Bay by a glacier 15 miles wide, or by that already alluded to in North-East Land, where the ice-cliffs are from 200 to 400 feet high. These glaciers, however, discharging into comparatively shallow waters, do not produce such icebergs as those of Greenland. The glaciers of the present epoch are but trifling in comparison with what they were during the Glacial period, when the entire country was buried under an ice-sheet, which probably connected all the archipelago into one ice-bound continent and spread far beyond to northern Europe.

The backbone of the islands consists of thick layers of granite, gneiss, and other archaic schists. But more recent formations bear­ing witness to a much more genial climate are not wanting. The Carboniferous period is represented by extensive coal-bearing strata, the lowest of which are intermediate with the Devonian (Liefde Bay strata). The Trias, also containing a rich fossil flora, is represented by black clay slate. The Jurassic deposits are widely spread ; they mostly belong to the Kelloway, and many of them are coal- bearing. To the same period belong the frequently occurring layers of what was formerly called hypersthenite, but has now been proved to be (according to Zirkel's classification) diabase and dolerite. The most interesting formation is, however, the Miocene. At a period close, geologically speaking, to the subsequent Glacial period, and even to our own, Spitzbergen was covered with a luxuriant vegetation the like of which is now found only in the 60th parallel in Scandinavia. The shores of Bel Sound, Ice Fjord, and Cape Starostine in 78° N. lat. were covered with extensive peat bogs, on the edges of which the marsh cypress flowered, dropping its leaves and blossoms into the marshes. *Sequoiæ,* poplars, birches, planes, and large oaks also grew there, while ivy and thick under­wood freely developed under their shadow, and thousands of insects swarmed in the thicket. The most striking feature of this Miocene vegetation—a feature conclusively established by the researches of Oswald Heer—is that Spitzbergen, Greenland, Franz-Josef Land, and Nova Zembla were at that time parts of one immense con­tinent, thus realizing the very conditions for the coldest climate, if climate had to depend on telluric causes only. Heer has shown, moreover, in a manner that hardly admits of doubt that the luxuri­ant vegetation so unmistakably borne witness to by the Miocene strata of the arctic regions could not have developed had it been condemned to endure the long arctic night it now undergoes. This feature of the arctic Miocene flora is unexplained, and will remain so until higher cosmical laws are formulated to explain changes of climate. A change in the position of the earth’s axis of rotation (recently the subject of a serious discussion in England and on the Continent) would seem to be the only adequate hypothesis by which to account for the warm vegetation of the period in ques­tion in such proximity to the pole ; but this hypothesis would be so much at variance with the present state of our knowledge that we may well hesitate to advance it. A brief recurrence of a warmer climate—not nearly so warm as the Miocene, yet somewhat warmer than the present—was also experienced by Spitzbergen after the long period of glaciation as is proved by the occurrence of beds with mussels, which are now found only in much warmer latitudes. This warmer Post-Glacial period—traces of which have been met with throughout the arctic and subarctic regions—was followed by a period of slow upheaval, which still continues.

The flora is of course poor. The only tree is the polar willow, which does not exceed 2 inches in height and bears a few leaves not larger than a man’s finger-nail ; and the only bush is the crowberry (*Empetrum nigrum),* to which the recently discovered cloudberry (*Rubus Chamæmorus)* may be added. But at the foot of the warmer cliffs some loam has been formed notwithstanding the slowness of putrefaction, and there, in contrast with the brownish lichens that cover the hills, grows a carpet of mosses of the brightest green, variegated with the golden-yellow flowers of the ranunculus (*R*. *sulphureus* and *hyperboreus),* the *Sileneæ,* the reddish heads of the *Pedicularis,* the *Oxyria reniformis* (a foot high), the large-leaved scurvy grass (*Cochlearia fenestrata),* several saxifrages, *Cerastium alpinum, Potentilla emarginata,* fox-tail grass (*Alopecurus alpinus), Dupontia Fischen, Poa cenisia, pratensis,* and *stricta,* with a few large-flowered *Polygona* and *Andromedæ* ; while on the driest spots yellow poppies and whitlow grasses (*Drabæ), Cardamine bellidifolia,* several *Dryadeæ,* &c., are found. Even on the higher slopes, 1500 feet above the sea, the poppy, *Luzula hyperborea,* and *Stellaria Edwardsii* are occasionally met with. Mosses, mostly European acquaintances, cover all places where peat has accumulated. The slopes of the crags and the blocks of stone on the beach are some­times entirely covered with a luxuriant moss and lichen vegetation, among the last being the so-called “famine bread” (*Umbilicaria arctica),* which has maintained the life of so many arctic travellers. Flowering plants are represented by as many as ninety-six species, of which eighty-one grow in Greenland and sixty-nine in Scan­dinavia ; forty-three species are alpine cosmopolites, and have been met with on the Himalayas. The ferns are represented by two species.@@1 Although thus limited in number, the flora is suggestive

in its distribution. The vegetation of the south has a decidedly Lappish or European alpine character, while that of the north coast is decidedly American, and recalls that of Melville Island. Many flowering plants which are common in north-west Spitz­bergen are absent from the east coast, where the cold current is inimical to both flora and fauna ; but, on the other hand, one moss (*Pottia hyperborea)* and one lichen (*Usnea melaxantha)* are found there which are of American origin and grow both in North America and on the Cordilleras. *Algæ* are most numerous, many, like the brown *Laminaria* and *Nostoc communis,* which fill all pools and are the chief food of many birds, being familiar in Europe. *Protococcus nivalis* covers the snow with its reddish powder.

The fauna, although not very rich in species, is exceedingly rich in individuals. It includes fifteen mammals, only two of which are terrestrial—the reindeer and the ice-fox—besides the usual in­habitant of the arctic regions, the polar bear.@@2 The number of reindeer is really puzzling. In a single summer, or rather in the course of a few weeks, no fewer than from 1500 to 2000 reindeer were killed by hunters for several consecutive years previous to 1868. Much emaciated in June, they grow very fat towards the end of the autumn, after feeding on the mosses. Great numbers are “ marked ” (that is, have both ears cut at the same height), and the hunters are persuaded that these individuals come from an un­known continent in the north-east, where they have been marked by the hand of man. However strange this hypothesis, it must be acknowledged that the objections urged against it by the Swedish explorers are not conclusive, and that frost-bite attacking young calves could hardly account for the symmetrical markings on both ears. The immense numbers of the reindeer strongly support the idea of their migration, and the only question is whether they came from Siberia *via* Nova Zembla, or whether they did not really come from the unknown archipelagoes on the north-east, the existence of which is supported by so many other data (immobility of the ice to the east of Spitzbergen, dirty ice, birds met with off North-East Land, as well as several other considerations of a more general character).

Eight Cetaceans are met with in the seas off Spitzbergen, viz.,— *Balænoptera boops,* 80 to 110 feet long; *B. gigas* and *B. rostrata,* 30 feet long ; the white whale (*Beluga catodon),* three species of seals (*Phoca barbata, grœnlandiea,* and *hispida),* and the walrus (*Trichechus* or *Odobænus rosmarus).* The Greenland whale has completely disappeared in consequence of the great havoc made during the last two centuries : according to Scoresby, no less than 57,590 individuals were killed between 1669 and 1775. A perfectly reckless extermination of seals is still going on. Numberless wal­ruses tumble about in the water, or lie in crowds on the floating ice ; and their number further increases when the flocks of Green­land seals arrive in August.

Birds visit the archipelago in such vast flocks that the cliffs are literally covered with them. The fulmar petrel (*Procellaria glacialis)—*a herald of polar regions—meets the ships approaching Spitzbergen far away from the coasts. Its colonies cover the cliffs, as also do those of the glaucous gull (*Larus glaucus),* or the “ burgo­master.” Rotches (*Mergulus alba),* black guillemots (*Uria grylla),* ivory gulls (*Larus eburneus),* auks, and kittiwake gulls (*Larus tridaetylus)* breed extensively on the cliffs, while geese, looms, and snipe swarm on and about the lagoons and small freshwater ponds. The bernacle goose (*Anser bernicla)* is only a bird of passage, as it goes farther north-east to nest. The eider breeds in large colonies on the islands, where its young are safe from the ice-fox, only the glaucous gull and the brent goose (*Bernicla brenta)* being admitted to keep them company, while the lumme (*Mormon arcticus)* and the tern confine themselves to separate cliffs. These birds, how­ever, are only guests in Spitzbergen, the snow-bunting (*Emberiza nivalis)* being the only species which stays permanently ; twenty- three species breed regularly on Spitzbergen, and four others (the falcon, snowy owl, swan, and skua) come occasionally.

There are twenty-three species of fishes, but no reptiles. Insects are few : *Lepidoptera* (one species), *Neuroptera* (one), *Hymenoptera* (four), and *Diptera* (twenty) have been met with by the Swedish expeditions. Arachnids, and especially Pantopods, on the other hand, are very common. Molluscs are also very numerous, embracing no less than 130 species. In June several *Limacineæ* are met with in such numbers on the coast and at the mouth of the glacier streams as to constitute the chief food of the gulls. At some places the mussels and univalves reach a comparatively colossal size and appear in incredible abundance. Of Crustaceans no fewer than 100 species have been recognized in the waters of the archipelago.

The marine fauna is exceedingly rich in the bluish warmer waters of the Gulf Stream, and the dredgings of the Swedish expeditions, which were prosecuted even under the ice, never failed to bring to the surface a rich variety of remarkable or new forms. From a depth of 8400 feet the “bull-dog” machine lifted mud of a tempera-

@@@1 According to Mr Naathorst’s researches in 1882 (*Sv*. *Vetenskaps Akad. Hand­lingar,* XX. ; *Botanisches Jahrbuch,* iv.), the flora of Spitzbergen is composed

as follows :—*Rosaceæ,* 7 species ; *Saxifragæ,* 10 ; *Cruciferæ,* 15 ; *Ranunculaceæ,* 8 ; *Sileneæ* and *Alsineæ,* 12 ; *Salix,* 2 ; *Compositæ,* 5 ; *Scrophulariaceæ,* 2 ; *Ericaceæ,* 2 ; *Gramineæ,* 23 ; *Cyperaceæ,* 12 ; *Juncaceæ,* 6 ; *Filices* (Ferns), 2 ; *Lycopodiaceæ,* 1. The whole of this flora immigrated during the Post-Glacial period, which was warmer than the present.

@@@2 The existence of the *Arvicola hudsonia* is not quite proved.