

KINGS BAY FROM COAL HARBOR, THE MINING SETTLEMENT OF THE NORWEGIAN KINGS BAY COAL COMPANY ON ITS SOUTHERN SHORE

On the right is shown the terminus of the most northerly railroad in the world (78° 56' N.) The line, 1½ miles long and of 36-inch gage, carries the coal from the mine to the harbor.

## The Norwegians in Spitsbergen\*

### Their Rightful Claims to Sovereignty of This Archipelago

By Charles Rabot

Société de Géographie de Paris

*Special interest attaches to this article in view of the fact that the Supreme Council of the Peace Conference at Paris on November 21 approved the text of an agreement granting political suzerainty over the Spitsbergen archipelago to Norway.—EDITOR.*

SEVERAL papers concerning Spitsbergen have recently been published, but they are incomplete and inaccurate, their authors being unaware of the great work done by the Norwegians in this archipelago and of the recent historical research work of the Dutch. It may therefore be useful to attempt to present a comprehensive account of geographical progress in Spitsbergen and of the industrial development of this polar land as well as its political history.

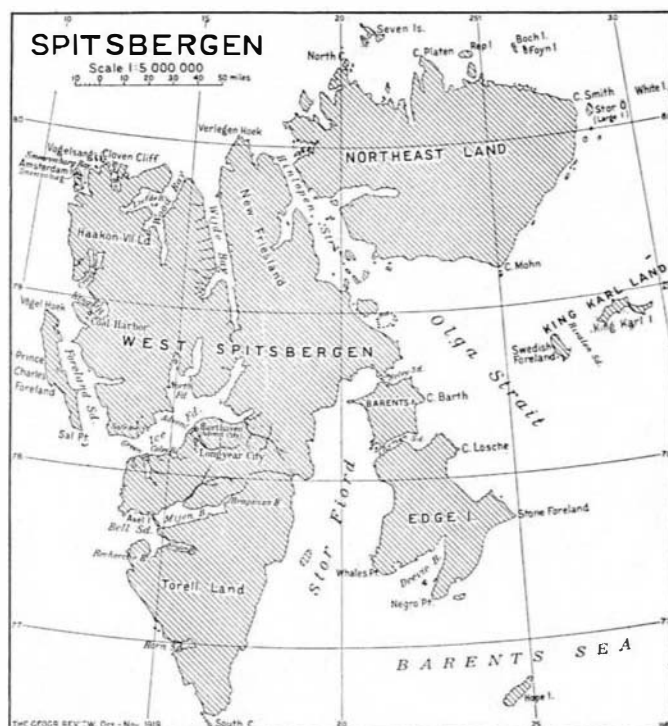
#### ICE CONDITIONS ON SPITSBERGEN COASTS.

Owing to the climatic effects of a branch of the Gulf Stream, the western coast of Spitsbergen and the westernmost part of its northern coast are usually ice-free from July to October. Sometimes the western coast is open until December. In 1892, on July 29, 30, and 31, between Jan Mayen and Ice Fiord, I did not see a single cake of ice. Thanks to these circumstances tourist-crowded liners in service before the war used to push up from the northwestern corner of Spitsbergen as far as the eightieth parallel to let their passengers enjoy a view of the polar pack. In no other part of the world can one reach so high a latitude in open water.

By contrast, a polar current flowing past eastern Spitsbergen, carrying a large amount of ice, blocks the eastern coast of Northeast Land, Barents Island, and Edge Island. Off the southern coast of the last-named island a branch of this current takes a westerly direction, rounds South Cape, and runs northward between the Gulf Stream and the western coast of Spitsbergen, carrying masses of ice which generally disappear by early summer. Such is the normal state of the ice, but it may be interfered with by the winds. In spring and summer northern and eastern winds prevail, the polar pack drifts southward and closes the generally open waters off the northern coast, while the eastern ice drifts southward also, opening Stor Fiord and the sea off the eastern coasts of Northeast Land, Barents Island, and Edge Island.

A great deal of this ice skirts South Cape and arrives on the western coast at the southern point of Prince Charles Foreland. In 1915 so much eastern ice gathered on the western coast that Bell Sound and Ice Fiord were blocked and navigation was very difficult until the end of August. Probably not since the discovery of Spitsbergen, certainly not in the last fifty years, had the western coast been so obstructed by ice.

It also happens, but very rarely, that owing perhaps to the



SKETCH MAP OF SPITSBERGEN

greater flow of the Gulf Stream, the sea all about Spitsbergen remains open the greater part of the summer, and in such seasons the circumnavigation of the archipelago becomes possible. This was the case in 1918 and, before that, in 1886, 1887, 1898, and 1899.

\*Reprinted from the *Geographical Review* for October-November, 1919, published by the American Geographical Society, Broadway at 156th Street, New York. Photographs loaned by the *Geographical Review*.



PANORAMA FROM BEN NEVIS, A SUMMIT 913 METERS HIGH SOUTHEAST OF RED BAY, NORTHERN WEST SPITSBERGEN. The view, which extends from south to northwest, shows practically the whole extent of the Grand Glacier, which ends in Red Bay on the right. (Photo by Captain Gunnar Isachsen.)

#### HISTORY OF EXPLORATION.

The story of the geographical exploration of Spitsbergen can be divided into three periods: (1) the Dutch-English, which lasted until the beginning of the eighteenth century; (2) the Norwegian-Swedish, between the end of the eighteenth century and the opening of the twentieth century; (3) the Norwegian, since 1906.

#### DUTCH-ENGLISH PERIOD.

The old Icelandic annals regarding the discovery of Spitsbergen by Norwegians in the eleventh century are vague, and the journey of Willem Barents in 1596 is considered as the first authenticated voyage to this Arctic land. The celebrated Dutch seaman visited only the western coast and a part of the northern coast of the main island, and the discovery of the other islands has been credited to English "adventurers" of the Muscovy Company. But this claim must be revised. The globe of the Dutch cosmographer Plancius, engraved in 1612 and newly discovered by Dr. F. C. Wieder, delineates the northern coast beyond Hinlopen Strait, the Seven Islands, the western and southern coasts of Edge Island, and Hope Island. Thus, previous to the English, even "before 1614 the entire circumference of Spitsbergen was known to the Dutch, except the vicinity of Heley Sound (Helis Sound) and the east coast of North-East Land and Edge Island, so that the Dutch may rightly be called the discoverers of the entire Spitsbergen group."<sup>1</sup>

<sup>1</sup>The Dutch Discovery and Mapping of Spitsbergen (1596-1829). Edited by order of the Dutch Minister for Foreign Affairs by Dr. F. C. Wieder. Published by the Netherland Ministry for Foreign Affairs and the Royal Dutch Geographical Society, Amsterdam, 1919. This splendid volume contains the reproduction of 83 maps of Spitsbergen between 1596 and 1829.

About the middle of the seventeenth century, while the English whale fishery declined, the Dutch whaling industry had a rapid development, which was of great advantage to geography. Returning home, the Dutch whalers gave to the cosmographers of Amsterdam information concerning Spitsbergen, so that in Holland there was continuous and uninterrupted progress in the cartography of these polar islands. From 1594 to 1892, according to Dr. Wieder, more than two hundred maps of Spitsbergen were published in the Netherlands. To the Dutch we are indebted for the first cartographical documentation concerning these islands. During two and a half centuries the Dutch were the masters of the cartography of Spitsbergen.

#### NORWEGIAN-SWEDISH PERIOD.

Toward the end of the eighteenth century the Dutch whale fishery declined, and the Norwegians arrived at Spitsbergen in order to hunt the walrus, seal, polar bear, and reindeer in summer. Their activity was at that time limited to the western coast and to the easily accessible part of the northern coast. In 1827 B. M. Keilhau, professor at the University of Christiania, chartered one of these sealing vessels and paid a short visit to Bear Island and Spitsbergen. This was one of the first scientific expeditions to these islands and one of the most successful. The geological, paleontological, and botanical studies which Keilhau had the opportunity of making during his voyage are fundamental. In 1837 the Swedish professor S. L. Lovén also made a scientific trip to the western coast in a Norwegian vessel.

In 1858 the second chapter of the history of Spitsbergen opens with the geographical exploration of the archipelago both by Swedish scientific expeditions and by Norwegian walrus hunters. From 1858 to 1908 twenty Swedish expedi-



LOOKING SOUTH DOWN ERDMANN GLACIER (RIGHT AND CENTER FOREGROUND) AND ITS OUTLET VALLEY TO THE FURTHER SHORE OF BELL SOUND (IN THE BACKGROUND).

The massif on the right is Mt. Conway, that on the left, South Halland Ridge. (Photo by Engineer Koller.)

tions went to Spitsbergen under the leadership of scientists like Otto Torell, A. E. Nordenskiöld, A. G. Nathorst, Baron Gerard de Geer and others. Besides valuable scientific studies they published in 1865 the first chart of the archipelago based on surveys. This chart has been the basis for later ones representing fresh discoveries. The British Admiralty's chart, reproduces the results of the Swedish surveys.

#### DISCOVERIES BY NORWEGIAN WALRUS HUNTERS.

During the second half of the nineteenth century no Norwegian scientist took part in the exploration of Spitsbergen.



LONGYEAR CITY IN SUMMER

Nevertheless important discoveries were made by Norwegians. About the year 1850 game became scarce in the easily accessible parts of Spitsbergen, and Norwegian walrus hunters sought new grounds in the generally ice-blocked waters stretching northward and eastward and made important discoveries in the hitherto unknown eastern parts of Spitsbergen.<sup>2</sup>

The first step in this direction was taken in 1847, when Captain Lund navigated Thymen Sound, between Edge Island and Barents Island, for the first time. At that time Barents Island was not known to be an island; it was represented as a large foreland of West Spitsbergen, and Heley Sound was shown as a fiord. In 1858 Captain Johan Nilsen crossed this inlet from sea to sea, demonstrating the supposed fiord to be a strait. By this discovery the features of eastern Spitsbergen were also completely changed. In 1859 another Norwegian seal hunter, the well-known Elling Carlsen, cruising eastward of Edge and Barents Islands, found himself near an unknown land. This was the island now named King Karl Land but then identified with Giles Land, an island seen in 1707 by Commander Giles, the position of which remained uncertain at that date. Three years later, in 1861, Carlsen for the first time circumnavigated the whole archipelago—a splendid achievement. During this cruise the true nature of Northeast Land was ascertained. It was discovered that the eastern coast of this large island is entirely occupied by a great glacier discharging into the sea and forming the eastern outflow of an inland-ice mass which covers the whole island. In 1864, off the eastern coast of Northeast Land, another gallant Norwegian hunter, Tobiasen, rediscovered Stor Ø (Large Island), seen by Dutch whalers in the seventeenth century.

In 1867, Rönneback circumnavigated West Spitsbergen and discovered a group of small islands on the western coast of Hinlopen Strait in 79° N.

In 1871, an English sportsman, B. Leigh Smith, chartered

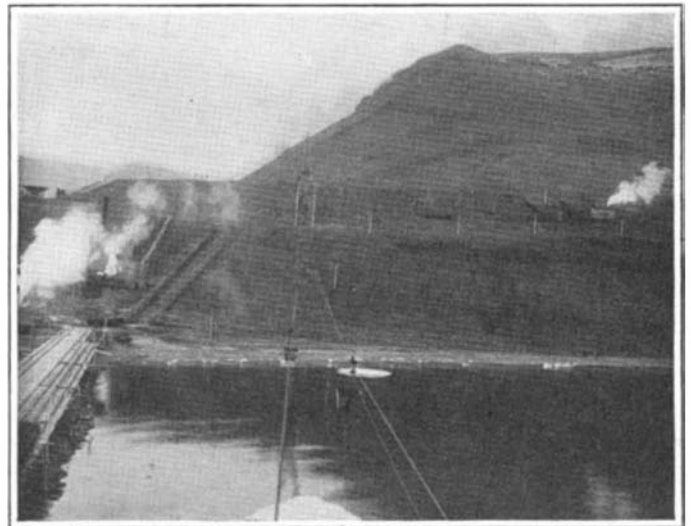
<sup>2</sup>The survey of the Norwegian exploration of Spitsbergen here given summarizes a statement compiled by order of the Norwegian Government by Adolf Hoel, of the University of Christiania, the leading Norwegian explorer of these islands in recent years.

a Norwegian schooner under the command of Captain Ulve, an expert Norwegian ice navigator. Reaching the southern and later the northern coast of Northeast Land, they stated that this land stretched about 43 nautical miles farther eastward than was formerly believed.

In the following year knowledge of eastern Spitsbergen was advanced by Norwegian seal hunters. Taking advantage of an open season, Altman, Johnsen, and Nielsen reached King Karl Land and reported that there were several large and small islands divided into two groups by a large sound. Johnsen landed on the northeastern point of the eastern group.

In 1876 and 1887, eastward of the northeastern point of Northeast Land, two Norwegian walrus hunters, Kjeldsen and E. H. Johannesen, came in sight of an unknown island, White Island, the true Giles Land. In 1889, another Norwegian walrus hunter, Hemming Andreassen, completed our knowledge concerning King Karl Land by navigating the northern part of the sound dividing the two main islands, Svenska Förland (Swedish Foreland) and King Karl Island. This sound was called Rivalen Sound from the name of Andreassen's ship. According to Professor Nathorst, the sketch map of this Norwegian walrus hunter was not superseded until the survey of this group of islands was made by the Swedish expedition of 1898; it is, however, much more accurate than the map that Dr. W. Kükenthal, the well-known zoölogist of Jena, published after visiting King Karl Land in a Norwegian hunting sloop that same summer. So strong is respect for established authority in old Europe that in a new issue of their maps of Spitsbergen the British and French hydrographic offices reproduced the incorrect sketch made by the German scientist rather than the accurate one by the Norwegian skipper.

Finally, in 1898, Norwegian hunters, starting from the northeastern corner of Northeast Land, discovered beyond



THE WHARF AND CABLEWAY ON ADVENT BAY FOR UNLOADING COAL FROM THE MINE AT LONGYEAR CITY

White Island a new island, which they named Victoria Island. These seamen also reported that Spitsbergen and Franz Josef Land have a fringe of islands between them. These two polar lands form a dam which prevents the polar pack from flowing southward in great masses. To this circumstance northern Europe is indebted, in part, for its relatively mild climate.

To summarize, we may say that in eastern Spitsbergen the Norwegian walrus hunters did admirable pioneer work, opening the way for further scientific expeditions. Also, geography is indebted to them for determining the directions of ice drift around Spitsbergen.

In order to complete the description of the contributions to our knowledge of Spitsbergen made by Norwegian hunters, it must be added that, of the trappers who have been winter-

ing in the islands since the last years of the nineteenth century to catch bear and fox, eighteen parties made regular meteorological observations, both on the western and the eastern islands, with instruments lent by the Meteorological Institute of Christiania, and thus added substantially to our knowledge of the climatology of this Arctic land.

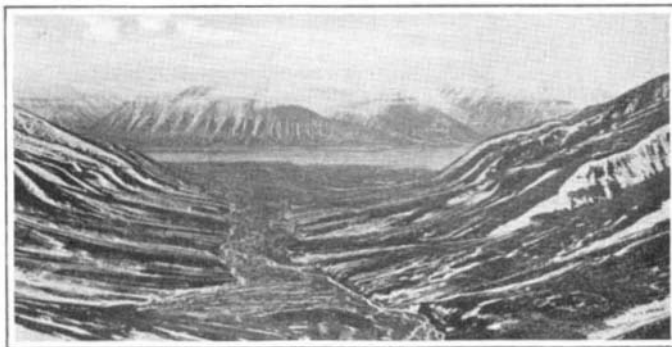
#### RECENT NORWEGIAN SCIENTIFIC EXPLORATION IN THE INTERIOR.

In 1906 the last chapter in the exploration of Spitsbergen was begun by Norwegian scientists, using new methods of exploration. Until then few expeditions had been undertaken in the interior, so that practically the whole inland portion of the islands remained a *terra incognita*. In 1906, the Prince of Monaco, having taken Spitsbergen waters as a field for oceanographical research, began the systematic survey of the western island. Establishing his headquarters in Cross Bay, he entrusted the mapping of the mountainous massifs stretching from that bay to Smeerenburg to Captain Gunnar Isachsen of the Norwegian army, who had been the topographer of Sverdrup's expedition to the American Arctic Archipelago. With a staff of Norwegian surveyors and naturalists and with Dr. Louet of the French army, Captain Isachsen admirably fulfilled his task in two summers.

The results are of great value.<sup>3</sup> About 200 square miles of Spitsbergen's ice world were mapped by accurate methods on the scale of 1:100,000 with contours of elevation. Never before had such a great area of the interior of Spitsbergen been surveyed, nor an Arctic land mapped so accurately. This successful expedition aroused in Norway a still greater interest in this region. The Norwegian parliament and private citizens granted large subsidies for pursuing the work initiated by Isachsen. Henceforward the foundations were laid for a systematic survey of the western fiord region of West Spitsbergen and every summer thereafter one or two Norwegian expeditions went to the island.

In 1907 and 1910 a large expedition set off under the com-

<sup>3</sup>The scientific results of the expedition are laid down in the splendid series of monographs published by the Prince of Monaco under the title "Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier, Prince souverain de Monaco," Fascicules 40 (surveys; with the map, 1:100,000, showing relief and glaciers in contours and shading, 41 (glaciology), 42 (geology and physiography), 43 (geology), 44 (botany).



THE MALAR VALLEY LOOKING DOWN (SOUTHWEST) TO ITS  
JUNCTION WITH ADVENT VALLEY  
(Photo by Engineer Koller, 1917.)

mand of Captain Isachsen, numbering, besides the leader of the expedition, nine scientists. Extending in all directions the survey made on behalf of the Prince of Monaco, they brought back maps of northwestern Spitsbergen between the northern coast, Wijde Bay, and Ice Fiord, of the region adjoining Green Harbor in the last-named fiord, and of Prince Charles

Foreland.<sup>4</sup> During the two summers in which the expedition was in the field more than 2,000 square miles were mapped, and a great quantity of geological data was gathered.

From 1911 to 1918, under the leadership of Adolf Hoel and Captains Arve Staxrud and Sverre Røvig, topographical and geological surveys were extended to the peninsula between Ice Fiord and Bell Sound and southward to the coastal region as far as Horn Sound. The work of

the Norwegians in Spitsbergen from 1906 until 1918 may therefore be summarized as follows:

All the western coastal region as far as a point lying three statute miles south of Horn Sound is now accurately triangulated and mapped in detail.<sup>5</sup> That is a piece of land about 200 statute miles long and 18 to 58 miles wide, covering 5,600 square miles. For the northern sheets the scale of 1:200,000 has been adopted, and for the southern sheets 1:100,000 and 1:50,000. All these maps will soon be published; a chart of the western coast of Spitsbergen, more nearly correct and more complete than the British and German charts, has already been published by the Norwegian Hydrographic Office.<sup>6</sup> In the coming years the survey will be continued southward; it is hoped to reach South Cape by 1922.

These expeditions also attained geological results of exceptional value. The chief points of interest about these re-

<sup>4</sup>The geographical results are contained in:

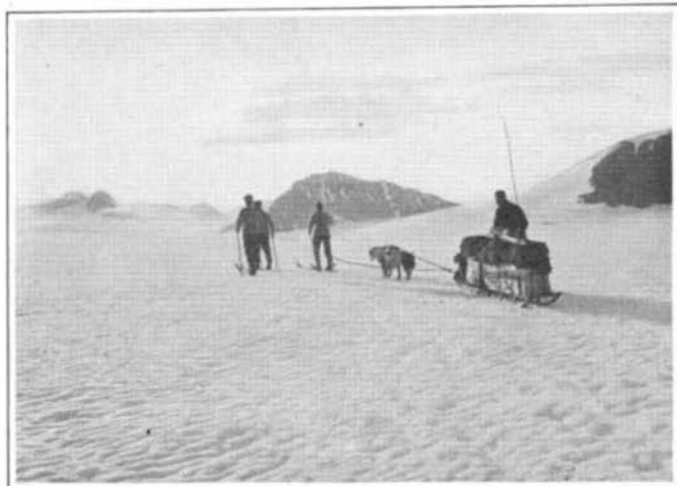
Gunnar Isachsen: *Travaux topographiques de l'expédition Isachsen, 1909-1910, Kristiania Videnskapsselskaps Skrifter: I. Mat.-naturv. Klasse, 1915, No. 7* (=pp. 1-63). [Contains the map of northwestern Spitsbergen in 1:200,000, showing relief and glaciers in contours.]  
*Idem*: *Green Harbour, Norske Geogr. Selskaps Aarbok, 1912-13, pp. 151-162.* [With a map of Green Harbor in 1:100,000.]

<sup>5</sup>Besides the Norwegian surveys there should be mentioned the map of Prince Charles Foreland, 1:140,000, by Dr. W. S. Bruce and M. J. Mathieson, published in 1913 by the Scottish Oceanographical Laboratory of Edinburgh with the support of the Prince of Monaco.

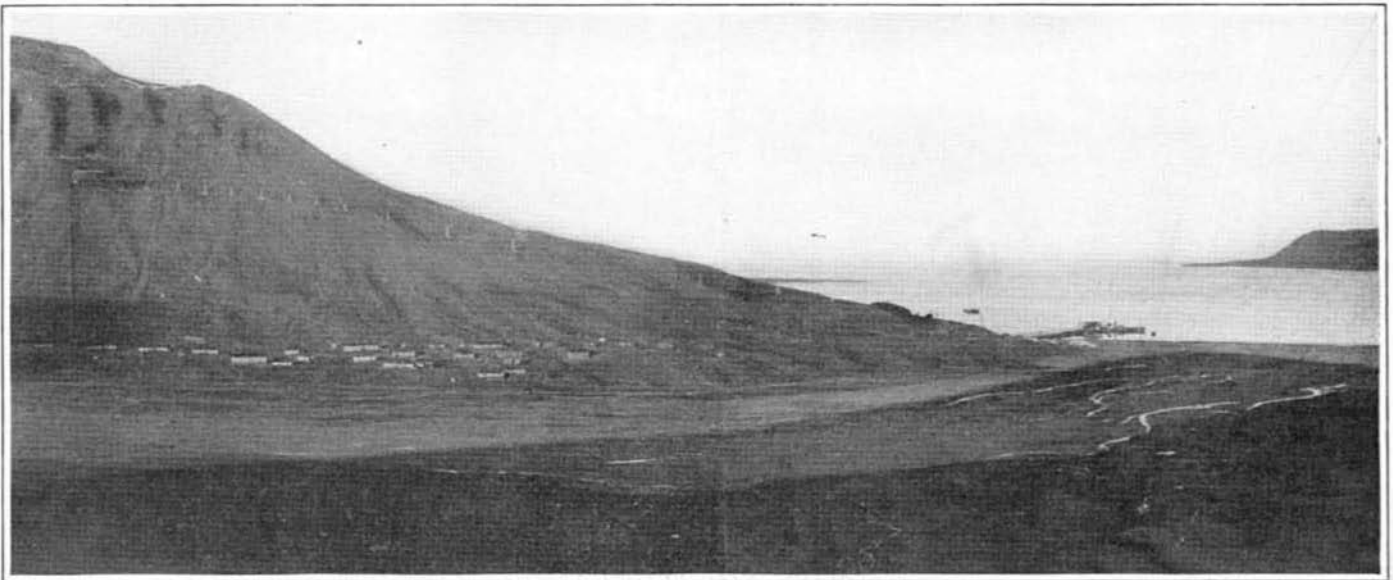
<sup>6</sup>Spitsbergen: *Farvand og Ankerpladser paa Vest-og Nordkysten, 1:200,000, with seven insets, Norges Geografiske Opmaaling Chart No. 198, Christiania, first edition, 1912.*



WINTER HUT OF NORWEGIAN TRAPPERS AT SAFE HARBOR,  
NORTHERN SHORE OF ICE FIORD  
(Photo by Dr. Holtedah, 1909.)



TRAVELING OVER THE ICE FIELD TOWARD THE THREE  
CROWNS, THE THREE SUMMITS SEEN AT THE LEFT  
(Photo by Captain Gunnar Isachsen.)



GENERAL VIEW OF THE COAL MINE AT LONGYEAR CITY

The mine lies on the western side of a small tributary valley entering Advent Bay from the south. The entrance to the mine can be seen high up on the hillside to the left with a cableway leading from it down to the harbor on Advent Bay in the center of the view. The houses at the foot of the slope are Longyear City.

searches are the study of the Devonian on the northern shores, the discovery of Quaternary volcanoes and of hot springs on the western shore of Wood Bay,<sup>7</sup> and the true determination of the age of the massifs of crystalline schists in the north-western corner. These schists, ascribed to Archean, belong to the upper Heckla Hoek series (Silurian).

Besides these systematic expeditions, there were several others equally successful.

In 1908, Mrs. Hanna Resvoll-Holmsen made a botanical survey of the fiord region in West Spitsbergen. The same year and again in 1912 her husband, Dr. Gunnar Holmsen, carefully studied the numerous strata of fossil ice<sup>8</sup> whose existence in the soil of Spitsbergen was discovered in 1892 by the author of this paper.

#### GLACIAL FEATURES OF WEST SPITSBERGEN.

Thanks to the Norwegian expeditions, the peculiar glacial phenomena of West Spitsbergen can now be outlined. In the northwestern corner there is no ice sheet. The former inland ice, which had totally covered the region, has shrunk, and now alpine crests rise above the ice to heights of 4,200 feet and delineate great ice streams. But eastward from a line joining Cross Bay with the head of Wood Bay the alpine crests merge into ice-covered plateaus. As reckoned by Isachsen, the glaciated area in the coastal region extending from Smerenburg Bay and Liefde Bay to Cross Bay is 67 per cent of the total area. On the other hand, the great peninsula between Ice Fiord and Bell Sound with large plateau massifs divided by wide valleys bears no arctic character. In that part of Spitsbergen the glaciation is only local. The large valleys are bare in summer and have boggy soils and meager pastures. Forty years ago numerous herds of reindeer were to be found there in autumn. Southward from Bell Sound and around Horn Sound there is a rugged land with large coalescing glaciers issuing from an ice sheet occupying the interior back of the high coastal crests.

<sup>7</sup>A. Hoel and O. Holtedahl: Les nappes de lave, les volcans et les sources thermales dans les environs de la baie Wood au Spitsberg, *Kristiania Videnskapselskabet's Skrifter: I. Mat.-naturv. Klasse*, 1911, No. 8 (=pp. 1-37). Adolf Hoel: Nouvelles observations sur le district volcanique du Spitsberg du nord, *ibid.*, 1914, No. 9 (=pp. 1-33).

<sup>8</sup>Gunnar Holmsen: Spitsbergens jordbunds og de bidrag dens undersøkelse har kunnet gi til forstaaelsen av de i arktiske land optraedende varige isleier i jorden, *Norske Geogr. Selskaps Aarbok*, 1912-13, Christiania, pp. 1-132, with summary in German, pp. 133-150.

#### THE SURROUNDING SEAS.

The Norwegians have explored not only Spitsbergen, but also the surrounding seas. The first undertaking of this nature was the classic Norwegian deep-sea expedition headed by Mohn, Sars, and Danielssen which explored the Arctic Ocean from Iceland to Jan Mayen, Bear Island, and Spitsbergen (1876-1878). Later on, in 1900, Hjort and Nansen carried out a very valuable oceanographic cruise in the Arctic Ocean as far as Bear Island. In 1901, before starting on his North-west Passage expedition, Roald Amundsen, on his celebrated *Gjøa*, investigated the oceanographic conditions around Spitsbergen.<sup>9</sup> During Isachsen's expedition in 1909 a great many vertical series of deep-sea observations were made.<sup>10</sup> Finally, in 1912, on his small yacht, Nansen investigated the waters of the western and northern coasts of Spitsbergen.<sup>11</sup>

The foregoing summary demonstrates the fundamental nature of the work the Norwegians have done in Spitsbergen. No other nation compares with them in their geographical discoveries, the number and accuracy of their surveys, and the extent of their scientific results in this archipelago.

#### INDUSTRIAL DEVELOPMENT—COLLIERIES.

With the twentieth century a new era begins in the history of Spitsbergen. Until then the archipelago had remained uninhabited, but during the past few years it has become a mining land and attracted a considerable number of Norwegian settlers. Coal deposits were long known to exist on the shores of Ice Fiord, but not until the first years of this century were they worked.

At present the best-developed collieries in Spitsbergen belong to Norwegian companies.

The Great Norwegian Spitsbergen Coal Company is working

<sup>9</sup>Fridtjof Nansen: Northern Waters: Captain Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, *Kristiania Videnskapselskabet's Skrifter: I. Mat.-naturv. Klasse*, 1906 No. 3 (=pp. 1-145).

Björn Helland-Hansen and Fridtjof Nansen: The Norwegian Sea: Its Physical Oceanography Based upon the Norwegian Researches 1900-1904 (Reports on Norwegian Fishery and Marine Investigations, Christiania, 1909, vol. 2, No. 2). [A standard work.]

<sup>10</sup>Björn Helland-Hansen and Fridtjof Nansen: The Sea West of Spitsbergen: The Oceanographic Observations of the Isachsen Spitsbergen Expedition in 1910, *Kristiania Videnskapselskabet's Skrifter: I. Mat.-naturv. Klasse*, 1912, No. 12 (=pp. 1-89).

<sup>11</sup>Fridtjof Nansen: Spitsbergen Waters: Oceanographic Observations during the Cruise of the "Veslemøy" to Spitsbergen in 1912, *Kristiania Videnskapselskabet's Skrifter: I. Mat.-naturv. Klasse*, 1915, No. 2 (=pp. 1-132).

the most productive coal seams on the island on the western side of Advent Bay, which it bought in 1915 from the Arctic Coal Company of Boston, Mass.<sup>12</sup> From 1909 to 1915 the total exportation of coal by the Boston company amounted to 150,000 tons. In the three following years it amounted to 85,000 tons.<sup>13</sup> This year (1919) the Norwegian company was also to start the exploitation of another coal deposit at Green Harbor.

The Norwegian Kings Bay Coal Company is working on the south shore of Kings Bay.

There are in addition four other Norwegian coal companies now beginning development. One has bought the holdings of an English company on the northeastern side of Advent Bay and will resume work this year. The capital invested in the six Norwegian collieries amounts to \$4,200,000.

After the Norwegians come the Swedish Spitsbergen Coal Company, working on both sides of Braganza Bay (Bell Sound), and a Russian company working between Green Harbor and Coles Bay under the management of a Norwegian engineer.

The British are far behind, with two companies: the Scottish Spitsbergen Syndicate, headed by Dr. W. S. Bruce, and the Northern Exploration Company. Several years ago Dr. Bruce did some mining work on coal seams on Prince Charles Foreland, but nothing further seems to have come of it. The Northern Exploration Company has quarried a conglomerate which was taken for marble on the north shore of Kings Bay. This stone is said to be of little value, and it is asserted that none has been exported. The same company also claims an iron-ore deposit in Recherche Bay (Bell Sound) which is emphatically proclaimed to be one of the richest of the world. Scandinavian geologists who have studied this deposit are not of the same opinion. The Northern Exploration Company has recently undertaken preparatory work for mining coal on an island in Bell Sound.

#### SETTLEMENTS AND POPULATION.

Advent Bay is the chief population center of Spitsbergen. On its western side lies Longyear City, the most important settlement of the archipelago, and now belonging to the Great Norwegian Spitsbergen Coal Company. It offers very good accommodations, comfortable houses, electric light—the last very necessary indeed during the four months of long polar night. There are also a telephone system, well-stocked stores, and a hospital attended by a physician. In the summer of 1918 Longyear City numbered 300 inhabitants, all Norwegians. On the opposite side of the bay there is another Norwegian settlement, Hiorthaven.<sup>14</sup> Its population, entirely Norwegian, does not exceed 100 souls in summer and 60 in winter.

Besides these there are, on the southern shores of Ice Fiord, two small Norwegian hamlets, one on land owned by the Russian company between Coles Bay and Green Harbor, and another in Ice Fiord, near the coal deposits belonging to the Great Norwegian Spitsbergen Coal Company. On the southern shore of Kings Bay a large Norwegian settlement has been built near the Norwegian colliery, and on an island of the same fiord are some houses belonging to the Northern Exploration Company. In Bell Sound, besides small Norwegian hamlets on both sides of the fiord, there are in Braganza Bay a Swedish village near the Swedish mine and a British settlement on Axel Island.

During the past summer the Norwegian population of Spitsbergen amounted to about 800 souls.

#### COMMERCE AND COMMUNICATIONS.

Among Spitsbergen shipping the Norwegian flag takes first rank:

Since Mr. Longyear sold his settlement to a Norwegian

<sup>12</sup>Cf. *Geogr. Rev.*, vol. 7, 1919, p. 318.

<sup>13</sup>All the statistical data concerning the present economic status of Spitsbergen are taken from an official statement prepared by the Norwegian Government which will be issued several months hence.

<sup>14</sup>It takes the place of the former English mining settlement of Advent City, which no longer exists.

company, the other flags are represented only by a few units.

In 1917 the general commerce between Norway and Spitsbergen attained its highest figure up to that time, \$1,240,000; in 1918 it was probably much higher, owing to the increase of coal exports.

At Green Harbor the Norwegian Department of Telegraphs has erected a powerful wireless station communicating with a station at Ingö, near the North Cape of Norway, and at the Norwegian settlements of Longyear City and of Kings Bay and at the Swedish settlement in Braganza Bay secondary wireless stations are installed. A Norwegian postal service is established between Norway and Spitsbergen, with three postoffices, at Longyear City, Green Harbor, and Kings Bay. In 1918, from June to October, postal steamers made 26 voyages.<sup>15</sup> At the wireless station at Green Harbor a complete meteorological station is working whose observations are published in the *Jahrbuch des Norwegischen Meteorologischen Instituts*.

#### BEAR ISLAND.

A Norwegian company has also occupied Bear Island (Bee-ren Eiland). Lying 108 nautical miles southwards from the South Cape of Spitsbergen, this island is not so cold as Spitsbergen. Its annual temperature is  $-4.3^{\circ}$  C. instead of  $-9.7^{\circ}$  C. at Green Harbor, but the East Spitsbergen polar current, flowing westward, carries extensive drift ice all around the island. When the season is good, Bear Island is entirely ice-free for at least four months; in bad years the sea remains ice-strewn until July, but navigation is possible before that time.

At Bear Island coal occurs in the Devonian and Culm strata. Since 1916 the building of a settlement and installations for the working of coal deposits have been under way; so far the exports have been small. Eighty men wintered this year on the spot.

#### PREDOMINANCE OF NORWEGIANS IN SPITSBERGEN NAVIGATION.

The Norwegians have also had the largest share in the industrial development of Spitsbergen. Besides this, their acquaintance with the ice conditions for more than a century has, in a way, given them the monopoly of navigation in this archipelago, and nearly all the expeditions that have visited this Arctic land have engaged Norwegians as ice masters, frequently even entirely Norwegian crews. Thus, if the Norwegian Government should forbid its nationals to pilot foreign ships to Spitsbergen, nearly all maritime traffic between these islands and other lands than Norway would cease or become very dangerous.

#### POLITICAL HISTORY.

Spitsbergen is not a "*terra nullius*," as it has been asserted. History establishes its rightful position.

At the end of the seventeenth century and for a long time afterwards Greenland was supposed to stretch northeastward and rejoin northern Russia by way of the Arctic Ocean. Barents himself and all his contemporaries were of the opinion that the land which he had discovered was part of a group of islands off the eastern coast of Greenland, and in this belief Spitsbergen was generally named Greenland until the beginning of the nineteenth century. Greenland belonging to the then united Norwegian and Danish crown, the King of Norway and Denmark accordingly claimed the ownership of Spitsbergen. This claim was also based on his generally accepted overlordship of the Arctic Ocean north and west of Europe, consequently of all the islands it contains wherever they might be and by whomsoever discovered.

In 1610 a number of whales in the western fords of Spitsbergen having been seen by Jonas Poole, the news spread rapidly, and soon after numerous British, Dutch, French,

<sup>15</sup>During the fiscal year 1917-1918 the Green Harbor station received 2,041 telegrams and dispatched 3,323. It has intercepted 3,317 telegrams from other European and from American stations. In 1918, 10,322 letters, newspapers, and parcels were sent from Norway to Spitsbergen and 5,649 from Spitsbergen to Norway.

Danish, and Hanseatic whalers arrived at Spitsbergen. Among all these competitors troubles and disputes arose; even sea fights were not infrequent. The King of Norway and Denmark, Christian IV., protested against these incursions of his domain, and long diplomatic negotiations on the whale fishery and on the overlordship of Spitsbergen opened between the Norwegian-Danish monarch and the King of England, the States General of the Netherlands, the King of France, the Hanseatic cities, and the King of Sweden. These polar islands were the occasion of the first colonial conflict among European nations.

The King of England, James I, never expressly acknowledged the claim of Norway-Denmark regarding the sovereignty of Spitsbergen. Nevertheless in 1614 he offered to pay a rent to the Danish King, provided that English subjects should be granted a monopoly of the whale fishery in these islands together with the Norwegians and the Danes. Later on he suggested to Christian IV that he should sell him his right to "Greenland," that is Spitsbergen. The diplomatic transactions with England ended in 1621 by an agreement giving equal rights to English and Norwegian-Danish whalers in Spitsbergen. On the other hand, in 1632 the overlordship of the King of Norway and Denmark was accepted by the States General; however, a century later, in 1741, this accept-

ance was questioned by the Dutch. In 1663, 1679, and 1692, France, Sweden, and the Hanseatic cities respectively recognized the sovereignty of the King of Norway and Denmark over these polar lands.

Why has Spitsbergen today been declared *terra nullius*? During the second part of the seventeenth century, whales having deserted the coastal water of Spitsbergen, there was a cessation of the disputes regarding these islands. When two centuries later, in 1872, Spitsbergen again found a place in the minds of diplomats, the old transactions were totally forgotten, and the archipelago was proclaimed *terra nullius*. Only recently, in 1912, Dr. Arnold Raestad revived a knowledge of their history, basing his information on the state papers of Great Britain, Denmark, the Netherlands, and France.<sup>16</sup> Is there no such thing in regard to treaties as title by long possession? By inheritance of the Danish king's rights Norway possesses the sovereignty of the archipelago, but this sovereignty is not complete, not having been recognized by all the powers.

<sup>16</sup>Arnold Raestad: Le Spitsberg dans l'histoire diplomatique (translated from the Norwegian by Charles Rabot). *La Géographie*, vol. 25, 1912, pp. 335-354; vol. 26, 1912, pp. 65-98. The Norwegian original, "Norges hoihetsret over Spitsbergen i aeldre tid," Christiania, 1912, contains 47 original documents.

## Higher Steam Pressures\*

### What Its Adoption Will Mean

**I**N theory it has long been established that there is everything to gain by the adoption of relatively high steam pressures, and practically nothing to lose. As long ago as 1896 Prof. R. H. Thurston made this abundantly clear in his paper on the "Promise and Potency of High-Pressure Steam." And since that time the science of thermo-dynamics having been more widely recognized by engineers as a sure guide to improvement of heat engine economy, the tendency to increase the temperature range of the working fluid has been more than ordinarily active.

But of these figures we have at the moment little concern; they merely lead the way to more practical considerations. They take us quite naturally up to that point where we begin to consider the ultimate possibilities involved in the adoption of much higher steam pressures. And here must we divide into two separate and distinct phases of treatment our lines of thought; for we shall have to consider (a) what the adoption of higher steam pressures would mean in the design and construction of boiler machinery, and (b) what it will mean in the design of those parts outside the boiler, and which are to be subjected to the proposed higher pressures and higher temperatures.

**An Example of Present-Day Practice.**—In the best present day practice, except for slightly higher pressures in some few isolated cases, the maximum steam pressure is 200 lb. per sq. in. absolute, the super-heat 200° Fahr. The corresponding temperature of evaporation is therefore 382° Fahr., the bulk of the heat being absorbed at a temperature 20° Fahr. below the maximum. An outside instance of the practical adoption of a considerably higher steam pressure than this is supplied by the 1,500 kw. turbine installation recently constructed by the British Thomson-Houston Co., in which a steam pressure of 350 lb. per sq. in. was employed together with a super-heat of 700° Fahr., exhausting into a condenser of 28½ in. vacuum. As clearly illustrating the measure of economy obtained as a result of such increase of pressure and superheat, it was claimed that during a 10-hour full load test only 1.83 lb. of coal per unit generated was consumed.

This, perhaps, might well be considered a notable achievement.

\*Reprinted from *The Electrician* (London).

ment in a twofold sense, inasmuch as such increase of pressure was accompanied with an almost unprecedented increase in temperature of the working fluid. Certainly it stood as an exemplification of far higher temperatures than had hitherto been employed outside experimental phases. But we will deal with this aspect of the case at a later stage.

**Effect on Standard Boiler Design.**—Assuming the employment of higher steam pressures to be justified what effect will this have upon standard boiler design? Present-day boiler designs and specifications do not permit the generation of steam at a pressure higher than 200-250 lb. per sq. in. without sacrificing safety, and without calling for an investment in the boiler plant high enough to offset the gain in economy caused by higher steam pressures.

Must all existing examples of boiler design be scrapped?

Must all drums and steam vessels of large diameter, flat surfaces and even dished ends be abandoned—yes, even if stayed? Will all riveted, expanded or beaded joints exposed to the action of the fire have to go by the board? Will nothing but electrically welded joints permit such an increase as contemplated? Will the high-pressure generator of the future be cylindrical? Of the water-tube type? Or of the flash type? Is increased efficiency to be effected primarily along lines altogether different from those obtaining in boilers working under pressures used today? Or is it possible to retain present-day design and to increase the evaporation per sq. ft. of heating surface twice as high as that represented by the present-day practice?

These are questions involving much thought, demanding perhaps new and original channels of investigation, pregnant with possibilities. Who knows? Perhaps, after all, our best brains in the realms of engineering science, our efforts, our striving after heating efficiencies have been utterly misdirected, in that they have been conducted along altogether wrong channels. When an apparent limit has been reached in one particular direction often it is that a striking off at a tangent into the seemingly impossible will result in undreamed of achievement.

In view of the considerably higher temperatures involved in the production of these high steam pressures we have in