice," on the coast of King Oscar Land. He was not able to ascertain whether this had any motion. The mode of formation of this shelf-ice is still uncertain. The ice conditions in the south are decidedly different from those in the north. The great mass of ice rests undoubtedly on land, and the ice caps are much bigger. And this mass of ice Dr. Nordenskjöld thinks is due mainly to the semi-oceanic climate, since Antarctica is surrounded by water, and there is much precipitation. But it is mainly due to the very cold summers: at Snow Hill, for instance, more snow fell in summer than in winter. Antarctic temperatures, however, vary in different places. The climate was not always as cold as now, as fossils have been found, probably of Tertiary times, which belong to a subtropical climate. They link West Antarctica to South America. The penguins already lived in the south in Tertiary times, and have gradually adapted themselves to the changed conditions. There are no land animals whatever in Antarctica, and one reason may be that, at one period, the ice covered absolutely every bit of land, and killed off any life there may have been.

All the lands so far mentioned, barring Iceland, Dr. Nordenskjöld considers true polar, with the ice as their chief characteristic. Those described in the second half of his book he looks on as semi-polar. These have sometimes polar characteristics, but sometimes quite different characteristics. Snow and ice play their part, but mainly in winter; in summer they must be looked for almost wholly in mountainous regions.

Of southern South America, Dr. Nordenskjöld speaks largely from his own explorations. Along the western coast there is the mountain range of the Andes, to the west of which extends a string of islands, with deep navigable channels behind them, and how these were formed, Dr. Nordenskjöld hesitates to say, but he evidently disbelieves that they were scooped out by ice. On the contrary, the fiords and valleys running inland he thinks were at least to some extent formed by glaciers, and he judges that these lands were at one period largely ice capped. Even to-day, in some places, glaciers reach to the sea. On the eastern coast, on the contrary, there is a plateau formation, which gradually slopes from the mountain to the sea. Much of this plateau is covered with masses of broken stone (*geröll*). Dr. Nordenskjöld thinks these may be due to great glacial rivers, which kept changing their courses, accompanied, as in Iceland, with some volcanic action: still he leaves the matter problematical. There are many moraines also, which prove a former great extension of the glaciers, but nothing which shows that there was a true ice cap. Dr. Nordenskjöld, while in Patagonia, heard of a find by some workmen of a skin in a cave. He visited the place and dug out himself a piece of this skin, covered with long reddish hair. It turned out to belong to a *Grypotherium*, a giant sloth of, probably, Pleistocene times, and this discovery led later to others. There are two native tribes in Patagonia: the Onas to the east, the Yaghans to the west, and about these Dr. Nordenskjöld makes an important new suggestion. Usually they are ranked as the lowest of races, because they have not invented clothes. Dr. Nor-

denskjöld says this is incorrect; that one should remember that the climate is no worse than that of Belgium and that real cold is never felt, that parrots and magnolias flourish, and that a guanaco skin cloak is really sufficient protection for a savage under the circumstances. In many other ways, also, the natives show that they have adapted themselves to their environment. Had they been treated as the Eskimos were in Greenland, they would undoubtedly have survived.

Of sub-antarctic islands, Dr. Nordenskjöld does not write from experience. But he calls attention to the fact that Kerguelen Land has the most oceanic climate in the world, in summer about like that of October, in winter about like that of November, in southern Sweden. And he also justly bewails the impending extinction there of the sea-elephant.

Of northern North America and Siberia, Dr. Nordenskjöld says they are quite different in their nature from true polar lands, and the underlying cause is that they are continental masses and therefore have continental climates. Though the winters are very cold, the summers are hot, and these melt the snows and restrict the glaciers to mountain regions.

The northern American archipelago, Baffin Land, Grant Land, etc., has a semi-oceanic climate, and is far north. It is therefore covered with ice in spots, but there is not a true ice cap. There was unquestionably a time when most of arctic North America was glaciated, nevertheless, there are spots where this does not seem to have been the case. For instance, in some parts of the Yukon Valley the shape of the hills, the absence of moraines, and the weathered slopes of the ranges would seem to prove that these places could never have been overlain by glaciers. The surface gold is also a proof, for had a glacier spread over the valley, the gold would have been swept away.

Dr. Nordenskjöld does not know Siberia at first hand. He calls attention to the fact that it is even more continental than North America, and that it has the most continental climate in the world, with very cold winters and hot summers. The latter, and also probably the lack of great mountain ranges, keep Siberia free from an ice cap. Large areas of the ground, however, are frozen solid, and these have yielded mammoths in a state of such good preservation, that we can be certain they were really a polar animal. When the hot summers begin, they loosen first the southern headwaters of the streams, causing fearful floods and ice gorges as the water piles up against the still frozen northerly sections of the mighty rivers. Dr. Nordenskjöld makes some comparisons between the Eskimos and the Siberian natives, showing how these also have adapted themselves to their environment.

Scandinavia is really a high plateau and resembles Labrador. It has an oceanic climate, but with relatively warm summers. Formerly northern Europe was entirely glaciated. Then one stream of ice from Scandinavia and one from Scotland poured into the North Sea and this may have formed shelf-ice not unlike the Great Ice Barrier. The summer climate must at that time have been under 0° C. There must have been cold and mild periods, and sometimes the climate must have been not unlike that of Patagonia, while at other times Scandinavia, with its sharp rock towers standing outside in the ocean, must have resembled the South Shetlands.

At present continental ice caps are found in Greenland and in Antarctica. Ice caps also cover some islands. In the glacial period, true ice caps extended over northern Europe and most of North America, but not over Siberia or Patagonia, where, however, there was heavy glaciation. There is nothing to show that the glacial period was not simultaneous in both hemispheres and the climate was certainly colder than now. For wherever there are ice caps to-day, as in Greenland and Franz Josef Land, there are arctic climates: with a maximum for the whole year of under —5° C., and with very cold summers. The glacial period could not have taken place if the climate had been mild and damp, as can be judged by Kerguelen Land. It can not be proved as yet what caused the lowering of the temperature, but the hypothesis of Arrhenius, that there was less carbonic acid (*kohlensäuregehaltes*) in the air, has some probability.

EDWIN SWIFT BALCH