

It will be seen from the foregoing account that there is a great similarity in the general character of the eruptions of Etna. Earthquakes presage the outburst; loud explosions are heard; rifts and *bocche del fuoco* open in the sides of the mountain; smoke, sand, ashes, and scoriae are discharged. The action localizes itself in one or more craters; cinders are thrown out and accumulate around the crater in a conical form; ultimately lava rises through the new cone, frequently breaking down one side of it where there is least resistance and flowing over the surrounding country. Then the eruption is at an end. Out of the seventy-eight eruptions mentioned above, a comparatively small number have been of extreme violence, while many have been of a slight and harmless character. According to Lyell, Etna is rather older than Vesuvius—perhaps of the same geological age as the Norwich Crag. At Trezza, on the eastern base of the mountain, basaltic rocks occur associated with fossiliferous Pliocene clays. The earliest eruptions of Etna are older than the glacial period in central and northern Europe. If all the minor cones and monticules could be stripped from the mountain, the diminution of bulk would be extremely slight. Lyell concludes that, although no approximation can be given of the age of Etna, "its foundations were laid in the sea in the newer Pliocene period." From the slope of the strata from one central point in the Val del Bue, he further concludes that there once existed a second great crater of permanent eruption.

Such are the principal facts in the history of a volcano justly called *famoso, immenso, terribile*, which has excited the wonder of all nations in all ages of the history of the world.

#### HUDSON BAY—CANADA'S GREAT LONE SEA.

By WILLIAM SMITH, Deputy Minister of Marine and Fisheries of Canada.

THE navigation of the waters of Hudson Bay and Straits, as a practicable commercial route for the transport of produce from the Northwest Territories of Canada, is a question that is now creating much attention. The extraordinary increasing yield of the harvest with each succeeding year requires an outlet from that country other than by rail, the facilities of which means of transport are already taxed to their utmost, and now leave on hand in the country large quantities of grain unshipped. A few years ago, the Canadian government equipped an expedition for the purpose of ascertaining the actual condition of the straits during the summer, the length of time available for navigating them, and wintering parties were left at several stations to report on the ice and its movements, open water, tides, climatic conditions, and meteorological data during that season. The result of this was a blue book or two, with an able report from Lieut. A. R. Gordon, R.N., in charge of the expedition, and a geological report from Dr. Bell, of the Geological Survey, who accompanied that expedition. There the matter rested, and since then nothing has been done to utilize the information so obtained. As the waters in question are very little known beyond the small circle of the officials of the Hudson Bay Company, whose ships make annual trips from the Orkneys, with supplies for York Factory and the other forts and posts in the northern wilderness, or by an occasional adventurous skipper of some American whaler, or fishing vessel plying its avocations in the bay, the following sketch may be of interest.

The little that, until quite recently, was known respecting this great northern inland sea of Canada and its surroundings is that, in 1610, Henry or Hendrick Hudson, an English navigator, entered the bay, in his ship the *Discoverie*, expecting to find the looked-for northwest passage to the China seas, one of the great objects of adventure in that age, and that failing in this, he was cast adrift by his mutinous seamen, in a small boat or pinnace, the fate of which was never ascertained. The waters he had sailed thus became his tomb, and in the name they have since borne, his epitaph. After the occupation of Rupert's Land by the British, it must have been looked upon as a strategic point of importance from the fact of a very large and strong fort having been erected in a commanding position (at the mouth of the Churchill River, where it discharges into the bay), which in its day mounted forty guns. This was surrendered, without firing a shot, to the French Admiral La Perouse in 1772, who spiked the guns, blew up some thirty feet or more of the ramparts, and did other damage, for which the British government presented a nice little bill for France to settle. A number of dismantled guns still lie among the ruins of "Fort Prince of Wales," which Dr. Bell styles "probably the largest ruin in North America."

In 1845, Admiral Sir George Back stated, before a committee of the imperial House of Commons, that if he had anything to convey to Red River (the Winnipeg of to-day), he would unquestionably prefer the route via York Factory. This fact also did not escape the eagle eye of the Duke of Wellington, who, in 1846, placed in Fort Garry, by means of boats on the Nelson River, and subsequent water communication through Lake Manitoba, a detachment of 400 rifles, in less than 30 days from York Factory, where they had been landed. Although in the popular mind Hudson Bay is apt to be associated with the Arctic regions, no part of it lies within the Arctic circle, the latitude of its southern extremity being south of London. An adequate conception of its extent, including James Bay at the south, may be formed from the fact that its total area is some 500,000 square miles, or nearly half that of the Mediterranean Sea; that it measures about 1,000 miles in length, and that it is over 600 miles wide in its northern part. The principal channel is 500 miles long, with an average breadth of 100 miles.

The numerous groups of islands along its eastern shores are surrounded by deep water; the depth over the bay is uniform, averaging 70 fathoms throughout, deepening to 100 or more in approaching the straits, while in the latter it varies in the center from 100 to 300 fathoms, the latter being the deepest sounding. The bottom consists of boulders, clay and mud. Near the shores a stiff clay, affording good holding ground for anchorage, is almost invariably met with on both

sides. The latter are high and rocky, but the northern is less precipitous than the southern. The bay itself is the great central basin of water drainage of the northern part of the continent from the center of the Labrador peninsula on the east to the Rocky Mountain range on the west, while from a point near latitude 45° the waters flow from every direction, and discharge by one great outlet—the Nelson River—into the bay. Dr. Bell asserts that the whole extent of territory drained into Hudson Bay approaches three millions of square miles, over the greater part of which extends a temperate climate, with large tracts of fertile soil. Of the other rivers flowing into the bay, thirty are of considerable size. Those from the east run parallel to each other, being progressively smaller toward the north, a fact due to the height of land in Labrador lying further inland toward the south; on the west coast the Albany and the Churchill are the longest rivers, but the Nelson discharges the largest volume of water in a course of 400 miles, combining as it does the waters of a number of rivers from the south, and it is the only muddy river that enters the bay. The Churchill is beautifully clear, somewhat larger than the Rhine, and with a rocky, deep and comparatively narrow mouth forming a splendid harbor, which can be entered with ease and safety by the largest ships at all stages of the tide, thus offering every advantage for shipping, and its entrance is destined some day to be the main commercial point of this inland sea. The drawbacks to most of the other rivers as harbors are the bars outside. The average rise and fall of the tide on the west coast is from eleven to twelve feet. Few of the rivers afford uninterrupted navigation for large vessels to any great distance from the coast. During the season of high water, shallow draught steamers might ascend the Moose River for upward of 100 miles, Hayes River 140 miles, and the Albany nearly 250 miles, but large steamers might ascend the Nelson River for 70 or 80 miles from the sea.

This Great Lone Sea, situated in the heart of British North America, and actually possessing a seaport in the center, 1,500 miles nearer than Quebec to the fertile lands of the Northwest, begins to possess a new interest to Great Britain, seeing that the future highway to the west may yet pass through it. York Factory, which is actually nearer Liverpool than New York, has been styled by Professor Hind the "Archangel" of the west, but the mouth of the Churchill may more fitly challenge that title. A glance at the map of the northern hemisphere shows the shortest route between the Northwest Territories and England is through Hudson Bay. A close calculation of relative distances, made in the Canadian Department of the Interior, shows Winnipeg, lying at the extreme southeastern portion of these territories, to be at least 800 miles nearer to Liverpool by the Hudson Bay route than by the St. Lawrence, while the difference in favor of the former increases continually as we advance northwesterly into the interior. This saving in distance represents economy in time and money, or in freight and passenger rates. Owing to its cooler and more uniform temperature, this northern route, besides shortening the distance, would afford greater advantages, especially as regards the live stock of the western ranches. And, what is of the greatest importance, an inlet by Hudson Bay is the only thoroughly independent channel which can ever be established between Great Britain and her North American possessions.

Previous to the report of Lieut. Gordon's exploratory expedition, an impression prevailed that on account of ice, navigation for the ordinary purposes of commerce was impossible through the straits. He, however, very plainly sums up his observations as follows: "While I am of opinion there will always be more or less fluctuation in the date of the opening of practical navigation for the purpose of commerce, the shipowner who sends in a freight-carrying steamer before the 15th of July will almost certainly be subjected to such delays as will add very materially to the cost of the voyage. In estimating the period of navigation of an ordinary year, I should say from the 15th of July to the 15th of October, with a possibility of navigation from 1st July to 1st November; and later than the 15th October, the risks of navigation are so increased that the question of insurance would in all probability settle the date."

Lieut. Schwatka, of the United States, who spent two years up in the northwest of Hudson Bay in search of the relics of the Franklin expedition, says: "From my experience, and conversation with navigators who had spent many years therein, I think the straits and bay would be considered navigable for at least two months for sailing craft, and this would probably be more than double for steam. Of course the bay is navigable much earlier and later than the straits, and the above estimate is for the latter." Again, a ship, "strengthened for the ice, might prolong these times considerably, and signal stations on prominent points could also materially assist vessels essaying the passage, by a simple code expressing the condition of the ice."

Much of the ice encountered in the straits consists of the giant bergs brought down by the Arctic current from the Humboldt and other glaciers, and field ice from the Arctic Sea coming down the east Greenland coast, together with all that comes down Davis Straits. The current from the latter flows west along the north shore of the straits, its set probably terminating at the east side of Salisbury Island, whence it takes an easterly course along the south side of the straits. A mass of Arctic ice outside pens up the ice in the straits till the end of June, when it tends southward, and the Hudson Straits ice is then free to pass out, and disappear under the influence of the rising temperature of both air and sea. The tidal currents in the straits flow with great rapidity, especially at the eastern end about the Buttons Islands, and at the western end near the Digges Islands, causing the ice to whirl in every direction. The records of a number of voyages made by the early explorers of the seventeenth century and of a later date all testify to the presence of broken ice during July in the straits, but broken sufficiently to make it safe for working through.

The uncertainties of the tidal currents in these waters, defying the calculations of the navigator, is instanced in the case of Captain Parry's expedition in 1821, with

the *Fury* and the *Hecla*, when on the 6th July these ships were close together in the ice, and on the following morning the *Hecla* had drifted eleven miles from her consort, without any breeze. Considerable fog hangs over the bay in the months of July and August. Safety in thick weather lies in the constant use of the lead and keeping a bright lookout, as the dead reckoning is frequently in error to a considerable extent. The most serious difficulty is the faulty work of the compass, especially off Digges Island, at the western end of the straits, where the magnetic pole is approached and the dip of the needle is 86°. This means great vertical force, with the horizontal force approaching the vanishing point. "The latter may be considered," says Lieut. Gordon, "as that portion of the earth's magnetic force which determines the direction of the needle, when counterpoised to hang horizontally; the vertical force is that by which induction in the iron of the ship to a great extent affects the deviation or ship's errors." In making a voyage from Great Britain to Hudson Bay the dip changes from 67° to nearly 87°. The practical meaning of this is that, supposing a residual error of one degree left uncorrected on one of the cardinal points when adjusting before sailing, this would—since the deviation changes with the tangent of the dip—have become an error of 6° when the ship had gone to a place where the dip was 87°.

As the mouth of the Churchill River, emptying into the bay at an angle in the coast lying between Cape Churchill and Seal River, offers the finest harbor in these waters, the following description from official sources may prove valuable: At its mouth the river flows nearly north, the estuary is narrow, being only some 600 yards wide. Here the tide runs with considerable velocity, estimated at half tide to run six knots. The basin for anchorage, with a depth at low water of over four fathoms, is about 1,500 yards north and south by about 1,000 yards east and west. The holding ground is good, the bottom being mud, and though the tide runs rapidly, the harbor is pronounced an eminently safe one. The approaches are well marked, and in clear weather the land stands out bold and high, being easily identified at a distance of ten or twelve miles. In thick weather the rule for making the harbor is to steer W. by S., keeping in 20 fathoms of water. If shoaler water is met with, haul up to the north at once till the water deepens again. The harbor is well adapted for a railway terminus, as the necessary docks could be easily and cheaply built and the deep water basin enlarged at small cost. Stone lies at the water's edge ready to be laid into docks or piers, and nature seems to have left little to be done to make this a capacious port, capable of doing business on a large scale.

Port Nelson, where is situated York Factory, the great *entrepot* in years gone by of the Hudson Bay Company, was selected, not because of any harbor facilities, but because the Hayes River, which enters the bay on one side of the tongue of land on which York Factory lies, was the best boat and canoe route to and from the interior of the country, a route which was the only means of communication with the early settlers of Red River and Selkirk settlements. The company's ships on arrival could not come up to the fort, owing to shoals, but discharged their freight into schooners in the outer roads, ten miles from the nearest land, which lies so low as to be out of sight from a ship's deck, the only distinguishable object being the Point Marsh Beacon, which towers up 80 feet above high water, and without which it would be impossible to make the anchorage even in clear weather. This condition of affairs practically precludes Port Nelson from ever being used as a commercial harbor.

Apart from the question of the navigability of Hudson Bay as a practicable route for the transport of grain and produce, its resources are great and capable of far more extension than they have yet received. In fact, a few New England whalers and the Hudson Bay Company have had everything in their own hands. Whale and porpoise fishing, walrus hunting, salmon and trout fisheries, and rich mineral resources, offer advantages in a comparatively new field. Water fowl abound, of which ducks of all kinds, geese, the trumpeter swan, which breeds on the islands off the east coast, loons, curlew and plover are the most common. The coast and islands of the bay are the main breeding ground of these birds, where they have been undisturbed for centuries and unapproached by man. On the land, as far as the limits of trees and brushwood extend, grouse and ptarmigan are in abundance. Large game is well distributed, and of bears, in addition to the polar, another species frequents the "barren grounds" south of the straits, the skin of which so closely resembles that of a grizzly as to pass for a variety of the latter in the trade. Dr. Bell, the geologist, accompanying the Canadian expedition in 1884, mentions a very curious fact. His party killed on Digges Island, on September 16, a she polar bear and two cubs, the stomachs of which were found to contain nothing but partially masticated grass. About four quarters of this were present in the stomach of the old bear, and two and a half and one and a half quarters respectively in the stomachs of the cubs. The Eskimo and Hudson Bay Company's servants informed the party that these bears are in the habit of occasionally using grass for food. Whether this is from preference or from the want of small game is doubtful, but in the case here recorded it could hardly have been from the latter at that period of the year. The musk ox is found only on the north western shores of the Bay, principally round Chesterfield Inlet. Before the Eskimo obtained firearms from the Hudson Bay posts in trade, they used in the chase the bow and lance, the former made of two or three sections of musk ox horn, tipped with the shorter horn of the reindeer, and lashed with its sinews. The barren ground caribou is the commonest of the large game found on both sides of the bay. Its migration is notable, for spending the winter along the border of the low forests southward, it travels north on the approach of spring. Its quite gray color so closely assimilates to the "barrens" that it is no easy matter to sight it at once, and the sportsman should approach down-wind. The caribou is to the Eskimo what the reindeer is to the Laplanders; but the numbers annually killed for the sake of their tongues, which are shipped to the London market, is materially thinning their ranks, and they may eventually share the fate of the bison.

Whaling in Hudson Bay has, according to Lieut.

Gordon's reports, for many years been carried on by United States vessels, chiefly from the ports of New Bedford and New London. This voyage is made in comparatively small vessels, and occupies about eighteen months. Leaving their New England port in June, they make their way to Marble Island on the northwest of the bay, arriving there some time in September, and going into winter quarters. As many as four whalers at one time have wintered there, and on Deadman's Island, appropriately named, a long row of graves bears testimony to the trials and hardships these men undergo in pursuit of their calling. After wintering the vessels are cut out early in June, cruise about the bay till August, and leave for home in September. A table was published in 1887 by Lieut. Gordon, showing that, in the twenty-five years preceding, 113 United States vessels, engaged in whale fishery, had visited Hudson Bay, the total catch of which was 1,620 barrels of sperm, 56,019 barrels of whale oil, and 900,063 pounds of whalebone, while during that period 16 vessels engaged in the trade were lost.

Comparing the above catch, and that the average size of the vessels is only 240 tons, the margin for profit is considerable. Vessels such as these, however, are only a risk, and must class as fishing boats, being in no way adapted for any other purpose than what they are engaged in. But the vessels recommended as practicable for the purpose of commerce must be, not the cheaply built freight steamer, but vessels of about 2,000 tons gross, fortified for meeting ice, and of such construction as to enable them to be fair freight carriers. They must be well strengthened forward, should have wooden sheathing, and be very full under the counter. The propeller should be of small diameter, and well down in the water. A limit of 2,000 tons is stated, as a larger ship would be unwieldy, could not make such good way through loose ice, and, being unable to turn sharply, would get many a heavy blow that the smaller ship would escape.

Already several railways are projected from different points in the Northwest to Hudson Bay, notably one from Winnipeg, and another from the Calgary and Peace River districts, over which much of the grain and a large portion of both American and Canadian cattle from the western ranches would be carried, and European goods for those districts would furnish return freight. The recent completion and opening of the Edmonton and Calgary Railway is rapidly filling up a very important agricultural country, and the near proximity the Hudson Bay route would afford to European markets will extend its benefits to the south of the boundary line. A railway running southwest from a port on the bay will materially alter existing conditions, and its extension, as proposed, into the United States or to connect on the western frontier with the American railway system of the Western States, will be productive of a large traffic both ways. Cold storage accommodation already exists at Calgary in connection with the shipment of frozen meat in refrigerator cars to the Pacific coast, a trade which has far exceeded the expectation of its promoters. With the shipbuilder and capitalist rests the solution of the problem of this new line for commerce to take, and if such parties will construct and equip vessel suitable for the route, not on the lines of the ordinary ocean freight steamer, but specially adapted for ice and northern waters, there is every reason to believe that such an enterprise would prove remunerative and successful.

That this great lone sea will become to North America what the Baltic is to Europe, is only a question of the near future.—*Nautical Magazine*.

#### HARDY CRINUMS.

THERE are half a dozen kinds of crinum in cultivation which may be classed among hardy plants in the warmer parts of England. They are, of course, happiest when planted in a sheltered border, preferably against a south wall, at any rate in the neighborhood of London. I suppose the hardiest of the six is *C. capense*, now called *C. longifolium*, with its two varieties album and Farinianum. These three are represented by large clumps in the borders at Kew, where they have been in flower for the past two months. The flowers of the type are rose colored, with a band of dull crimson down the middle of each segment; those of the variety album are white, with a faint streak of rose on each segment.

Farinianum was introduced from the Kalihara desert by Mr. Farini, of Westminster Aquarium fame, and presented to Kew, where it flowered in 1887. It is remarkable for its narrow, long-necked bulb, very long tapering leaves, and dark, rosy flowers. Mr. Farini found the plant in thousands in a stream mixed with rushes, the whole of the bulb and neck being buried. The species is very common in South Africa, whence it appears to have been introduced into England before Miller's time. Herbert had a large bed of it out of doors at Spofforth over sixty years ago, and his observations upon it are worth quoting here. He says: "It is a very hardy species, endures the winter, and flowers in profuse succession during five or six months in a bed covered with leaves in winter, and ripens seeds by the bushel. It delights in wet and will flower in a pond. . . . It might be advantageously planted by the edge of any ornamental piece of water, and would form a beautiful clothing for a small island, where it would afford thick covert for water fowl. Nursery gardeners might easily rear it from seed to sell by the hundred."

The following species had been successfully hybridized with *C. capense* in Herbert's time: *C. zeylanicum*, *C. pedunculatum*, *C. exaltatum*, *C. scabrum*, *C. latifolium*, *C. Careyianum*, *C. revolutum*, *C. defixum*, *C. asiaticum*, *C. erubescens*, *C. cruentum*. The offspring of these combinations were all in cultivation in Herbert's time, and some of them he describes as being very beautiful and quite hardy. So far as I can learn, none of them are in existence now, but the parents are, and what Herbert and his contemporaries accomplished could be easily repeated.

The only hybrid crinum in cultivation now is *C. Powellii*, raised by Mr. Powell, of Southborough, Tunbridge Wells, from *C. capense* and *C. Moorei*. Mr. Powell communicated the following note respecting the origin of his beautiful hybrid to *The Garden* in 1886:

"This hybrid crinum was raised from seed in Suffolk ten years ago, and having within the past two or three years become widely distributed in many districts both in England and Ireland, its complete hardiness may be said to have been thoroughly tested, and those who have grown it find it to increase in vigor and size yearly. All it wants is to be planted in a suitable spot, and if not meddled with, it will then take care of itself. It seems to grow twice as fast as *C. Mooreanum* in Kent, though *Mooreanum*, as seen out of doors at Glasnevin, is most satisfactory, both as regards foliage and bloom.

"I have tried *Powellii* in a pot, but could not get it to thrive, though in the same house *Mooreanum* succeeded well. The leaves of *Powellii* have great substance, and taper to a point; whereas those of *Mooreanum* are uniform in width and soft, and out of doors easily broken. They are not rigid and erect, like those of *Powellii*, which they somewhat resemble in color, being quite distinct from the glaucous green

of its parents. It may be propagated from offsets, which it produces rather freely, as do also both *C. capense* and *C. Moorei*.

I suppose *C. Moorei* is the best of all the cool-house or hardy crinums. It is a superb plant for the conservatory, as may be seen from the grand specimens of it now in full bloom in the greenhouse (No. 4) at Kew. It is deciduous, requires to be kept dry in winter and liberally treated in regard to soil and water in summer. It is not quite as hardy as *C. capense*, scarcely thriving out of doors in gardens near London, severe winters, such as our last, being too much for it. But in the extreme southern counties, such as Devon, Dorset, etc., in South Wales and in Ireland no doubt it would be quite as hardy as *C. capense* is here. It has been a feature in the open border at Glasnevin for years. It is a native of Natal and Kaffraria, whence it must have been introduced into England at least twenty years ago. According to Mr. Baker, it was first made known to botanists by a sketch sent to Kew by Bishop Colenso



CRINUM MOOREI ALBUM.

and prostrate leaves of *C. capense*. The flowers of *Powellii* vary in color from pure white to deep rose, but bulbs of the white kind are very scarce as yet, and it does not develop many offsets. Strange to say, the white-flowered plants were obtained from *C. capense roseum*; while those from *C. c. album* (which was also used as a seed parent) had the deepest shades of rosy pink. The flower stems of *Powellii* reach fully five feet in height when the bulbs are well established; the latter must be planted deep, with plenty of manure beneath them, but not in contact with the bulbs. This variety has never shown any signs of producing seed, but it has not been fertilized with any pollen except its own."

In the garden of Sir Trevor Lawrence at Burford Lodge there is a grand bed of *C. Powellii*; Mr. Gumbleton also grows it well at Cork, and it thrives in the open border at Kew. Planted with the base of the bulb a foot below the surface in an open well-drained border of loam it is quite happy and as regular in its copious production of large handsome flowers as either

in 1838. It has been called *C. Colensoi*, *C. Makoyanum*, *C. Mackenii*, and *C. natalense*. Its present name was given by Sir Joseph Hooker in compliment to Dr. Moore, of Glasnevin, who grew it successfully and supplied the specimen drawn for the *Botanical Magazine* (t. 6, 113).

The variety album, of which a figure is given in the supplement of the current issue, prepared from a plant flowered at Kew last year and in bloom there again now, is similar to the type in all characters except the color of the flowers, which in the ordinary *C. Moorei* are pink, but in album are pure dazzling snow white. The Kew bulb of the latter was obtained from Mr. E. H. Woodall, of Scarborough, who obtained it from Madeira under the name of *C. giganteum*, and who states that he saw it there in a garden represented by a grand clump with thirty spikes of its snow white blossoms on long stalks above the bright green foliage. He asked for a bulb, never dreaming it would be possible for such a magnificent crinum to be hardy, or nearly so, in England. There is a figure of it in Regel's