The results of these tests seem to point to one conclusion of very considerable interest. It happened that the competition in both the arc and incandescent systems was between low electromotive force and great strength of current, on the one hand, and high electromotive force, with weaker current, on the other. In one arc system the electromotive force was almost exactly double, and the current almost exactly half, that of the other. In the incandescent systems, the contrast, although not so great, was very marked. In these trials the advantage was decidedly on the side of high electromotive force.

NOTES ON THE VOLCANIC ERUPTION OF MOUNT ST. AUGUSTIN, ALASKA, OCT. 6, 1883.[1]

ON the western side of the entrance to Cook's Inlet (forty-five miles wide) lies Cape Douglas; and to the northward of the cape the shore recedes over twenty miles, forming the Bay of Kamishak. In the northern part of this bay lies the Island of Chernaboura ('black-brown'), otherwise called Augustin Island. It is eight or nine miles in diameter, and near its north-eastern part rises to a peak called by Cook, Mount St. Augustin. As laid down by Tebenkoff, the island is nearly round. The northern shores are high, rocky, and forbidding, and are bordered by vast numbers of rocks and hidden dangers. The southern shore is comparatively low.

Mount St. Augustin was discovered and named by Capt. Cook, May 26, 1778; and he describes it as having 'a conical figure, and of very considerable height.' In 1794 Puget describes it as

> "A very remarkable mountain, rising with a uniform ascent from the shores to its lofty summit, which is nearly perpendicular to the centre of the island, inclining somewhat to its eastern side. . . . Towards the seaside it is very low, from whence it rises, though regular, with a rather steep ascent, and forms a lofty, uniform, and conical mountain, presenting nearly the same appearance from every point of view, and clothed with snow and ice, through which neither tree nor shrub were seen to protrude; so that, if it did produce any, they must either have been very small, or the snow must have been sufficiently deep to have concealed them."

At that time there were native hunters, under the direction of two Russians, hunting or living in the vicinity of the north-eastern point of the island.

Vancouver placed the peak of this mountain in latitude 59° 22′: Tebenkoff places it in latitude 59° 24′.

The peak of St. Augustin is distant forty-nine miles nearly due west (true) from the settlement on the southern point of Port Graham, or, as it is sometimes called, English Harbor. This harbor is situated on the eastern side of Cook's Inlet, near Cape Elizabeth.

In connection with the fall of pumice-dust at Iliuliuk on Oct. 16, 1883, it may be of interest to observe, that the peak of Augustin is over seven hundred miles to the north-eastward of Bogosloff Island, off Unalashka (see map).

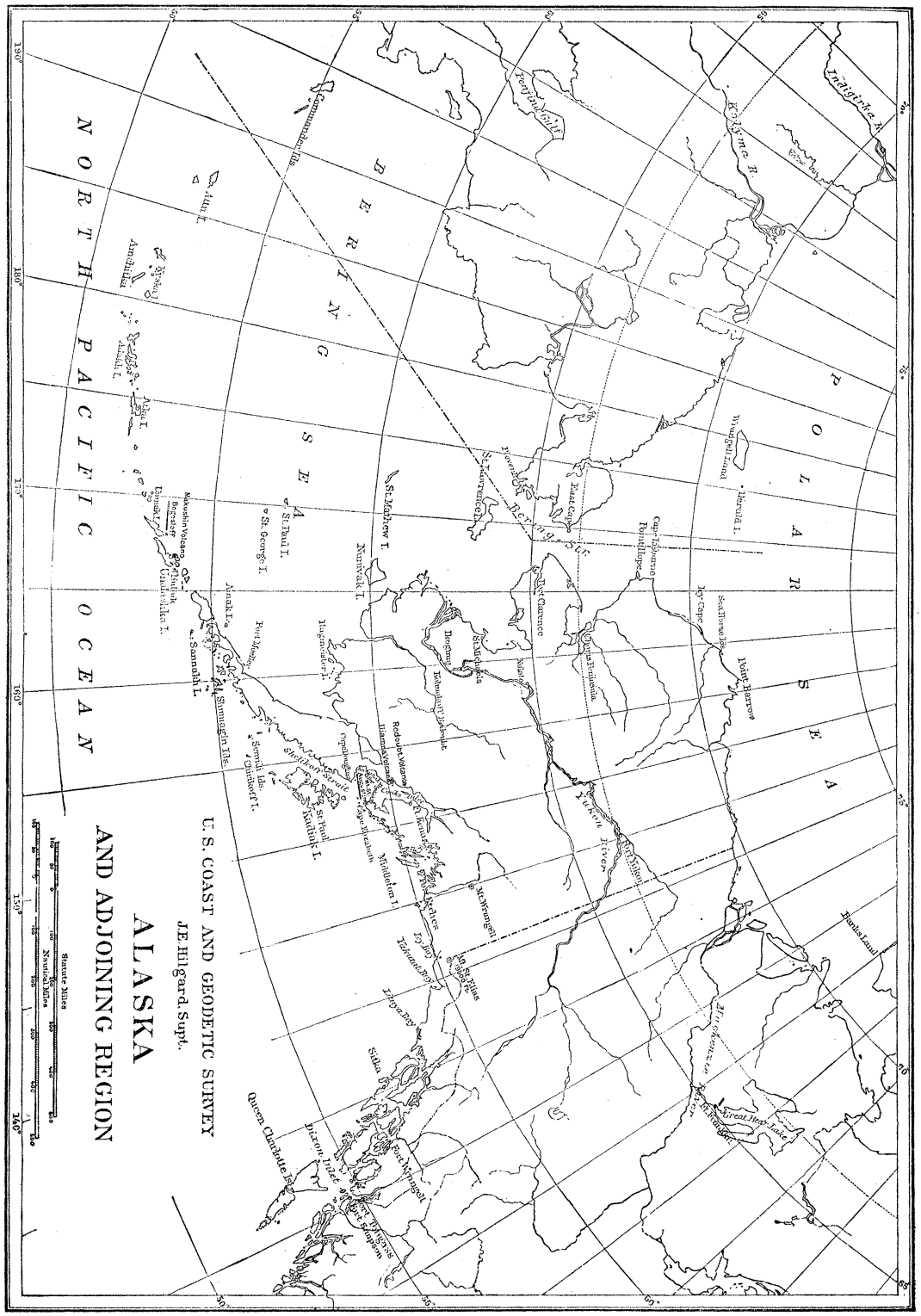
About eight o'clock on the morning of Oct. 6, 1883, the weather being beautifully clear, the wind light from the south-westward (compass), and the tide at dead low water, the settlers and fishing-parties at English Harbor heard a heavy report to windward (Augustin bearing south-west by west three-fourths west by compass). So clear was the atmosphere that the opposite or north-western coast of the inlet was in clear view at a distance of more than sixty miles.

When the heavy explosion was heard, vast and dense volumes of smoke were seen rolling out of the summit of St. Augustin, and moving to the north-eastward (or up the inlet) under the influence of the lower stratum of wind; and, at the same time (according to the statements of a hunting-party of natives in Kamishak Bay), a column of white vapor arose from the sea near the island, slowly ascending, and gradually blending with the clouds. The sea was also greatly agitated and boiling, making it impossible for boats to land upon or to leave the island.

From English Harbor (Port Graham) it was noticed that the columns of smoke, as they gradually rose, spread over the visible heavens, and obscured the sky, doubtless under the influence of a higher current (probably north or north-east). Fine pumice-dust soon began to fall, but gently, some of it being very fine, and some very soft, without grit.

At about twenty-five minutes past eight A.M., or twenty-five minutes after the great eruption, a great 'earthquake wave,' estimated as from twenty-five to thirty feet high, came upon Port Graham like a wall of water. It carried off all the fishing-boats from the point, and deluged the houses. This was followed, at intervals of about five minutes, by two other large waves, estimated at eighteen and fifteen feet; and during the day several large and irregular waves came into the harbor. The first wave took all the boats into the harbor, the receding wave swept them back again to the inlet,

[1] Communicated by Prof. J. E. Hilgard, superintendent U. S. coast and geodetic survey.


U. S. COAST AND GEODETIC SURVEY
J.E. Hilgard, Supt.
ALASKA
AND ADJOINING REGION
NORTH PACIFIC OCEAN
BERING SEA
POLAR SEA
Statute Miles
Nautical Miles
Kuskokwim Bay
Nunivak I.
St. Matthew I.
St. Paul I.
St. George I.
Unalaska I.
Amchitka I.
Attu I.
Semidi Isls.
Shumagin Isls.
Sannakh I.
Kodiak I.
Sitka
Queen Charlotte Isls.
Yakutat Bay
Mt. St. Elias
Mt. McKinley
Great Bear Lake
Great Slave Lake
Herald I.
Wrangell Land
Point Barrow
Cape Lisburne
Point Hope
Icy Cape
Kotzebue Sound
Norton Sound
Behring Strait
Anadyr R.
Kolyma R.
Indigirka R.
Yukon River
Mackenzie River
Hanks Land

and they were finally stranded. Fortunately it was low water, or all of the people at the settlement must inevitably have been lost. The tides rise and fall about fourteen feet.

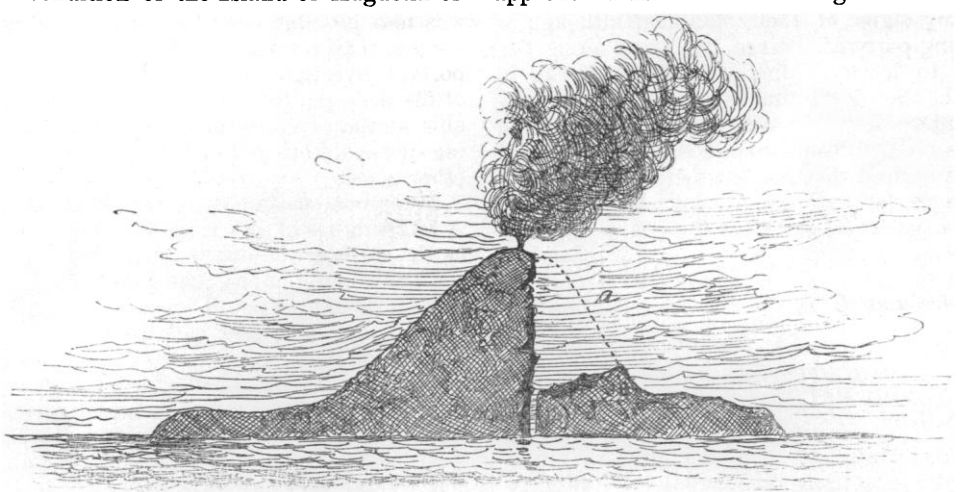
These earthquake waves were felt at Kadiak, and are doubtless recorded on the register of the coast-survey tide-gauge at that place. Also the pumice-ashes fell to the depth of four or five inches, and a specimen of the deposit was given to the tidal observer at St. Paul. It will be interesting to compare these ashes with those collected at Iliuliuk on the 16th of October, and which, from a confusion of dates, were supposed to have come from the new Bogosloff volcanic island. I am of the opinion that they came from St. Augustin.

The condition of the Island of Augustin or Chernaboura, according to the latest accounts, is this: —

At night, from a distance of fifty or sixty miles, flames can be seen issuing from the summit of the volcano; and in the day-time vast volumes of smoke roll from it. Upon nearer approach from English Harbor, it was found that the mountain had been split in two from peak to base by a great rupture extending across it from east to west, and that the northern slope of the mountain had sunk away to the level of the northern cliff.[1] This is corroborated by the statement of the hunting-party in Kamishak Bay. Smoke issued from the peak at a very short distance to the southward of the rupture.

The party of natives on Kamishak did not approach the islet, though they gave clear and distinct accounts of its eruption and subsequent appearance; but Capt. C. T. Sands, who was at English Harbor, gave the Alaska company a full description; and Capt. Cullie of the Kodiak states, that, if there were plenty of water in the line of rupture, it would be possible for a vessel to sail through (see figure). At the time of Capt. Sands's observations the low ground of the island was visible, and seemed to be a vast crater, from which smoke and flames were issuing.

But beyond all these phenomena, apart from the volcanic eruption and the rupture of the island, we have the report of Capt. Cullie of the schooner Kodiak (from whom we also obtain a statement in regard to the rupture), who approached the island from English Harbor on the 10th of November, and found that a new island, about a mile and a half long and seventy-five feet high, had been upheaved in the ten-fathom passage between Augustin and the mainland to the westward. This passage is from six to eight miles wide, and was sailed through by Puget in Vancouver's voyages of discovery.



MOUNT ST. AUGUSTIN AFTER THE ERUPTION, AS SEEN BY CAPT. CULLIE, Nov. 10, 1883. *a*, THE ORIGINAL OUTLINE.

This new island (also reported by the hunting-party in Kamishak) would appear to have arisen during the late volcanic activity. It lies to the north-westward of Chernaboura Island (Augustin), and was distinctly seen from the Kodiak, as that vessel lay ten miles to the north-eastward, and had clear weather.

To show the violence of the volcanic convulsions at this time, two extinct volcanoes on the Alaska peninsula, which are reported to be about west (true) from the active volcano Iliamna (twelve thousand feet high), had burst

[1] Capt. Cullie's account.

into activity; and during the day volumes of smoke were distinctly seen, and columns of flame at night. Usually, at that season, Augustin and the peak are covered with deep snow. On the 10th of November, however, when Capt. Cullie approached the island, while there was a depth of four feet of snow at Port Graham (English Harbor), Mount St. Augustin was bare and black.

During this same season, a party of seven or eight Aleuts had established themselves on Chernaboura (Augustin) Island to hunt the otter during the winter. Two of the women refused to remain on account of the violent noises inside Mount St. Augustin; and they were taken to St. Paul, Kadiak. Since the eruption no one of this party has been seen, nor any signs of their bidarkas, although a rescuing party of natives had gone along the coast to learn of their whereabouts. It is feared, therefore, that they have been destroyed. In confirmation of this report of the native women, Capt. Sands says that he and others noticed that St. Augustin was emitting smoke as far back as August; but no other signs were observed before the heavy report of Oct. 6.

GEORGE DAVIDSON,
Assistant U. S. coast and geodetic survey.

THE COD-HATCHING EXPERIMENTS AT GLOUCESTER BY THE FISH COMMISSION.

IN the winter of 1878 and 1879 the Fish-commission at that time having a station at Gloucester, Mass., made very extensive experiments upon the hatching of certain salt-water fish, but more especially of the cod (Gadus morrhua). For years the cod has been almost entirely confined to the deeper waters on the coast, having been driven there by many causes, sewerage being the most probable and potent; and it has been since the discovery of America that these fish, at that time extremely abundant everywhere along the shore, even to such an extent that they could be caught in great numbers from any point of rocks, have become reduced in numbers to their present comparative scarceness, and at the same time driven from their former haunts to the deeper waters. Taking into account this remarkable decrease in numbers, and change of habitat, Professor Baird conceived the idea that the former abundance of cod could in part be restored by means of artificial propagation, which had proved so successful with the fresh-water species of fish. Many difficulties stood in the way, — difficulties which had never been encountered in any previous experiments. The principal trouble which was experienced resulted from the floating of the eggs, and it was only after many trials and numerous failures that an apparatus was invented which in part prevented the eggs from clogging the screen placed over the overflow-pipe.

The location for the primary experiments was fixed at Gloucester, on account of the great industry of catching and preparing these fish, which is centred there. Vessels and boats arrive every day during the winter months, bringing in fresh cod, many of them containing spawn. By the request of the commissioner, such fish were kept alive until they could be put into the live-box at the hatchery. It was also possible, and this was the most important reason for the choice, to carry on important investigations into the natural history of the deep-sea food-fishes, and to gather valuable statistics concerning the fisheries; it being impossible to get such information in any other place.

Many obstacles arose, owing to the location. A temperature of 30° F. is fatal to cod; and, as the surface-water in the harbor is liable to reach this point at any time during two or three months of the winter, it was necessary that the car containing the live fish from which spawn was to be taken should be constantly watched, and sunk to the bottom during every cold snap. The filthiness of the water caused by decaying waste portions of fish thrown into the docks — these being common receptacles for all dirt and refuse formed by the dressing-process — was such, that, even after the most careful filtering, the water was in a decidedly impure condition. The north-east storms so prevalent on the Massachusetts coast, especially during winter, kept the water in a roiled condition for a greater part of the time; so that when it reached the aquaria, although a great part of the mud had been filtered out, still the mudiness was apparent. Such a condition could not be other than an unhealthy one for young fish whose parents had been accustomed to the clear, cool, outer waters. When there were no storms, the great rise and fall of tide, about eleven feet, sufficed to keep the finer mud in constant circulation. But, notwithstanding these numerous obstacles, over one million and a half young cod were successfully hatched, and placed in the clearer waters of the outer harbor at Gloucester. On account of the impurity of the water even there, and the adverse conditions under which they were hatched, it was scarcely expected that any