MUIR GLACIER, ALASKA.*

BY S. P. BALDWIN.

The first known of that greatest of Alaska's wonders, the Muir glacier, was reported in the account of Vancouver's explorations about Sitka in 1794, where he describes what is supposed to have been Glacier Bay as completely filled with ice and "terminated by compact, solid mountains of ice rising perpendicular from the water's edge." In 1879 the glacier was first described by Prof. John Muir, who spent some days wandering over the ice, a blanket and a few biscuits on his back and only the ominous roar of the sub-glacial waters to break the solitude. His vivid description, seconded by the tales told by Dick or "Professor" Willoughby, an old hunter of that region, led the steamer company to explore the bay, and now every steamer makes the extra journey of fifty miles necessary to allow its load of tourists to set foot on this great frozen sea.

As the steamer turns into Glacier Bay, what a marvelous sight appears! To the west the great St. Elias Alps tower above; Mt. Crillon (15,900 feet high), Mt. Fairweather (15,500 feet high), La Perouse, Lituya, and others nearly as high, covered with snow and ice to within four thousand feet of the sea, sending immense glaciers down to the ocean on one side and to the bay on the other.

A ring of peaks from eight to ten thousand feet high form the background to the north and east, a few of them bare of snow, but only because so precipitous. And now while we speak a great white cloud wraps itself gently about one of these bare peaks only to disclose it to view in a few minutes, shrouded in white fresh snow.

From the flanks of these mountains come great frozen rivers, flowing steadily though slowly on to meet in one immense glacier in the amphitheater below, and march majestically on to the front to join in the cannonading of the icebergs.

At the head, the long, narrow bay divides into two inlets. The next one, as yet not named, contains several glaciers which have not been explored. The Muir Inlet, to the east, is perhaps five miles long and two to three miles wide; on either side mountains rise abruptly, often perpendicularly, for the land here is "all on end," as is the whole of our northwest coast; at the head a wall of blue ice, a mile long and about four hundred feet high, cut into towers, castles, and caverns, threatens with groaning and thundering, as prisms from the size of a paving stone to the size of the Cologne Cathedral go crashing down to the water, throwing the salt spray hundreds of feet into the air, sending forth waves to lash the shores throughout the bay and echoing among the mountains as a thunder storm.

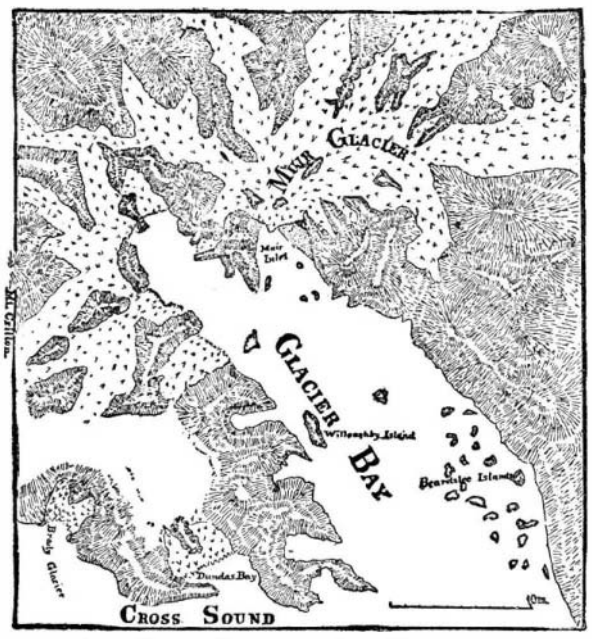
These icebergs float off down the bay, some stranding and melting where they are confined; others, pushed about by wind and tide, form impassable jams, ringing merrily as the waves rock them back and forth.

The ascent of one of the neighboring mountains discovers the home of the mountain sheep, for to the height of three thousand feet there extends a rich carpet of grass, and many familiar flowers, as the epilobium, goldenrod, and blue-bell, remind one of home, while each little ravine contains its snow bank and the accompanying pool of clear, cold water. The scene from here is magnificent; high mountains on every side, and nestled at our feet, this great sea of ice thirty miles in diameter and formed of many branches, any one of which is as large as the Gomer or Aletsch of Switzerland.

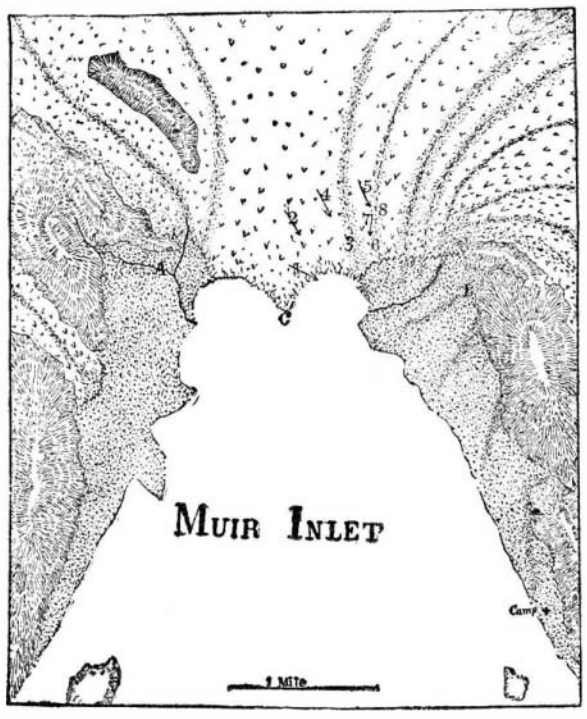
This glacier is as large as all the Alpine glaciers together, twelve hundred square miles, an area equal to Lehigh, Northampton, and Carbon Counties in Pennsylvania combined, and a thousand feet deep at the mouth, three hundred feet above water, seven hundred feet perpendicular below the surface. It contains more water than Lake Erie, and it is estimated that seventy-seven billion cubic feet of ice are discharged into the bay as icebergs every year, and no less than one hundred and seventy-five billion cubic feet of water melt from the surface and flow into the bay as sub-glacial streams in a year.

The most rapid motion is from the north through the center, and so rough is the ice here that it is impossible to cross it. Immense crevasses, ridges, pyramids, and towers are mingled in the wildest confusion, as in a stormy sea; moraines and bowlders—all that dare approach are swallowed up in the yawning crevasse.

The ice of the eastern half is moving much more slowly and is consequently much smoother, broken only here and there by crevasses, so that one may walk for miles up the glacier at a gradual ascent of one hundred feet to the mile until the névé is reached.



Map of Glacier Bay, Alaska, and its surroundings. Arrow points indicate glacial area. (Courtesy of Prof. G. F. Wright.)



Map of Muir Inlet, showing converging moraines and form of front in 1886. A, buried forest; B, base-line. (Courtesy of Prof. G. F. Wright.)

During the summer the surface disintegrates and melts off two inches a day, forming thousands of little rivers flowing in all directions and joining in larger streams until finally they reach a crevasse or a round deep hole, called a moulin, into which the waters are precipitated to join the rumbling streams beneath.

While the surface appears white, a glance into a moulin tells a different story, for just below this white ice a clear sea-green appears, which grows darker and clearer as the ice is thicker, until an intense blue beckons us to the crystal depths.

The slower moving ice is often heavily loaded with stones and earth, for of course each branch bears two loads of moraine in to the great basin, and this protects the ice from the sun as a blanket until the moraine forms a ridge, and on this ridge each large stone by further protection is raised on a pillar of ice often several feet above the general level. Here are collections already made for the geologists, and besides granites, some peak many miles back has sent specimens of silver ore, while another has tried to rival Carrara for marble.

When Professor Wright tried to measure the motion in 1886 he found it was practically impossible to set a line of stakes across the glacier, partly because the surface melts off so rapidly, but mainly because of the roughness of the central portions; then, after a base line had been established and accurately measured, it was suddenly discovered that the base line was on moraine-covered ice and probably moving. Finally a base line was staked off on dry land and measurements taken on certain peculiarly shaped ice pillars at various distances, and the angles read every four days.

The motion found by Professor Wright was in the center about sixty-five feet a day, and less, of course, nearer the sides. That seems very rapid when compared to the Alpine thirty-three inches a day, but here we have an enormous mass of ice all crowding through a narrow opening, but pressing toward that opening from every side. The width and depth of the ice greatly reduces friction.

Since the Muir glacier was measured, a similar rate has been found in a number of glaciers in Greenland, and in one case a rate of ninety feet a day was found. In 1890, when Professor Reid measured the motion, the front was found to have retreated more than half a mile, so that the first two branches barely, if at all, added their pressure, and the rate was increased.

The width of the water front is about a mile, but the whole width between the mountains at the mouth is about two miles. On either side is a triangular patch of moraine half a mile wide at the head, in which the glacier ends, and extending about two miles down the inlet, separating the water from the foot of the mountains, but narrowing and disappearing beyond that point.

Near the foot of the mountain, on the east side, a large subglacial stream bursts forth, under a considerable pressure, so that a column of water three feet in diameter boils up to a height of about four feet.

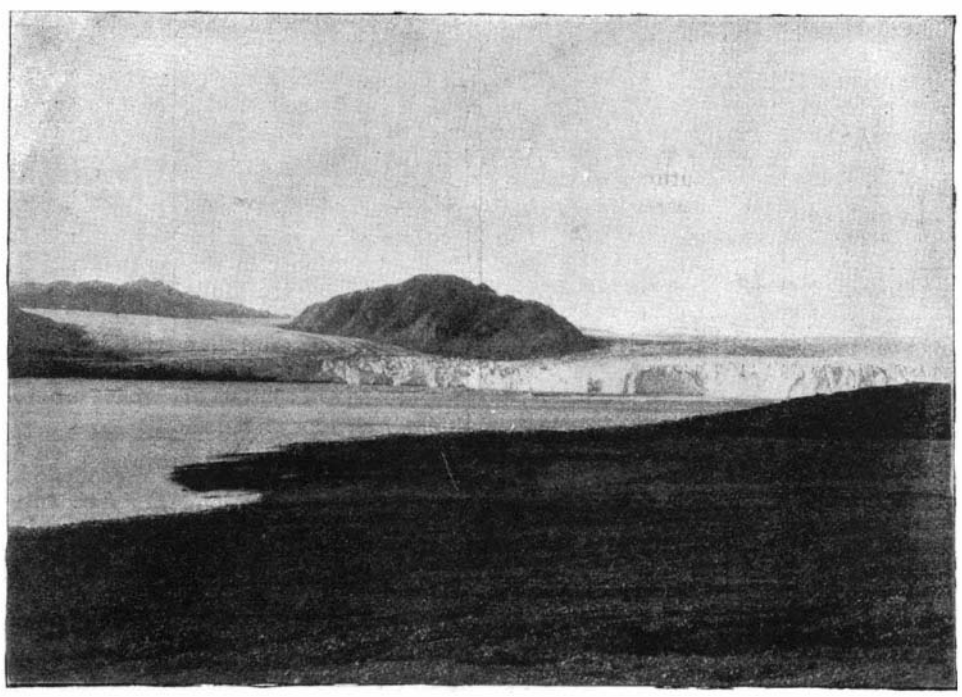
Not only do great columns of ice break off above water and become bergs, but quite often large blue masses rise from the bottom and these usually carry quantities of debris, locked in their embrace, to be dropped one by one, as the berg melts, into the fine deposit just described. Here is formed what is known as modified drift.

Examining the terminal moraines at the sides, we find very few scratched stones and very little chance to study the deposits made beneath the ice, for it is all covered by the coarse material of surface moraines—bowlders of all shapes and sizes, sharply angled and mixed with very little fine clay, very different in appearance from the till near Belvidere, yet having the same unstratified, plums-in-a-pudding character.

It seems that the glacier has been receding for many years, and as it has retreated the side streams have cut new and shorter channels successively, until there are now on the east side nearly a dozen such empty channels and as many parallel ridges.

One form of deposit, which has led to great misunderstanding as found in the States, is shown at the Muir glacier, but not so well as that found by Mr. Russell in the summer of 1891 on the Malaspina glacier near Mt. Saint Elias. Sometimes the surface water, unable to find escape, is held backed up into a lake against the mountains at the side, there to form a true lake terrace. This may explain many of the high level terraces found in the glaciated area, without the great submergence sometimes claimed. Mr. Cushing, who visited the glacier with Prof. Reid in 1890, describes several of these lakes as found near the heads of valleys of the eastern side. The stream which cuts through the moraine of the west side has uncovered an ancient forest buried deep in the glacial sands.

Rooted in the peat and sending their roots far into the blue clay are many stumps or trunks of trees of various sizes, from an inch or two to more than a foot in diameter, quite bare of bark and invariably broken off at a height of ten to twenty feet and the top bruised



MUIR GLACIER, ALASKA.

(From a photograph by J. F. Morse, Cleveland, O.)

* Abstract from the *Lehigh Quarterly* for January, 1892.]

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in the direction down the inlet. This forest has been covered to a depth of nearly a hundred feet by the fine sand of a portion of the moraine, which extends several miles down the inlet, on that side, at a constantly decreasing altitude. The fact is that since these trees grew the glacier has advanced until it glided over the trees and over this whole moraine, then it has receded again and a little stream is now doing what the great glacier could not do, root out the trees.

How long the ice may have passed over the buried forest, or how old the trees are, cannot be certainly stated, but the ice must have filled Glacier Bay since the trees grew, and that must have been several hundred years ago—and may have been several thousand. Yet the wood is now so fresh that it might well be but a few years old. That the ice filled Glacier Bay within a few hundred years is very evident from the condition of the vegetation, for there are no trees nearer than Beardslee Islands, though the conditions are very favorable. The smaller vegetation has spread more rapidly and covers the mountains, while it is gaining some foothold on the moraines about the mouth. Here the plants grow less in quantity and variety nearer the glacier, until within half a mile of the ice no plants are found. Again the mountain sides are very handsomely grooved to a height of 3,000 feet, and even the polish is well shown, though rocks in this atmosphere disintegrate very rapidly. Debris, too, can be found at a height of 3,000 feet, and Vancouver's descriptions seem to show that the ice in his time, though not filling the bay, extended much farther down. Not only has the glacier retreated a long distance since Vancouver's time, but it is now retreating very rapidly. Photographs taken by Professor Reid's party in 1890 show that the front has receded about 3,000 feet in four years, and the steamer company report that since 1883 it has receded over a mile. The ice front has decreased in thickness also, for it is now at the same height, above water, 300 feet, but back at a point which was 400 feet high in 1886. Mr. Cushing shows that the glacier is dying out, about the heads, with equal rapidity, so that the ice retreats from the mountains into the basin and the source of supply is cut off.

Railway Rust.

The rusting of rails in long tunnels is the subject of a recent article in the *Civil Ingenieur*, describing the results of observations in the Altenberg tunnel, which is about 1,230 feet long and located on a curve of 2,950 feet radius. The rails had been down for 11 years, and at the end of that time were covered to a depth of 0·16 to 0·24 inch by hard scales, which could only be removed by a knife. They were composed mainly of iron sulphide, and were found principally on the web. While the weight of the rail was much reduced in this manner, its sectional area was found to have increased, owing to the flaky character of the rust. The new rails have been covered with a mixture consisting largely of tar, which is renewed every six months. The gravel ballast has also received a partial covering of broken limestone, and by these means it is hoped that the formation of rust will be retarded. In the Brandleite tunnel, in Thuringen, it was found that rails and metal ties were destroyed by rust as fast as by the passing trains. The ties lost about 5·9 pounds each in six years. This tunnel is nearly 10,000 feet long, and is on a tangent having a 1 per cent grade.

Tropic and Semitropic Fruits and Nuts.

For the first time the Census Office has made a special investigation for the purpose of ascertaining the extent and value of the production of oranges, lemons, figs, almonds, cocoanuts, and other tropic and semitropic fruits and nuts as industries of the United States. A preliminary report has been prepared by Mr. J. H. Hale, special agent, under the direction of Mr. Mortimer Whitehead, special agent in charge of horticulture.

The material from which these statistics are compiled was obtained direct from the growers upon schedules specially prepared for that purpose and by personal visits of special agents to sections of the country where these products are grown.

From the tabulations in Census Bulletin No. 161, it appears that, in addition to the tropic and semitropic fruits and nuts grown for home and family use, there were in the census year 13,515 acres of almond, 677·50 of banana, 169·88 of citron, 9,864 of cocoanut, 4,477 of fig, 550 of guava, 1,362·25 of kaki, 7,256 of lemon, 495·58 of lime, 12,180 of madeira nut, 7,097 of olive, 184,003 of orange, 2,189·50 of pineapple, 171·89 of pomelo, and 27,419·50 of pecan trees, representing 658,566 bearing and 800,010 nonbearing almond trees, 577,782 bearing banana plants, 4,237 bearing and 14,110 nonbearing citron trees, 123,227 bearing and 1,199,549 nonbearing cocoanut trees, 138,186 bearing and 285,201 nonbearing fig trees, 32,943 bearing and 120,529 nonbearing guava trees, 58,390 bearing and 124,522 nonbearing kaki trees, 167,663 bearing and 498,784 nonbearing lemon trees, 19,096 bearing and 44,255 nonbearing lime trees, 188,409 bearing and 411,248 nonbearing madeira nut trees, 278,380 bearing and 331,022 nonbearing olive trees, 3,885,890 bearing and 9,705,246 nonbearing orange trees, 21,750,000 pineapple plants, 3,279 bearing and 12,867 nonbearing pomelo trees, and 214,988 bearing and 657,980 nonbearing pecan trees.

Excluding pineapples and bananas, which are all counted as bearing plants, as they commence fruiting within a year of planting, it will be noted that the average number of all nonbearing trees is about double that of the bearing trees, the product of which in the census year was, as far as reported, valued at $14,116,226.59, divided as follows: Almond $1,525,109.80, banana $280,653.75, cocoanut $251,217.41, fig $307,271.76, lemon $988,099.92, lime $62,496.90, madeira nut $1,256,958, olive $386,368.32, orange $6,602,099.06, pineapple $812,159.17, pomelo $27,216, and pecan $1,616,576.50. On the basis of present prices, with all the nonbearing trees in fruitage, the next census ought to show a value of product of more than $50,000,000. As a forecast of the future growth of these branches of horticulture, in addition to the acreage already planted, the number of acres of land in the United States susceptible of development in plant in any one or all of the fruits and nuts named has been ascertained, and the aggregate figures are also given.

THE LOVELL DIAMOND SAFETY BICYCLE.

The accompanying cut shows the 1892 model which the John P. Lovell Arms Company, of Boston, Mass., have just placed on the market. The frame is of the diamond pattern, and made entirely of seamless steel tubing and drop steel forgings. Front wheel 30 inches, with 1¾ inch pneumatic tire; and rear wheel 28 inches, with 2 inch pneumatic tire; ball bearings of the improved pattern to wheels, crank shaft, pedals, and head; gear, 57 or 60 inches. Scorcher saddle and loop saddle post furnished, if preferred. Weight, complete, 43 pounds; stripped, 38 pounds. The Lovell wheels are guaranteed in every respect. They are a reliable and high grade wheel. The Lovell Company have moved their factory to Fitchburg, Mass., and their works, when completed, will form one of the largest manufactories of bicycles and firearms in the world.

THE LOVELL DIAMOND SAFETY BICYCLE.

The Future of Manufacture.

Ex-Governor Goodell, of New Hampshire, responding to this toast at the recent hardware dinner in this city, said: We have been told this evening truthfully that we made a year or two ago about ten millions of tons of iron in this country. This is certainly an enormous amount, but it is easily explained, yet, when we remember that, when we make 10,000,000 tons of pig iron in a year, we are making 27,000 tons in a day, and we are making a car load of pig iron a minute for every day of the year counting Sundays and holidays, are we to continue such an enormous production? Can this country consume such a quantity? Or are we in the near future to find such a reversion in this business that many of our furnaces will be obliged to bank their fires and go out of blast? It is a question too much for me, and I think, possibly, too much for you to decide. Yet I have great confidence in the future. In considering the future we must consider the past. A few years ago our bridges were all made of wood, with the exception of a few bolts and pins. Now they are made almost wholly of iron. A few years ago our fences were made almost wholly of wood. Now barbed wire is used everywhere and the barbed wire business is one of the largest in the country. It is spreading all over the country, and it is likely to spread more and more in the future. We are constantly designing and discovering uses for iron and steel. Last night, as I was riding in a railway car, a fellow passenger asked what would the railroads do for ties in a short time. I then remember that just a few days before I had heard that steel ties had been put into use and that very soon it would be likely that they would take the place of the wooden ones on every railroad in the country. Then, when I remember that invention is going on all the time; when I realize that Morse, Fulton, Edison, and all the greatest inventors of history have been Americans; when I realize that a few years ago a hall like this would have been lighted with sperm oil distributed from New Bedford, then a little later by gas, and that to-night we have this beautiful light, I have great hopes for the future of manufacture.

You tell me that we are living in a generation the like of which has never been known in the earth's history, and you will also perhaps tell me that we are living in a generation the like of which will never be known again, but I believe that we have just begun to discover great things. What they will be no one can tell. We have been told about iron in the blood to-night, how it makes mind and muscle strong. My friend and myself are strong prohibitionists and we believe that the time is speedily coming when prohibitionists will have prohibition, and when those who are accustomed to the use of such things as produce intemperance will be seeking it as a substitute. (Applause.)

We can hardly conceive of its various uses. I am told that Edison is just now engaged in putting up wires around a mountain of iron, by which he expects to hear the sound of the great explosions that occur from time to time in the sun. I am afraid that I shall never hear the sound of the explosions in that great luminary, as I am growing old, and I am afraid, too, that should he be able to hear them, the great Creator of all things would cause him confusion as he did at the tower of Babel.

We can scarcely imagine, in the midst of all this, what the future is going to bring us. I have great confidence in her gifts, but perhaps something should be said about the profits in the manufacture of the future. Are we going to make money by them? The price of everything is going down, is cheaper to-day than yesterday. A few years ago, the price of steel was 10 cents a pound, and we can buy just as good steel now for a third of that sum. The price has been constantly decreasing in almost every branch of manufacture. We are constantly being told that the price is so low and the profits so small that we will be obliged to give up business soon. I tell you that we old fellows who have an oldish way of doing business, a rut in which we have been accustomed to let things run, and who think that we can do business in no other way, will be obliged to go out of the trade. We will go to the wall, but the young man with his eyes open, and who is awake to the responsibilities of his position and who is not content to remain in the groove of his father's methods, which were the proper ones thirty years ago, will devise some new method, some new way, and he will produce the goods we have been selling at a ruinous loss so that he will be able to make money on them.

Cement Floors.

Recently I visited a newspaper pressroom, says a contributor to the *Art Printer*, which was, like the majority of pressrooms, especially those for newspapers, located in the basement of the building—an essential in placing a large machine or a number of them on a solid foundation. To prevent the dampness arising from the earth and injuring the press and rollers a concrete floor had been laid before the press was set up.

After examining the press, the pressman informed the writer that he had swept the floor several times during the day, but that the dust seemed to accumulate rapidly again. No dust was blown in from the outside when the doors were opened, as the ground was frozen and covered with snow. The dust was ground out of the concrete by the tramping of the persons employed in the room.

This dust is not like the ordinary house dust, but is of a coarse, gritty nature, and when blown about the press by the circulation of air through the room is sure to settle on the joints, journal boxes, and in the oil holes and fountain, no matter how carefully they may be covered or protected, and in a short time will do incalculable injury to the machine.

Joists should first be laid and the spaces between them filled with concrete until nearly level with the top, and a well joined, hard wood floor laid over all, which will wear better than the concrete and be more satisfactory than any other floor that can be put in a printing office or workshop. The proprietors of printing offices, who contemplate the erection of new buildings or repairs, would do well to make a note of this.

[The trouble above mentioned was due to poor cement, which did not bind the sand. First class Portland cement one part, fine, sharp, clean sand two parts, properly mixed and laid, will make a superior floor—a veritable artificial stone, which ordinary use will not abrade.—ED. S. A.]

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