SKETCH OF THE GEOLOGY OF SPITZBERGEN

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BY

A. E. NORDENSKIÖLD.

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STOCKHOLM
P. A. NORSTEDT & SÖNER
1867.

The first notice of the geology of Spitzbergen is found in an appendix to the narrative[1]) of Sir Edward Parry's celebrated attempt to reach the North Pole, by crossing the ice North of Spitzbergen. In conformity with orders issued by the English Admiralty, enjoining the officers, when not engaged in the duties of the expedition, to devote all their time to scientific pursuits, they collected and brought home numerous specimens of rocks from the places they visited; and on this collection were afterwards based several, though rather incomplete, accounts of the geological features of the Northern coast of Spitzbergen. Amongst interesting objects brought home by Parry were some fragments of *Encrinites*, found among the calcareous strata at Cape Fanshawe.

In the same year (1827) Spitzbergen was visited by the Norwegian geologist Keilhau[2]), but in the narrative of his voyage the geological features of the country are scarcely mentioned. From Mount Misery on Beeren Island he however brought home a collection of fossils, which were afterwards examined and delineated by Leopold von Buch[3]) in a geological description of Beeren Island, based on the observations made by Keilhau. The

[1]) Narrative of an Attempt to Reach the North Pole in the year 1827, under the Command of Captain William Edward Parry. London 1828.

[2]) B. M. Keilhau, Reise i Ost- og West-Finmarken samt til Beeren Eiland og Spitsbergen i 1827 og 28. Christiania 1831.

[3]) L. v. Buch. Spirifer Keilhaui und dessen Fundort. Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin aus dem Jahre 1846. p. 65.

coal-strata of that island, most likely tertiary, are by v. Buch erroneously referred to the Coal-period.

Ten years later (1837) Professor Sven Lovén visited the Western coast of Spitzbergen, and among other places, Ice Sound, where he discovered several fossils belonging to the Mountain-limestone and the Jurassic formation, which until then had not been met with in so northern latitudes.

During the two following summers Spitzbergen was visited by a French Scientific Expedition on board the "Recherche" [1]); — Bel Sound in 1838, and the granite-region North of Magdalena Bay in 1839. The "Recherche", however, remained each time only a few weeks on the coasts of Spitzbergen, so that, notwithstanding the great resources of the expedition, the results of their geological researches were comparatively inconsiderable. Nevertheless Mr. Robert brought home a collection of fossils which were figured in the plates of the great work published on that expedition, and afterwards described by v. Koningk [2]). In the same work there are also some excellent views of the Western coast of Spitzbergen, which give a striking picture of those remote northern regions, especially interesting as an illustration of the origin and extension of the glaciers. Mr. Robert, too, ranged the strata containing *Spirifer* and *Productus* with the tertiary coal-bearing strata, and accordingly referred them both to the coal period.

In 1858 I visited, on board the yacht "Frithiof" hired and fitted out by Mr. Torell, Horn Sound, Bel Sound, Ice Sound, English Bay, Magdalena Bay, Amsterdam- and the Norway Islands, and made rich geological collections, among others, specimens of fossil leaves of different Miocene trees and plants.

In the same and the following year, Mr. Lamont [3]) visited Spitzbergen, and from the interesting and lively account he gives

[1]) Voyages en Scandinavie, en Laponie, au Spitsberg et au Feroë, sur la Corvette "la Recherche". Géologie, Minéralogie et Métallurgie par M. E. Robert. Livraison 4:e p. 87; 26:e p. 129. Géologie, Minérologie, Métallurgie et Chimie par M. I. Durocher. Livraison 29:e p. 469.

[2]) Bulletin de l'Académie Royale de Belgique. T. XIII (№ 6). T. XVI (№ 21.)

[3]) Seasons with the Sea-horses, by James Lamont. London 1861.

of his voyage, we find that he devoted some attention to the geology of the country. Mr. Salter afterwards published a description [1]) of the fossils brought home by Mr. Lamont, which were chiefly found at Bel Sound, and almost exclusively belonged to the Mountain-limestone. A few shells are also enumerated, belonging to the genera *Nucula* and *Aviculopecten*, but they could not be more definitely classified. They were found at Black Point near Deevie Bay, and most likely belong to the Jurassic formation.

When the last Swedish expeditions were undertaken, it was consequently known that the soil of the most arctic land consisted of strata formed at widely distant periods of the formation of the earth's crust, but it was impossible to arrive at any real knowledge respecting the geological structure of Spitzbergen from the scattered observations previously made. A vast field for more extensive researches was here opened to the Swedish explorers, whose attention had been especially directed by the commissioners of the Royal Academy of Sciences at Stockholm to a geological exploration of the country. In order to make this survey as complete as possible, every member of the party endeavoured to contribute to the extensive geological collections brought home from Spitzbergen, and deposited in the Riks-Museum at Stockholm. Besides that, a geologist who was to devote his attention chiefly to those pursuits, was attached to each ship engaged in the expeditions. Thus, in 1861, Mr. Blomstrand, on board of the "Magdalena" visited and examined the North-western part of Spitzbergen, between Sorge Bay and Ice Sound; Torell and myself, the North-eastern part between Sorge Bay, Seven Islands, Dove Bay and South Waijgats Islands. In 1864, during a forced stay of four weeks at Ice Sound, this bay which had already been visited by Mr. Lovén, myself and Mr. Blomstrand, was again explored, chiefly in boat-expeditions undertaken by Mr. Malmgren and myself. Later in the same year, I visited Bel Sound, Horn Sound and Stor Fjord. The observations

[1]) Appendix to the above-mentioned work by Lamont.

made during the expeditions of 1858 and 1861, have already been published [1]) in the Transactions of the Royal Swedish Academy of Sciences, and I might therefore have given here a description merely of the geological features of the tracts visited during the expedition of 1864. But since the publication of these papers, some of the rich collections of fossils brought home by us, have been examined and described by Mr. Lindström [2]) of Visby, and Professor Osw. Heer of Zürich [3]); and thus for the first time it has been possible to give a description of the geological features of the coasts of Spitzbergen, comprising all the essential information we at present possess of those arctic regions. Instead, therefore, of confining myself to a description of the observations made during the expedition of 1864, I will give here the outlines of a geological map of Spitzbergen, illustrated by a sketch, as complete as possible, of the geology of that island.

Spitzbergen consists of five large islands, and a great number of minor ones, situated between 76° 26′ and 80° 50′ North latitude, and 10° and 26° longitude East from Greenwich. The two largest of these islands, West Spitzbergen and North-east Land have, like many other mainlands and large islands, the form of a triangle, the point of which extends towards the South. The same form seems also to characterize those peninsulas, into which the main-land is divided by the large bays that extend far into the country. By a glance at

[1]) C. W. Blomstrand. Geognostiska iakttagelser under en resa till Spetsbergen år 1861. Kongl. Vetensk. Akad. Handl. B. 4 № 6.

A E. Nordenskiöld. Geografisk och geognostisk beskrifning öfver nordöstra delen af Spetsbergen och Hinlopen Strait. Kongl. Vetensk. Akad. Handl. B. 4 № 7.

[2]) Om Trias- och Jura-Försteningar från Spetsbergen af G. Lindström. Kongl. Vetensk. Akad. Handl. B. 6 № 6.

[3]) Oswald Heer. Om de af A. E. Nordenskiöld och C. W. Blomstrand på Spetsbergen funne fossila växter. Öfversigt af Kongl. Vetensk Akad. Förhandl. 1866. № 6.

the map we find that these bays have a most peculiar form, differing from that common in more temperate climes. They are everywhere almost equally broad and are most frequently divided, at a little distance from the entrance, into two arms of equal size, which suddenly terminate with a glacier or a low-land, without running into a narrow point; the shores are, except at the bottom of the bay, precipitous, and exhibit a fine section of the rocks of the country. Every thing seems to indicate that the bays and inlets of Spitzbergen are neither formed by a subsidence of the earth's crust, nor by the action of running water; but that they are either ancient glacier-beds, or have been excavated by powerful glaciers which, as the rock beneath was ground down and borne away, moved farther towards the interior, excavating the broad and deep slope, the bottom of which is now occupied by the sea. Frequently there is still a remnant of such a glacier at the bottom of the bay, as for instance, in Horn Sound, Kings Bay, Wijde Bay and other places. When no glacier is found at the bottom, the descent of the bay is generally continued towards the interior by an extensive and marshy low-land, which gradually, and without any such steep slope as is common along the sides of the bays, passes into the highland in the interior. We have here the bed of the névé which gave origin to the ancient glacier that once excavated the frith.

A similar formation of bays is undoubtedly still progressing on several parts of the coast as, for instance, North of the Rotges Mountains near Horn Sound. The mighty glaciers which here protrude into the sea, seem according to Dutch charts to have stretched as far as the low Dun Islands, the surface of which is in many parts polished by glaciers [1]). These islands are not marked

[1]) Though I had the opportunity of examining at several places in Spitzbergen old beds of glaciers surrounded by *solid* rocks, I have only very seldom met with any rocks polished and furrowed by glaciers; and those were besides always situated on the very edge of the sea. Such extensive and highly polished surfaces of rock as are every where met with in Scandinavia, are not to be found there. This evidently arises from the action of the frost which in connection with humidity will, in the course of only a few years, split the surface of the exposed rock. *The scored surfaces of rock in Scandinavia must therefore either have been formed beneath the surface of*

on the charts, although they were no doubt known to the Dutch, as being very rich in down, and situated in the vicinity of one of the most frequented harbours. The little sound, too, which unites Stor Fjord with Hinlopen Strait, has evidently been formed not long ago, probably by the decrease of those glaciers which descend at the North-east point of Barents Land.

There are, on the other hand, many circumstances proving that glaciers in other parts have, during the last centuries, advanced considerably as, for instance, at Horn Sound. That sound was apparently well known to the Dutch, as an old chart marks two anchorages there. They describe the sound as stretching one of its arms, containing two islands, somewhat Northward; but at present this arm is occupied by an immense glacier, and, excepting some small rocks, there are no other islands to be found in the bay. A similar case was noticed by Mr. Robert, at one of the arms of Recherche Bay (Bel Sound), and most likely analogous circumstances very much changed the shape of Stor Fjord, the bottom of which is occupied by an extensive and low glacier stretching in an even slope as far as Mount Chydenius. The large islands which, according to old charts, were situated at the inner extremity of the bay, cannot be the same small islets that are now to be found there; and it seems more probable that Mount Edlund, now encompassed by glaciers, and some other neighbouring mountain, similarly shut up by ice, were, at the time the whalers visited them, surrounded by water, and identical with those islands which on old charts are called Sea-horse Island and Seal Island. At Bel Sound I myself witnessed a most striking proof of glaciers, thus descending upon tracts hitherto free from ice. On the North coast of Bel Sound, directly to the East of the large island which separates Van Mijens Bay from the main bay, there existed, only a few years ago, one of the best harbours of Spitzbergen. The whalers on

the water by floating ice mounts, or else in a more temperate climate, where the glaciers that originated on the heights of the mountains, stretch far beneath the snow line, and where consequently the rock, laid bare by the the melting of the glacier, is no longer exposed to such severe cold as in the arctic countries.