GEOGRAPHY-NAVIGATION

Icebergs in the North Atlantic

"A Classic of Science"

Former Governor of Greenland Describes Icebergs' Birth
Captain Tells How Vessels May Avoid Ice Collision

DANISH GREENLAND, ITS PEOPLE AND ITS PRODUCTS, by Dr. Henry Rink. Edited by Dr. Robert Brown. London: Henry S. King & Co., 1877. *This is an exact reprint of extracts from the original English publication.*

A DESCRIPTION of the monstrous fragments of ice which are called "bergs" has so frequently been repeated in the accounts of arctic voyages, that we need only in a few words mention their size and general occurrence on the ocean. What in the Greenland sea is called an *ordinary large iceberg* rears its walls from the surface of the water either to a height of from 60 to 100 feet, with a somewhat horizontal surface, or in a more conical shape ending in pointed summits or ridges, in which it often rises 150, sometimes 200, and more rarely 300 feet, or even more, above the level of the sea. The circumference is from several hundred to some thousand yards. These dimensions only refer to the visible part of the floating block—viz., the top of it emerging from the sea. Considering that seven or eight times as much lies under the surface of the water, the whole bulk of an ordinary large berg must be calculated to have a thickness or height of several hundred or even of a thousand feet, and its weight must be counted by millions of tons. In short, the visible portion of a large iceberg equals the largest buildings made by human hands, and its whole bulk is only to be compared with mountains. The icebergs, being in a manner themselves fragments, are liable to break asunder and produce more fragments. For this reason the same kind of ice that constitutes the ordinary large bergs occurs in pieces of every size inferior to that of the bergs here described. Every bursting asunder of glaciers or bergs by which fragments are discharged is called calving, and the fragments *calves* or *calved ice.* The latter expressions consequently also comprise icebergs, but are chiefly applied to masses too small to be called bergs. There is, however, no sharp distinction to be made between large and small icebergs and mere calves.

Floating icebergs are scattered over the Atlantic to an amazing extent. Numbers of them annually reach the shores of Newfoundland, and the fishing banks off this island are not unfrequently crowded with them. But stragglers occasionally travel as far south as the latitude of Spain, and one berg is said to have been met with on June 18, 1842 in 38°40′ N. La., measuring 100 feet in height and 170 feet in breadth. The whole mass of these strange productions, of a nature so widely differing from that of the regions over which they spread, have their sources in Greenland, are moreover *exclusively discharged from the inland ice* above described, and only emerging from a limited number of narrow branches protruding from it into the sea. The icebergs thus issuing from Greenland are mostly drawn southwards on both sides of this country, without spreading very far to the east and west of it over the rest of the arctic seas.

Glaciers in general have their origin in the snow on the mountain-tops which grows and slides down their sides, and are partly at least pushed on by the direct force of gravity. When they abut on the sea, and their icy walls are constantly washed and undermined by the waves, their projecting parts will of course be dismembered, and fragments will be thrown off and drifted away. This process is going on in numerous places along the arctic shores, but however considerable the fragments may be in many instances, we are still far from having accounted for the manner in which a large iceberg can be launched and set afloat. It is the margin of the inland ice dipping into the sea in certain places, and being broken asunder, which gives rise to this phenomenon.

On the coast which we here particularly treat of—viz., the Danish part of the west coast—these places lie hid at the heads of the fjords or behind islands, while on the same tract many stupendous glaciers present themselves from the ocean, and may give rise to the supposition that bergs are issuing from them. Bearing in mind that the fragment to be detached measures upwards of a thousand feet in thickness, as well as in breadth and length, the solid mass from which it has been severed must likewise be supposed to have at least the same thickness. If the fragment has to be loosened chiefly or more directly by the force of gravity, the main body must rest upon a ground sufficiently smooth and inclining. But in this case it would seem more likely to break asunder gradually, and we should have reason to believe that small pieces would almost continually be detached and rush down the sloping ground, whereas we can hardly imagine how so fragile a mass can be dismembered into parts of a mountain's magnitude. Moreover, granting this to be possible, there seems little probability that such blocks should come rushing down and reach the sea in an unbroken state. Finally, to be properly launched and set afloat they would require an extraordinary depth of water immediately outside.

All these difficulties will disappear when we regard the process which actually goes on in the interior of those inlets which, by reason of the bergs they

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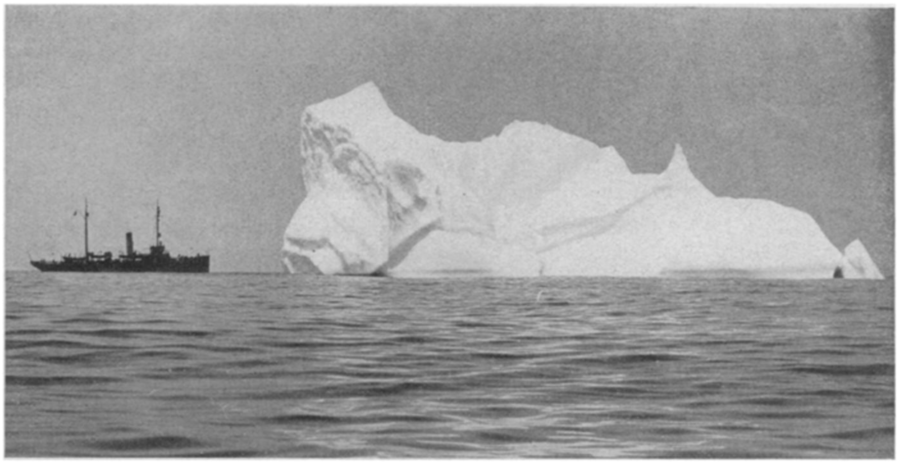
Following the sinking of the "Titanic" by collision with an iceberg April 14-15, 1912, England and the United States sent ships to patrol the southern edge of the ice field and report by wireless all icebergs near the transatlantic steamer lanes. The following spring the U. S. Coast Guard sent the revenue cutters "Seneca" and "Miami" to take up the work, and in the fall of 1913 the International Ice Patrol was established.

produce, are termed *icefjords*. In reality the force of gravitation seems to have no direct influence at all in loosening the bergs from the firm ice, and even the movement of the glacier itself seems only in a small degree to be promoted by the inclination of the ground. The projecting and advancing branch of defluent of the inland ice that has taken its way down to an icefjord, and which might more specifically be called a glacier, continues sliding along the bottom of the sea until it reaches a certain depth where the buoyant action of the water begins to lift it and keeps its outermost part in suspension. In the sheltered waters of the said inlets the huge mass may still be pushed on for several miles without resting on the ground or losing its coherency. Being kept in suspension by the buoyant power of the water, it presents a nearly horizontal surface like the frozen sea. But from time to time, external or accidental causes, such as, for instance, the tides in particular, will be apt to cause fissures to be formed, and the foremost part to be detached and go adrift. The results of this breaking asunder are the bergs. Consequently they are by no means formed by any "launch" or "fall," but in a manner more in accordance with the breaking up of a frozen sea. The displacement of the water caused by the calving of the glacier is, however, violent enough to cause great disturbances.



LION-FACED ICEBERG

Floating masses of ice have individuality, and sometimes take fantastic shapes. This one was photographed by the International Ice Patrol's expedition aboard the "Marion" under Commander Edward H. Smith in 1928, with studied exhaustively the sources of the North Atlantic's bergs. The report of this expedition is in itself a classic.

As Seen by the Ice Patrol

STATISTICS AND DEDUCTIONS FROM OBSERVATIONS AND REPORTS ON THE ICE SITUATION, SEASON OF 1913. *By Capt. C. E. Johnston, U.S.R.C.S., of the "Seneca". In Reprint of Hydrographic Information from the Pilot Charts and Hydrographic Bulletin published by the United States Hydrographic Office under authority of the Secretary of the Navy. No.* 24. *Washington, D. C., October* 24, 1913.

The largest berg we saw was about 400 feet long by 300 feet wide by 70 feet high out of water; the smallest was about 225 feet long, 100 feet wide, and 35 feet high. All were white in color, some having one or more distinct veins of blue ice running through them, these veins running from 18 inches to 6 feet in width. As to shape no two bore any striking resemblance to each other. There were round tops, flat tops, sloping tops, and pinnacled tops; sloping sides, sheer sides, craggy sides; regular shapes and extremely irregular shapes. The only type we did not see is the kind popularly pictured in school books, with high, overhanging, craggy pinnacles. I have read in recent newspapers of ships reporting bergs half a mile long and 300 feet high. I am not prepared to refute such statements, but we saw nothing of that size. I estimate 150 feet as the highest berg we saw. It looked at a distance like the picture of Matterhorn.

Visibility of Ice

The greatest distance we observed ice was 18 miles. The day was clear, with light easterly winds and a tendency to mirage. It seemed to suddenly jump into view, and could be plainly seen from the bridge as soon as from the crow's nest. On ordinary clear days the average berg can be seen 12 to 15 miles from the bridge, about a mile farther from the crow's nest, and a mile still farther from the signal yard. On a cloudy day, with good visibility, deduct about 2 miles from the foregoing. In clear weather, with hazy horizon, we have seen a big berg 11 miles, its top being visible well above the horizon; in light fog, 2 miles; dense fog, 200 yards; drizzling rain, 2½ miles. In bright moonlight, with naked eye, 2½ miles; moon shining through thin mackerel clouds, 2 miles; starlight, 1 mile with naked eye, 2 miles with glasses; overcast and dark, but with horizon visible, one-half mile with glasses. In the last case the berg looms up dark; in the other cases its effulgence shows lighter than the surrounding space. With the searchlight we were able to see a berg about 3 miles on a dimly moonlight night, and 2 miles after the moon set. In using the searchlight we found that an observer standing behind or under the beam could see practically nothing, but that 15 feet away to one side he could see readily. With the beam turned on a berg abreast the ship and 2 miles away, I could see it as plainly as an illuminated store front from the quarterdeck, about 100 feet abaft the light. Another point to be noted is that the beam must be drawn to a fine focus. A flaring beam blinds the observer. Owing to the blinding effect of a searchlight on the observer, I should not recommend its general use for a vessel under way. *On a dark night or in thick weather a vessel in the vicinity of bergs should slow so as to be able to maneuver within the limit of visibility.*

A berg may or may not give an echo. If its sides are steep or perpendicular an echo will probably be heard from some directions, but not from others, according as the face presented to the ship is normal or slanting. Any slanting face will reflect sound away. We were not successful in getting echo farther than half a mile. About 90 per cent of our attempts were without result. The existence of an echo indicates an obstruction, but its absence proves nothing. In one case we were between a berg and a growler; the growler gave an echo, but the berg none.

Sudden changes of temperature mean nothing, so far as bergs are concerned. The sea water is streaky, as a rule, and where its temperature is constant we found no change up to a ship's length of a berg. The (*Turn Page*)

coldest water we found was 31°, on the tail of the Bank, in April, about 100 miles from the nearest ice. . . .

In a light, low fog an observer can see a berg from aloft sooner than from deck, but in a dense fog we found that the lookout was best kept from the spar deck, as the first sight of the berg was the lapping of the water on its base.

Speaking about lookouts, it occurs to me that on a very large ship, with decks some 70 feet above water, bridge some 20 feet higher, and lookout posted higher up still, the lookout might well be higher than the top of a small berg; and hence on a dark night he would have an unobstructed view of the horizon over a berg half a mile or a mile away. In that case he might easily miss seeing the obstruction until too late to avoid it.

As a rule, we found little or no change in temperature of the air near a berg.

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SEISMOLOGY

Quake Centers on Sea Bottom Where Mountains are Growing

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tially destroyed some weakly constructed buildings. But the great earthquakes of Los Angeles recorded in history occurred in 1769, 1852 and 1855.

Four violent shocks, on July 28, 1769, with strong aftershocks on five days following, are listed in the records of the California missions. This earthquake was probably strongest along San Pedro Bay near the present harbor of Los Angeles. This is the location of the present earthquake center.

October and November, 1852, brought many earth shocks to the southern California of gold rush days. October 26 saw eleven severe shocks at Los Angeles. On July 10, 1855, a quite severe earthquake did considerable damage in Los Angeles.

The ocean region off the San Pedro-Long Beach coast near Los Angeles lying between the coast and Catalina Island is known as San Pedro Channel. Geologists describe it as the San Pedro submarine fault zone and they know that this is an area where the mountains are growing. It is probable that the recent earthquake was caused by a crustal adjustment in this area under the sea.

Although aftershocks from the earthquake will be felt for months, the disturbance was not a general one and probably did not relieve the strain in the earth's crust in other parts of Southern California. This is the opinion of Prof. Bailey Willis, eminent authority on geology and seismology who is professor emeritus at Stanford University.

There is, therefore, continued danger of severe earthquakes in Southern California. When these will come, whether tomorrow or a decade or more from now, neither Prof. Willis nor other geologists can attempt to predict.

"The Long Beach earthquake appears to be a shock of moderate intensity on one of the several faults of the San Pedro fault zone," Prof. Willis said in response to a Science Service inquiry. "This fault zone was recognized by H. O. Wood, who described it in the Bulletin of the Seismological Society, 1916, in his account of the 1812 quake.

"Among the effects of movements on that zone we may recognize the elevation of the San Pedro point which is terraced by marine benches up to more than 1000 feet above sea and demonstrates activities extending back more than a million years. The zone has the earthquake habit and may be expected to behave accordingly from time to time as in the past.

"Aftershocks are likely to continue for several months and some of them may be strong. Measures of safety should be rigidly enforced. Although locally disastrous this Long Beach shock is not a general one and probably does not relieve the strain in the San Jacinto or San Andreas faults.

"The disaster emphasizes the need of earthquake resistant buildings under a reasonable building code recognizing earthquake hazards."

The San Andreas fault is the long cleavage in the earth's crust which runs from north of San Francisco along the coast to northwest of the Los Angeles region inland. Along this fault the great 1906 San Francisco earthquake occurred. The San Jacinto fault is to a certain extent an extension of the San Andreas fault southward of it.

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SIESMOLOGY

Earthquake Was Not Noticed By Einstein

PROF. Albert Einstein walked through the earthquake and did not notice it. He had just emerged from a California Institute of Technology building after attending his last seminar with Pasadena scientists before leaving for New York. Walking with Dr. Beno Gutenberg, the eminent authority on seismology, both he and Dr. Gutenberg were so absorbed that they said later they had not noticed the earthquake. This was ironical because Dr. Gutenberg had never before had an opportunity to experience an earthquake.

Prof. Einstein had a few hours previously announced that he would not return to Germany because he prefers to live where freedom prevails. He will spend next summer in Oxford and return to his new position at Princeton next fall.

Buildings of the California Institute of Technology at Pasadena creaked and swayed greatly in the earthquake but no damage was done to these structures especially designed to withstand earthquakes.

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A piece of silk goods which lay for ten years in the sunken steamship Egypt was recently examined and reported to have "no injuries as to resistance, feel, or luster, and only a slight loss of color in some places."