

4.—REPORT UPON THE INVESTIGATIONS OF THE U. S. FISH COMMISSION STEAMER ALBATROSS FOR THE YEAR ENDING JUNE 30, 1889.

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INVESTIGATIONS ON THE ALASKAN COAST.

San Francisco to Departure Bay.—The steamer *Albatross* left San Francisco at 9:30 a. m. July 4, 1888, for Alaska, the object of the expedition being to explore the waters adjacent to the Aleutian Islands and the Alaska Peninsula, for the purpose of ascertaining the character and extent of the cod and halibut fishing grounds, and of obtaining all possible information regarding the fishing interests and resources of that region.

We had on board 30 lobsters, recently received from Wood's Holl, Massachusetts, which were to be deposited at some point on the California coast north of San Francisco. It was decided, on the recommendation of Prof. George Davidson, to plant them near Trinidad, as in his opinion the natural conditions of the New England coast, the home of the lobster, were more fully realized at that point than anywhere else on the northern California coast. The shores are bold and rocky, the sea-bottom ledges covered with kelp, alternating with sandy patches, and the water pure. The lobsters were placed in tubs of salt water and covered with kelp to exclude the light, the water being changed at frequent intervals. At 7:30 p. m. July 5 they were deposited in 13 fathoms, $1\frac{1}{2}$ miles S. $\frac{3}{4}$ W., magnetic, from Trinidad light-house, all in good condition except one. The temperature was 50° F., about the same as the waters of the northern New England coast during July.

NOTE.—All bearings are true unless otherwise stated.

We encountered strong head winds and heavy seas along the coast, and on arriving in the Straits of Fuca found our coal supply so nearly exhausted that we considered it prudent to call at Esquimalt, where we were promptly supplied by Mr. James H. Innes, in charge of Her British Majesty's dockyard. We left Esquimalt at meridian, July 9, and arrived at Departure Bay, British Columbia, at 7:50 p. m.; went to the coal wharf at 6:45 the following morning, and finished coaling at 4:15 p. m. on the 11th, having taken on board 185.5 tons.

Departure Bay to Unalaska.—We left the wharf an hour later and proceeded to sea, anchoring for the night in Tribune Bay. Getting under way at 3:30 the following morning, we passed Seymour Narrows at 8:35, just as the tide was beginning to ebb, which caused strong eddies and whirls, but the passage was made without difficulty.

We learned in Departure Bay that clams were plentiful at Alert Bay, where they had been canned extensively; so, wishing to procure some for bait, we called there, but learned that they could be had more plentifully at Fort Rupert. We then went to the last-named place, where we anchored at 6:55 p. m. A large party was sent out in the morning at low tide, and gathered about 4 barrels, two species being represented, *Schizothærus nuttalli*, and the small round clam, *Saxidomus nuttalli*, both excellent for table use. About half of them were "shucked" and salted for bait, a bushel or more were placed in the cold room at a temperature of 40°, and the remainder packed in barrels, through which sea water was pumped at intervals.

We left Fort Rupert at 11:30 a. m. July 13, and, passing through the Goleta Channel, were in the open sea, well clear of the land, before dark. The passage was made under one boiler, with reduced grate surface, as the expenditure of coal was limited to 10 tons per day.

Gentle to moderate winds from SE., S., and SW., with much overcast, misty, and foggy weather, were encountered. At 6:15 a. m. on the 19th we sounded in 2,550 fathoms brown ooze, latitude 52° 15' 00" N., longitude 156° 37' 00" W. This was the first of a series of soundings extending N. 88° W., 390 miles, and made to further develop a remarkable submarine depression, discovered by the U. S. S. *Tuscarora*, to the southward of the Aleutian Islands. The soundings of that vessel revealed a depression simply, but geologists predicted the existence of a submarine trough running parallel to the islands, and extending probably their whole length, to the *Tuscarora's* sounding of 4,037 fathoms off Attu. The *Albatross* soundings, supplementing those of Captain Belknap, developed this predicted trough to the extent of 400 miles. The direction was S. 65° W. and N. 65° E., nearly parallel with the islands, the center being 60 miles from the Shumagins and 100 miles from the SW. extremity of Unalaska. It is about 30 miles in width, between the 3,000-fathom lines, with a maximum depth of 3,820 fathoms, in latitude 52° 20' 00" N., longitude 165° 00' 00" W. It is to be regretted that the *Albatross*, which is eminently fitted for the purpose,

was unable to pursue the explorations further, but our work called us in another direction.

Unalaska to the Shumagin Islands.—Having crossed the trough and reached the normal depth west of it, we ran a line to the island of Unalaska, in the vicinity of Kiliuliuk Bay, developed the contour of the slope, and located ourselves with reference to the land, which was visible at times during the afternoon, when the fog lifted for a moment. At 5:30 we sounded in 28 fathoms off the bay above mentioned, then stood off shore, sounding at intervals. Trial lines were put over at several stations inside of the 100-fathom line, cod (*Gadus morrhua*) being taken at every station, and halibut (*Hippoglossus vulgaris*) at most of them—good fish, but averaging smaller than on the Atlantic coast.

The direction of the offshore line was N. 60° E., with depths of 55, 58, 83, and 174 fathoms, the latter at 20 miles from the starting point and 16 miles from Cape Promiunce, the nearest land.

Having reached the 100-fathom line, we developed it for 95 miles in a northeasterly direction, to latitude 53° 42' 00" N., longitude 163° 58' 00" W., thence N. 22° E. 30 miles, sounding at intervals of 10 miles in 43, 45, and 45 fathoms, to a point S. 68° E., 34 miles from Seal Cape, passing 6 miles inside of a reported bank in 54° 00' 00" N. and 163° 33' 00" W. We intended to pass over the position, and supposed we had done so until our work was verified by a subsequent landfall. Later soundings seemed to indicate its location about 18 miles to the northward and eastward, where we found 25 fathoms. Trial lines were put over at station 1166 in 45 fathoms, fine gray sand, cod and halibut taking the bait freely.

Turning in shore we ran a line N. 75° W. 60 miles to a point S. 57° W., 8 miles from northwest Cape of Unimak, the northern entrance, to a pass of that name. The depth increased to 56 fathoms, 9 miles to the eastward of Seal Cape; 30 fathoms were found off Scotch Cap, and 80 fathoms at the end of the line.

We took our departure from the land off Kiliuliuk Bay at 6 p. m. July 21, and passed Scotch Cap at 3:43 a. m. on the 23d. As we had been enveloped in a dense fog during that time, our intermediate positions depended upon dead reckoning, but the greatest error did not probably exceed 4 miles.

A line was run from the above position S. 70° W. 23 miles, passing within 3 miles of the north head of Akuu, at which distance it was sighted. The fog became lighter as we approached the islands, and after passing the head it was comparatively clear. The volcano of Akutan, 3,332 feet in height, became prominent as we approached the island of that name, although the summit was enveloped in fog. The whole visible portion of the island was covered with a luxuriant growth of grass, which could be seen surrounding great patches of snow still remaining in the gorges at an elevation of 1,000 feet or more, but there was not a tree of any kind to be seen. Two hauls of the

trawl were made off the northern extremity of Akutan in 72 and 86 fathoms, a great variety of specimens being taken. We then laid a course for Cape Cheerful, about S. 55° W., 24 miles distant. It was not visible until we were nearly up with Kalekhta Point, when it came out of the fog with such remarkable distinctness that it appeared close at hand in comparison with Kalekhta, not one-third the distance from us, but just visible through the mist. Appearances were so deceptive that it was only after cross bearings had been taken that we could convince ourselves that we were not several miles out of position.

Priest Rock, near Kalekhta Point, is nearly as high as the point itself, is very conspicuous and an unmistakable landmark when open of the point, but in approaching from the northward it does not begin to open until it bears about S. 67° E. Needle Rock, lying off the NW. extremity of Amaknak Island, near Ulakhta Head, is a small pinnacle which has been mistaken for Priest Rock when the latter was obscured by fog or mist, and has led vessels to the westward of the island into Captain's Bay instead of Iliuliuk, the port to which they were bound.

It may be said that cross bearings would make such a mistake impossible, but it too often happens in this region that anchorage must be made on a momentary view of one point only. Priest Rock once recognized there should be little difficulty in reaching Ulalashka, as a direct course leads to the outer harbor.

We anchored in the inner harbor of Iliuliuk at 3:15 p. m., entering without the least difficulty, the channel having been buoyed by the Alaska Commercial Company. The steamer *St. Paul*, belonging to the company, was at the wharf, preparing for a trip to the Seal Islands, and at the mooring buoy was the schooner *Angel Dolly*, with a cargo of walrus hides which she took in Moller Bay. I called upon the company's agent, Mr. Rudolph Neumann, immediately after we anchored, and ascertained that provision had been made to supply us with 100 tons of coal, which insured a fair season's work at least.

We have used Baird's bronze reel on the Sigsbee deep-sea sounding machine during the past year with great satisfaction, and every confidence in its ability to resist the crushing strains likely to be brought upon it by the exigencies of the service. We took some deep casts en route to the Pacific, and on one occasion reeled back a 60-pound sinker from a depth of over 2,000 fathoms, without its showing the slightest indication of weakness. On our arrival in San Francisco it was carefully calipered and found to be true, but after taking a sounding of 3,820 fathoms, on the evening of July 20, slack turns were detected and it was observed to be out of true, so much so, in fact, that we found it necessary to condemn it and to transfer the wire, such as was not spoiled by kinking, to a spare steel reel which we had in reserve.

The *St. Paul* left the wharf at 2:30 p. m. July 25, the *Albatross* taking her place an hour later. We commenced coaling the following morning and finished at 4:30 p. m. July 27, having taken on board

113 $\frac{2}{2}$ $\frac{171}{40}$ tons, for which we receipted to the agent of the Alaska Commercial Company.

The naturalists were actively employed during our stay in port, adding materially to the collection of fishes and invertebrates. Attention was given to the birds of the island, and botanical collections were also made. Fog and rain prevailed, with intervals of partially clear, pleasant weather during our stay in port.

We left Iliuliuk at 9 a. m. July 28, after several hours' detention by a dense fog, which, however, had begun to lift at intervals, enabling us to see land at a distance of half a mile. Rounding Kalekhta Point, we stood for the southwest extremity of Unalga Island, and through the pass of that name, which is to be preferred to all others for a steamer bound to or from Unalaska, particularly in thick weather. The distance through is short and there are no hidden dangers, the rocks lining the shore on either side being close to the land and above water. The tide rushes through the Narrows with great force, causing heavy rips and at times overfalls, but it was quite smooth when we passed out, near high water. A vessel bound in would make the Signals, Egg Island, and the Old Man, lying off Cape Burka, all of which can be approached with comparative safety, the distance from the latter to the southeast extremity of Unalga Island not exceeding 4 miles. Once in the pass, a vessel has only to keep Unalga in sight until passing its southwest end, when it is but 2 miles to Erskine Point and about 3 $\frac{1}{2}$ miles to Kalekhta Point.

There is a rock off Erskine Point, which in thick weather might be mistaken for Priest Rock, but it may be recognized by another one between it and the point, having a flat top and showing smallest at the base. In approaching Kalekhta Point Priest Rock will begin to open out at WSW. $\frac{1}{4}$ W. (magnetic).

A full-powered steamer may use this pass at any stage of the tide, if time is an object, but under ordinary circumstances it would be advisable to enter it near slack water. It is not intended to include sailing directions for the Aleutian Islands in this report, and my only excuse for describing this pass so much in detail is that there is no published information concerning it, so far as I know, and it would naturally be avoided by a stranger unless he had some such information as I have given.

We found 30 fathoms at the southern entrance of the pass, in mid channel, and 36 fathoms 2 miles north of Old Man Island. The weather partially cleared as we entered the Pacific, enabling us to locate our stations by bearings of land during the afternoon.

A line of soundings S. 88° E., 36 miles, was run from the above position, the depth increasing to 57 fathoms. The trawl was lowered at the second and fourth stations: No. 2843, 45 fathoms, black sand, stones, and pebbles, and No. 2844, in 54 fathoms, gray sand. A large number and great variety of specimens were taken, showing a rich fauna and

live bottom. Trial lines were put over at the last station, taking halibut and cod, the former being more plentiful.

We then ran N. 56° E., 10 miles, and sounded in 59 fathoms, intending to take a departure for an offshore line, but the fog having shut in we anchored until 9 p. m., when it lifted for a moment and we found that Sea Lion Island bore N. 11° E. From this point we ran a line S. 75° E., 45 miles, sounding at intervals of about 10 miles, with 61 fathoms at the first station, then 43 fathoms, and at the end of the line, 7 miles further, 342 fathoms. We ran N. 11° E., 11 miles, and sounded in 62 fathoms, thence N. 75° W., 44 miles, to a point S. 75° E. from the north-east end of Ugomok, where we located the end of the line by cross-bearings.

The trawl was lowered at No. 2845 in 42 fathoms, coarse black sand, about 27 miles from Ugomok, developing a rich fauna, and the trial lines being put over cod were found abundantly. A comparison of this line with those north and south of it shows a less depth than previously found near shore, which seems to indicate a deposit along the line from the swift current of Unimak Pass. We found 71 fathoms in mid channel at the eastern entrance of the pass, and 63 fathoms S. 26° E., $1\frac{1}{2}$ miles from Promontory Cape, from which point a line was run S. 80° E., 39 miles, the depth increasing to 72 fathoms, 25 miles from land, and shoaling to 33 fathoms at the end of the line. A line S. 25° W., 15 miles, showed a least depth of 25 fathoms 3 miles from the starting point, and 44 at the end. We then stood S. 85° E., in depths between 41 and 44 fathoms, and at 7 a. m., July 30, cast the trawl in the latter depth, fine gray sand, No. 2846, making a successful haul. The trial lines were put over and both cod and halibut taken.

We were under low speed during the night and early morning, waiting daylight, to approach reported dangers, the first, Lenard Rock, in latitude $54^{\circ} 00' 00''$ N., longitude $163^{\circ} 12' 00''$ W., and Anderson Rock, $54^{\circ} 00' 60''$ N., $162^{\circ} 47' 00''$ W., the latter showing above water. We intended passing over the positions given, and supposed we had done so until several hours later, when we found that we were about 12 miles N. 57° E. out of our reckoning. The low speed at which we ran all night, and the prevalence of a moderate southerly breeze, probably accounts for the unusual effect of current on our positions. At 7:45 a. m. we left the above station, and stood S. 7° E., 10 miles, finding bottom at 51 and 464 fathoms, the latter S. 52° E., 3 miles from the reported position of Anderson Rock. We saw no indication of shoal water, but that proves nothing, for we were enveloped in so dense a fog that we were unable to see more than one-quarter of a mile most of the time, and probably not to exceed one-half mile at any time while we were in the vicinity. The rock may be in or near the position assigned to it, but considering the influence of the current on our course from Promontory Cape, and the absence of any indication of shoal water in our last two soundings, it seems possible that the rock seen by Captain Anderson might have been one of the outer rocks on the Sannakh Reefs.

Leaving the region described we ran a line N. 48° E., 20 miles, sounding in 265, 60, and 47 fathoms, cod and halibut being taken at the last station, thence S. 50° E., $5\frac{1}{2}$ miles, with bottom at 62 fathoms, and N. 50° E., 18 miles, sounding in 51, 37, and 38 fathoms, rocky bottom being found at the last two stations. We then ran $10\frac{1}{2}$ miles N. 8° E., sounding in 80 and 82 fathoms, then N. 42° W., 3 miles, sounding in 56 fathoms, and finally S. 22° W., $6\frac{1}{2}$ miles, where we found 81 fathoms. The last three courses were run in the vain endeavor to make Caton Island, in order to verify our position, and it was not until the last sounding that we realized how much we had overrun our reckoning. We were in the channel between the Sannakh and the Saudman group, and furthermore our sounding of 38 fathoms was on the cod bank of the Coast Survey chart No. 806, in latitude $53^{\circ} 17' 00''$ N., longitude $161^{\circ} 55' 00''$ W. As the fog was still very dense and night approaching, we took our departure from the position and ran a line N. 58° E., 62 miles, to a point S. 35° E., 5 miles from Sea Lion Rocks, Shumagin Group, the depths ranging from 81 to 45 fathoms. A successful haul of the trawl was made at the above station, in 48 fathoms, fine gray sand, No. 2847, and cod were taken in 52 fathoms, fine gray sand, 8 miles S. 58° W. This line of soundings increased the known area of cod-fishing grounds in the region of the Shumagins, and while it did not define the extent of the banks, it was a hopeful indication of what further investigation may reveal. It will be particularly valuable from its position, partially protected by adjacent land, and its proximity to safe and commodious harbors. Another successful haul of the trawl was made 10 miles N. 13° E., in 110 fathoms, green mud, No. 2848.

The weather partially cleared as we approached the land, enabling us to locate the last two positions by bearings, but the fog shut in again while the trawl was down, restricting our line of vision to one-fourth mile or less. It was impracticable to work near the land in such weather, as the expenditure of coal in groping about searching for land to locate ourselves was greater than we could afford, to say nothing of the danger attending it. The fog had been almost constant since our arrival among the islands, but we were in daily expectation of a change, so we concluded to run into Humboldt Harbor to wait for it.

Shumagin Islands to Mitrofanina Bay.—Entering Popoff Strait we saw nothing until up within Barloff Bay, when the high and bold headland forming its southern shores emerged from the fog not more than 400 yards distant; thence to Egg Islands the course was clear, and after making them, the fog partially lifted ahead, Sand Point and Arch Rock being visible. Off the former was the fishing schooner *Arago*, from Bristol Bay, Bering Sea, with a fare of codfish bound into Humboldt Harbor. When up with Sand Point, the station of Lynde & Hough was seen, and at 12:34 p. m., July 31, we anchored off the wharf in 12 fathoms, the schooner anchoring near us.

Humboldt Harbor has been surveyed by the U. S. Coast and Geodetic

Survey (Chart No. 814). The holding ground is good, and it affords excellent protection from all winds. Messrs. Lynde & Hough, of San Francisco, have established a fishing and trading station on the north side of the bay, where they have all necessary appliances for salting salmon. There is a wharf at which ships' boats can land at any stage of the tide. Mr. O'Brien, the superintendent of the station, seemed much interested in the progress of our work, and the captain of the *Arago* gave us such information concerning the regions about the Shumagins and Sannakhs as he had gained by several years' fishing in their waters. His reasons for going to Bristol Bay were that the fish ran a little larger and the weather was much better, there being less fog and smoother water.

August came in with a dense fog which partially cleared towards noon, only to shut down thicker than ever for the remainder of the day. Our work, up to this time, was done without the services of a pilot, but it frequently resulted in the loss of time and expenditure of fuel, trying to recognize our landfalls through mist and fog where it was the exception to see more than a single point at a time, and that dimly, a condition of affairs requiring local knowledge. Fortunately Capt. Paul M. Pavloff, one of the best coast pilots in the Aleutians, arrived during the morning, and we lost no time in securing his services.

Preparations were made to get under way at 4 a. m. August 2, but the fog was so thick, and the rain pouring down so heavily, that we held on until 6:40, when the sun appearing through the mist enabled us to leave the harbor and steam through Popoff Strait. At 7:30 we cast the trawl in 69 fathoms, green mud, No. 2849, making a successful haul notwithstanding the rocky bottom, which tore the net badly. The fog settled again while the trawl was down, obscuring the land on every side, which, with the general aspect of the weather, was so unpromising that we thought it advisable to seek an anchorage. Steaming across the strait at 9:45 a. m. we anchored in Eagle Harbor. A vessel may anchor anywhere in the harbor in from 15 to 22 fathoms, and in the cove on the northern side she would find perfect protection from the sea, where she could haul out for repairs, fill her water casks, or gather driftwood on the beach. The south cove has a narrow tortuous entrance, too shoal for anything larger than a ship's boat at low water, but a vessel drawing 6 or 8 feet could be warped or towed in at high tide, and once inside would be as secure as in a dock.

The weather cleared toward midday, giving us the first distinct view of the Shumagins, among which we had been cruising. Being too late in the day to start on our contemplated line, we spent the afternoon in drying sails and various gear, sounding, setting a trawl line, and making general collections. Unfortunately the line was set on the bar at the mouth of the harbor in about 17 fathoms, mud. But the fact of taking cod and halibut under such unfavorable circumstances augurs well for the future success of the shore fisheries.

We were under way at 3:20 the following morning, and leaving the harbor steamed in the direction of Sea Lion Rocks until, at 4:55, we slowed the engines and swung ship under steam for compass errors, observing azimuths on every point. The evolution consumed an hour and fifteen minutes, after which we resumed our course.

At 6:35 we sounded, in 34 fathoms, broken shells, Sea Lion Rocks bearing N. 39° W., one-half mile. These rocks are about 100 feet high and can be safely approached within half a mile. They are the resort of sea lions and birds. From our position near the rocks we ran 9 miles N. 85° W., and sounded in 38 fathoms, then N. 60° W., 24 miles, sounding in 71 and 74 fathoms, the latter position being located by cross-bearings of the large and more important islands to the northward and westward. The weather was clear at this time, and we could see land at a great distance, particularly to the northward and westward, where the snow-capped peak of Pavloff's volcano was distinctly visible. Deer Island and most of the smaller islets and rocks of the Sandman group were in sight, and directly ahead of us was a small pinnacle-shaped island not more than 10 miles distant, far from its position on the chart. Changing the course a little, to bring it on the starboard bow, we steamed ahead a few miles, when breakers and, a moment later, rocks were reported on the port bow, still more out of position than the island.

At 11:34 we sounded in 31 fathoms, 7 miles S. 47° W. from the last station, then ran S. 26° W. 3.3 miles, and at 11:57 sounded in 43 fathoms, Low Rocks, bearing N. $66^{\circ} 30'$ W., distant 0.6 mile. Continuing on the same course we ran 0.6 mile to meridian, when we were in latitude $54^{\circ} 44' 00''$ N., longitude $161^{\circ} 27' 30''$ W. The latitude was by meridian altitude of the sun and the longitude by chronometer, forenoon observations, the position being entitled to the same credit usually accorded to sea observations. Another sounding was taken at 1:12 p. m. in 49 fathoms, S. 47° W., 10 miles from the last station. We then ran 20 miles S. 51° W., sounding in 75 and 63 fathoms. Hay Island was located by cross-bearings and found to be several miles out of place on the charts.

The following are the positions we assign to the rocks and islands mentioned above; based on cross-bearings and the noon position of the ship: Low Rocks, latitude $54^{\circ} 45' 00''$ N., longitude $161^{\circ} 28' 00''$ W.; Pinnacle Island, latitude $54^{\circ} 45' 00''$ N., longitude $161^{\circ} 35' 00''$ W.; Hay Island, latitude $54^{\circ} 39' 00''$ N., longitude $161^{\circ} 53' 30''$ W.

A dense fog set in at 3 p. m., again obscuring the land, making it impossible to sight the Saunakhs, and, as there was no immediate prospect of improvement of the weather, we stood off shore, S. 70° E., 6 miles, and sounded in 34 fathoms. The trial lines being put over, halibut and cod were taken. The sounding was on the NW. extremity of the cod bank before mentioned.

We then ran 10 miles S. 49° W., sounding in 30 and 40 fathoms, the depth increasing to 435 fathoms 11 miles S. 25° E., which showed an

abrupt termination of the bank in that direction. A line was then run N. 49° E. 16 miles, with 52, 50, and 44 fathoms, then N. 64° E. 76 miles, a depth of 42 fathoms being found 4 miles from the last station, increasing irregularly to 72 fathoms about midway between the Sannakhs and the Shumagins, then shoaling to 21 fathoms, broken shells, at the end of the line, 2 miles N. 34° W. from the center of Bird Island, No. 2850, where the trawl and trial lines were put over. A successful haul was made with the former, but, for the first time since our arrival among the Aleutian Islands, we failed to take fish of any kind with the hand lines.

Another successful haul was made in 35 fathoms, gray sand, broken shells, No. 2851, 4 miles N. 48° W. from the last station, and, running 3½ miles N. 40° W., the trial lines were put over in 25 fathoms, gray sand, two sculpins only being taken. The station was midway between the Twins and Near Island. A depth of 27 fathoms was found 3 miles N. 22° E. from the last station; then running S. 78° E. 5 miles, we found 26 fathoms; thence N. 40° E. 4 miles, to 37 fathoms, gray sand and broken shells, when the trial lines were again put over and one halibut taken.

Our experience during the day demonstrated the absence of cod in August in a region in which they are found in great numbers at other seasons of the year; in fact, it is one of the favorite fishing grounds during the winter.

The last station was at the southern entrance of the strait between Spectacle and Big Koniushi Islands. After steaming through an apparently clear passage we found 57 fathoms in midchannel, abreast of the north end of Spectacle Island, N. 20° E., 4 miles from the last station, and 39 fathoms 4 miles N. 10° W., the north end of Peninsula Island bearing N. 80° E. 1½ miles. A successful haul of the trawl was made 5¾ miles N. 20° E. from the last station in 58 fathoms, black sand, Cape Thompson bearing S. 76° E., 5 miles. We then steamed through the passage between the latter cape and Castle Rock, sounding in 23 fathoms about midchannel; then following along the east side of Big Koniushi, we anchored in Yukon Harbor at 6:50 p. m.

Several inaccuracies were observed in the U. S. Coast and Geodetic Survey Chart No. 816, and among the more important may be mentioned the following:

(1) Spectacle Island is about 3 miles in length, high and rounded at both ends and connected by a narrow strip of low land near the center. A deep bight on the east side and a prominent point projecting to the westward give it the general form of a pair of spectacles, from which it derives its name.

(2) Peninsula Island is placed N. 35° E. about 2½ miles from its correct position. It lies directly midchannel of the strait, and is, in fact, the projection shown on the west side of Big Koniushi. A low spit makes off from the east side of the former, but there is a passage between the two islands.

(3) The bays on Big Koniushi, north end, south of Peninsula Island, are much deeper than shown on the chart.

Fog prevailed throughout the night, but cleared as we approached the island in the morning, enabling us to see land at a great distance during the day. A spirited sight was presented to us as we approached Yukon harbor, the surface of the water being literally covered with myriads of kanooskies and crested auks; large flocks of the active little birds filled the air; their flight was exceedingly rapid and erratic, the flocks in the distance reminding one of a dense black cloud within the influence of a tornado.

We left our beautiful little harbor at 3:34 on the morning of August 5, with partially clear pleasant weather, and starting from a point S. 68° E. from Atkins Island, in 27 fathoms, ran a line offshore in the same direction for 25 miles, with depths between 40 and 50 fathoms at the end of the line. A bank of small extent, having from 25 to 30 fathoms, was reported on this line 20 miles from Atkins Island, but we failed to find it.

We ran 5 miles S. 22° W. and sounded in 56 fathoms, then turned inshore N. 68° W. for 25 miles, sounding at equal intervals in 46, 45, 41, 45, and 35 fathoms, the latter 4 miles S. 70° E. from the N.E. extremity of Simeonoff Island. We then ran 5 miles S. 22° W., sounding in 38 and 35 fathoms; S. 68° E., 15 miles, in 57, 44, 47, 49, and 55 fathoms; S. 22° W., 10 miles, in 99 fathoms; N. 68° W., 20 miles, in 69, 56, 46, 41, and 35 fathoms; and S. 75° W., 3½ miles, in 35 fathoms; S. 22° E. 4 miles from the south end of Chernabura Island.

We next turned offshore and ran a line S. 28° E., 15 miles, with 43 fathoms at 5 miles and 115 fathoms at the end of the line; N. 81° W., 14 miles, with 105 fathoms; N. 3° E., 15 miles, with 49 fathoms at 10 miles and 42 fathoms at the end of the line; N. 75° W., 5 miles, with 44 fathoms; and S. 29° W., 19 miles, with 49 fathoms at 5 miles, 67 fathoms at 20 miles, and 119 fathoms at the end of the line.

Trial lines were put over in 35 fathoms, 4 miles S. 22° E. from Chernabura Island, and several cod and halibut were taken. This was the only trial during the day, as we wished to utilize the clear weather to locate stations by bearings of the land. Our soundings during the morning did not extend to the 100-fathom line, but terminated within sight of land, where bearings supplemented the ordinary observations, enabling us to attain a greater degree of accuracy than usual in this region.

The 6th was cloudy, but the atmosphere was clear, the Shumagins being visible nearly all day, so that we frequently verified our positions by bearings. Having completed our examination inshore, we ran N. 75° E. 50 miles and sounded in 53 fathoms; then, in order to develop the 100-fathom line offshore from our work of the previous day, we ran N. 80° E. 10 miles, sounding in 57 and 86 fathoms; N. 29° E., 5½ miles, in 110 fathoms; N. 51° W., 6½ miles, in 87 fathoms; and N., 11 miles, in 90 and 114 fathoms.

Turning inshore, we ran a line N. 67° W., 30 miles, sounding in 87, 79, 50, 47, 53, and 58 fathoms at the end of the line, S. 78° E., distant 6 miles from Cape Thompson. Hydrographic Office Chart No. 68 gives 40 fathoms in latitude $54^{\circ} 36' 00''$ N., longitude $158^{\circ} 25' 00''$ W., where we found 86 fathoms.

The general aspect of the Shumagins is mountainous, with numerous streams rushing down the mountain sides, often forming cascades of great beauty. Copious rains and a humid atmosphere favor the rank growth of grass, ferns, flowers, etc., which cover the islands during the summer months, and give the impression of great fertility when viewed from a distance. There is no timber on the islands larger than alder bushes, but the beaches are lined with driftwood in sufficient quantities to supply the probable demand for many years. There are but few outlying dangers, and as a rule the shores can be approached within half a mile or less with safety. There are many secure harbors in the group, and vessels can find anchorage almost anywhere near the land in 10 to 20 fathoms. The region off Simeonoff is an exception, however, and should be navigated with great caution, as there is foul ground surrounding the island.

We ran N. 6° W., 5 miles from the last station, and sounded in 102 fathoms, Castle Rock bearing S. 78° W., distant 5 miles; thence N. 84° E., sounding at intervals of 10 miles in 103, 97, 80, 68, 56, and 46 fathoms. Forty-seven fathoms was found 5 miles farther in the same direction, in latitude $55^{\circ} 25' 00''$ N., longitude $157^{\circ} 28' 00''$ W., 65 miles from the point of departure, and about 19 miles to the southward of Light House Rocks, to which the bank undoubtedly extends. Increased depths on the above line indicate a marked depression between the Shumagins and the mainland, the extent of which can only be determined by further investigations.

Turning inshore we ran N. 66° W., 25 miles, then N. 45° W., 27 miles, sounding at about 10-mile intervals in 53, 73, 73, 64, and 68 fathoms, the last station being in latitude $55^{\circ} 54' 00''$ N., longitude $158^{\circ} 40' 00''$ W. The mainland was sighted soon after daylight, and Mitrofanía Island at 8 a. m., but we failed to recognize the latter for several hours owing to fog banks which hung over the land. We were up with the island at 1:30 p. m., August 7, and leaving it on the port hand steamed into the bay of the same name, anchoring off Long Beach at 2:48 p. m. in 15 fathoms, latitude $55^{\circ} 58' 00''$ N., longitude $158^{\circ} 47' 00''$ W. (approximate.).

Mitrofanía Bay to Old Harbor, Kadiak.—Our anchorage was near the SW. extremity of a steep black sand beach which lies back of the bay, and extends in crescent form about 3 miles NE. and SW. This beach is flanked on the eastern end by a nearly vertical cliff 600 or 800 feet in height, made conspicuous by many strata of different-colored rocks, and on its western extremity by a precipitous mountain covered with a dense growth of alder bushes. An isolated rock lies near the base of

the mountain about 300 yards back of the beach, nearly rectangular in form, the sides being vertical, about 100 feet broad by 60 feet in height, and the top slightly rounded and covered with grass, ferns, and small bushes. Seen from a distance it had the appearance of a huge native sod house (barabara), with the roof overgrown with grass. An extensive valley lay back of the beach, in which were several ponds of fresh or brackish water, their shores being surrounded by a fringe of alder bushes. The land was covered by a rank growth of grass and wild flowers.

Long Beach is a good anchorage, except with winds from S. to SE., when a heavy swell rolls in. Better harbors are found on the east side of the bay. To make this anchorage, leave Mitrofanía and the small islands on the port hand, passing midway between them and the mainland until well up with the sand beach, then stand to the westward and anchor off the rock above mentioned, giving due attention to the lead, as the bank is steep.

The collectors went on shore as soon as the anchor was down, returning in the evening with several species of birds, fishes, plants, etc. Trout were plentiful in the larger ponds, and cod and halibut were taken with hand lines from the ship.

A dense fog prevailed on the morning of the 8th, which detained us until 5:25, when, partially clearing, we were able to get under way and steam out of the bay. We took a departure at 6:12 from the following bearings: NW. extremity of Mitrofanía Islands, S. 72° W.; east extremity, S. 6° W.; outer point on mainland, N. 14° E.; which, plotted on Hydrographic Office Chart No. 68, placed us in latitude $55^{\circ} 53' 00''$ N., and longitude $158^{\circ} 37' 00''$ W. We then ran a line of soundings about S. 77° E., 43 miles, to Light House Rocks, and at 12:30 p. m. anchored in 49 fathoms, 890 yards N. 28° E. from the largest.

The group consists of several detached rocks ranging from 90 feet in height and 500 feet in length, to 10 feet in height, with two or three nearly awash, over which the sea was breaking. They are about 500 yards in extent, and can be approached within half a mile with safety. No two charts agree as to their location, giving it from latitude $55^{\circ} 44' 00''$ to $55^{\circ} 45' 00''$ N., longitude $157^{\circ} 25' 00''$ to $157^{\circ} 30' 00''$ W. It was our intention to verify their position, but a dense fog, which settled down soon after we left the mainland, prevented. Our run placed them in $55^{\circ} 43' 00''$ N., and $157^{\circ} 20' 00''$ W., but was not sufficiently reliable to justify us in changing their position on the chart. Latitude $55^{\circ} 44' 00''$ N. and longitude $157^{\circ} 25' 00''$ W. is about the mean, and not far from correct.

They are entirely barren of vegetation, but harbor an extensive rookery of sea lions, which covered nearly the whole surface of the rocks. Sea birds were nestling among the cliffs, and the naturalists collected several specimens with their eggs and young. They also brought off the skin of a large sea lion, 13 feet in length, which was preserved in salt. The hand lines were put over, but no fish were taken, the sea lions having driven them away from the vicinity. We left the rocks

at 4:12 p. m. and ran a line of soundings S. 79° E., 33 miles, in 49, 48, 49, 50, 55, and 135 fathoms; N. 31° E., 24 miles, in 137 and 119 fathoms, the latter being midway between the Semidi and Chirikof Islands. A line was then run S. 36° E., 29 miles, sounding in 89, 60, and 96 fathoms, and N. 23° E., 20 miles, in 57, 26, and 27 fathoms, terminating 6 miles S. 22° E. from the north end of Chirikof Island. Trial lines were put over and codfish taken in abundance. We reached the island early on the morning of the 9th after a night of dense fog, which lifted sufficiently to allow us to locate the last station by bearings.

Leaving the island, a line was run S. 34° E., 12 miles, sounding in 76 and 287 fathoms; N. 28° E., 32 miles, in 89, 81, 76, 60, and 37 fathoms, terminating S. 17 miles from the S. end of Tugidak Island. Trial lines were put over, resulting in the capture of 47 codfish in a few minutes, the ship drifting rapidly in the meantime. A line was then run S. 50° E., 13 miles, sounding in 61, 66, and 159 fathoms gray sand, where a successful haul of the trawl was made. Then turning inshore we ran a line N. 14° E., 29 miles, in 75, 54, and 28 fathoms, terminating 4 miles S. 14° W. from Sikhinak Island.

The fog lifted as we approached the land, giving us a very good view of the Trinity Islands. Tugidak and the western portion of Sithinak Islands are low and apparently marshy, while the eastern portion of the latter is higher. They are surrounded by foul ground, and in the absence of proper surveys should be approached with caution.

Leaving the islands, we ran a line S. 56° E., 30 miles, sounding in 23, 52, 46, 52, and 88 fathoms; N. 19° W., 23 miles, sounding at 10 miles in 36 fathoms, followed by 45 and 73 fathoms; then N. 74° E., 38 miles, sounding at intervals of about 5 miles in 53, 58, 49, 44, 51, 49, and 37 fathoms. Trial lines were put over at the last station and several halibut taken. Turning inshore a line was run N. 62° W., 28 miles, sounding in 61, 37, and 60 fathoms, No. 2854, where a successful haul of the trawl was made. Continuing the same course 4 miles we found a depth of 18 fathoms $3\frac{1}{2}$ miles S. 21° E. from Black Point, the south end of Sitkaldak Island. A successful haul of the trawl, No. 2855, was made at the entrance to Kiyavak Bay in 69 fathoms, 5 miles N. 62° W. from the last station. Two soundings were subsequently taken at 5-mile intervals on a north course, in 68 and 57 fathoms, the latter off the entrance to the Bay of Three Saints.

Old Harbor to St. Paul, Kodiak.—At 2:05 p. m., August 10, we anchored in 7 fathoms in Old Harbor, latitude $57^{\circ} 11' 00''$ N., longitude $153^{\circ} 13' 00''$ W., off an Indian village called by the natives Three Saints. It lies about 4 miles to the northward of the bay of Three Saints, the beautiful harbor of Lisiansky Bay intervening.

The country surrounding Old Harbor is mountainous, with a narrow belt of comparatively level land, on which the village stands near the water. It is covered with a luxuriant growth of grass and flowers during summer. Alder bushes grow to greater size than on the islands

farther to the westward, and in the sheltered valleys the poplar is found of sufficient size to make it valuable to the natives in building their houses and for other purposes. The rugged mountain range, sometimes called the backbone of Kadiak, was in sight, and the great gorges, still filled with snow and ice, lent an Arctic hue to the otherwise summer aspect.

To enter Kiyavak Bay, make Two Headed Island (miscalled Two Headed Cape, C. S. Chart No. 702), which has two irregularly rounded peaks and is easily recognized. Leave it on the port hand, and, if the weather is clear, Black Point will be seen, showing darker than its surroundings. There is a small islet, about 200 yards in prolongation of this point, and one-fourth of a mile farther on is a rock, just above water, which marks the outer end of a ledge extending from the point. Having passed this rock, a mid-channel course around the second prominent point, on the starboard hand, leads to the strait, where Old Harbor is located, and off which lies the Bay of Three Saints and Lisiansky Bay. There is bold water in the strait, which is free from hidden dangers, except near the land. Passing Old Harbor there is a narrow tortuous channel into Sitkalidak Strait, through which small vessels have passed, but a stranger should not attempt it with a vessel drawing more than 8 feet.

We were surprised by the shrill whistle of a steam launch a little after dark, which soon came alongside with Mr. Ivan Petroff on board. He is manager of the Alaska Coast Fishery Company station at Port Hobron, some 10 or 12 miles to the northward and eastward of Old Harbor. An Indian messenger reported the *Albatross's* arrival, and he lost no time in paying us a visit. His launch required some small repairs, for which we furnished materials.

I visited the station on the following day and found it located in a snug little harbor on the north side of Sitkalidak Island, the second deep bay coming from seaward. The quarters, mess room, store and kitchen are under one roof, and the curing house is at the water's edge, where boats or barges can load and discharge at half tide. It is supplied with running water from a mountain stream, and everything was scrupulously clean and well arranged. A cooper shop, stable, and storehouse are conveniently located, and in the harbor were several dories, barges, and a fine schooner, in addition to the steam launch already mentioned. This is the first season the station has been in operation, and they have thus far confined themselves to taking and salting salmon, but they intend starting a cannery eventually. The fish are mostly caught in a lake a mile from the bay, opposite the station, and transported over a horse railway to the beach, where they are transferred to barges or dories which deliver them at the curing house. Our visit occurred between the runs of salmon, and we found the entire force, except the coopers, engaged in cutting and curing hay for the horses used at the station. The location seems to be well chosen, not only for salmon fishing but for cod and halibut.

A dense fog prevailed on the morning of the 12th, detaining us until 2 p. m., when it partially cleared and we steamed out of Kiyavak Bay. Taking a departure from a point 5 miles N. 72° E., from the center of Two Headed Island, in 71 fathoms, we ran a line S. 48° E., 46 miles, sounding in 111, 60, 46, 38, and 347 fathoms, and N. 38° E., 22 miles, in 173 and 29 fathoms. Then, to ascertain the distance our newly discovered bank extended off shore, we ran S. 67° E., 10 miles, sounding in 60 and 296 fathoms, and N. 38° E., 12 miles, where we found a depth of 495 fathoms, which indicated that we were outside of the bank.

Lines were run N. 41° W., 44 miles, sounding in 58, 49, 44, 86, and 53 fathoms, the latter station being 4 miles S. 32° E. from the extreme point of Dangerous Cape, then S. 45° E., 11 miles, in 39 and 25 fathoms, where we anchored at meridian, August 13, to wait the lifting of a dense fog, which obscured everything more than a ship's length from us.

Cod and halibut were taken with hand lines in great abundance at the anchorage as well as at the previous station in 39 fathoms. The weather cleared partially half an hour after we anchored, and Ugak Island was found to bear N. 44° E., distant 4 miles. We got under way at 12:53 p. m. and ran a line S. 35° E., 35 miles, sounding in 45, 43, 46, and 90 fathoms, a notable feature being the absence of the depression between the bank and shore line of Kadiak, which we found farther south.

From the end of the line we ran N. 41° E., 15 miles, sounding in 75 fathoms, and N. 53° W., 35 miles, sounding in 71, 31, 57, and 81 fathoms, the last position being S. 60° E., 5 miles from Cape Greville, which, with Ugak Island, enabled us to locate our last positions by cross bearings. It was partially clear during the evening, although fog banks hung over the land, the more prominent points only being visible. It was very thick inside of Cape Greville, so we hove to from midnight until 3:27 a. m., August 14, when we steamed toward the Cape, and making the rocks lying off it, we ran WNW. (mag.) for Long Island, which has a bold, clear shore, much safer to make in thick weather than the Outer Humpback.

The fog lifted, however, before we reached the rock, and steering for it we passed within half a mile; then stood over for the south end of Popoff Island until we were in midchannel; thence for the usual anchorage off the astronomical station, St. Paul, where we anchored at 6:15 a. m., in 13 fathoms.

Directions for entering St. Paul.—In coming from the southward make Ugak Island, then Cape Greville (known locally as Chiniak Point). The east or seaward side being free from dangers, can be approached with safety, but a ledge of rocks which makes off to the northward must be left on the port hand. The rocks are above water, and being prominent should be cleared without difficulty if the cape has been sighted, and no vessel would attempt to pass inside without seeing it. The lead should be used in thick weather, as the outer limit of Portlock Bank is well defined, and from 35 to 40 miles distant.

Having cleared the rocks off the cape, stand WNW. (magnetic) for Long Island, which will carry a vessel about three-quarters of a mile outside of the Outer Humpback. If it is not seen, the island will be the next land-fall, and can be approached with comparative safety. Outer Humpback should be seen if the weather is suitable for a stranger to make the harbor, in which case pass within one-quarter to one-half mile, leaving it on the port hand, and steer W. $\frac{1}{2}$ N. (mag.) for the south end of Popoff Island. When the passage between Wooded Island and Long Island is shut in, steer N. by W. $\frac{1}{2}$ W. (mag.) for the channel, passing 100 yards from the point of Wooded Island, off the settlement; continue the course until the storehouse on the wharf at St. Paul opens out, then stand in for the anchorage off the astronomical station (C. and G. S. Chart No. 776), anchoring in about 13 fathoms. The Wooded Island side of the channel should be favored to avoid a reef on the west side, and the course continued to clear a rock about one-eighth mile off the north end of Holiday Island, which is not shown on the chart.

To enter the inner harbor keep the crib, lying just off the end of the wharf about 50 feet from Near Island, open until nearly up with it, sailing as close as practicable until inside of the reef, and then steer for the wharf. A vessel should enter with the tide running a little flood, which sets to the northward. The channel is very narrow, and a stranger should not attempt it without a pilot. It is high water at the wharf, full and change, at 1:00 hour.

I called on Mr. M. L. Washburn, agent of the Alaska Commercial Company, soon after we anchored, and he assured me that he would be pleased to do anything in his power to forward our work. He informed me that provision had been made to supply us with 100 tons of coal, and delivered a large mail with dates to August 1. The company's steamer *Bertha* arrived on the 17th and left for San Francisco at 1 p. m. the following day, carrying our mail. The *Kartuk* came in at 1:30, and at 3 p. m. the *Albatross* entered the inner harbor and moored to the wharf. We commenced coaling at 5:30 on the morning of the 20th, and finished at meridian the following day, having taken on board 100 tons.

We left the wharf 2 hours later, steamed to the outer harbor, landed our pilot on Wooded Island, and proceeded to sea. At 3:24 p. m. we sounded in 69 fathoms, S. 36° W., $1\frac{1}{2}$ miles from the south end of Long Island, and at 3:50 in 17 fathoms, N. 24° E., 0.4 mile from the Outer Humpback.

Kadiak to Middleton Island.—The development of Portlock Bank was then commenced by running the following lines of soundings: N. 53° E., 15 miles, in 28, 37, and 47 fathoms; S. 51° E., 50 miles, in 30, 33, 35, 38, and 42 fathoms, at intervals of 5 miles; 48 and 57 fathoms at 10 miles intervals, and 72 fathoms at the end of the line. It was completed a little after midnight, and, the weather being favorable, we located our positions with accuracy. The 22d was partially cloudy, with light variable winds and smooth sea, admirable weather for our

work. We ran a line N. 67° E., 17 miles, sounding in 200 fathoms; then N. 5° W., 63 miles, in 59, 51, 43, 40, 36, and 78 fathoms, at intervals of about 10 miles, and 68 fathoms, No. 2856, 5 miles further, at the end of the line, where a successful haul of the trawl was made. The station was occupied at noon; the latitude was obtained by meridian altitude of the sun, the longitude by chronometer, and both verified by bearings of the land, all of which showed Marmot Island to be improperly placed on the Coast and Geodetic Survey Chart No. 702, in accordance with which its nearest point would be 9 miles distant, yet we could see the surf breaking on the beach not more than 5 miles away.

It will be observed that the last two lines vary in depth from soundings shown on the chart, and seem to indicate the extension of Portlock Bank to Cape Greville without the intervening depression so generally found in this region near the land. Trial lines were used at Station 1521 in 36 fathoms, where cod and halibut were taken, the former in great abundance.

Starting soon after noon, a line was run N. 45° E., 18 miles, sounding in 41 and 60 fathoms; then S. 52° E., 61 miles, sounding at intervals of 10 miles in 56, 61, 102, 114, 113, and 140 fathoms off the eastern extremity of the bank. A successful haul of the trawl was made at Station No. 2857 in 51 fathoms, gray sand and black specks. Codfish and flounders were taken with the hand lines. The afternoon being clear and the sea smooth, we availed ourselves of the unusually favorable opportunity to swing ship for compass errors.

From the end of the last line we ran N. 45° E., 18 miles, sounding in 119 and 166 fathoms; then N. 55° W., 65 miles, in 112, 128, 69, 37, 37, 50, 99, and 99 fathoms. Trial lines were used at Station No. 1436 in 37 fathoms, and several codfish taken. The line was completed about 2 p. m., August 23, when we ran N. 27° E., 19 miles, sounding in 76 and 97 fathoms. The Chugatz Islands, Point Gore, and the Pye Islands were in sight during the afternoon, and cross bearings were taken frequently to verify our positions. Many snow-capped mountains were visible on the mainland, and in Nuka Bay an immense glacier extended apparently to the water's edge.

From the last station a line was run S. 51° E., 98 miles, sounding in 84, 105, 69, 67, 84, 90, 84, 77, 98, and 507 fathoms; N. 56° E., 10 miles, in 594 fathoms; N. 3° W., 10 miles, in 761 fathoms; and N. 53° W., 10 miles, in 230 fathoms, where at 11:38 a. m., August 24, we made a successful haul of the trawl, No. 2858. As soon as the haul was completed, we ran a line N. 38° W., 47 miles, sounding at intervals of about 9 miles, in 71, 66, 71, 103, and 122 fathoms; S. 56° E., 62 miles, in 118 fathoms at 17 miles, and 99, 106, and 902 at equal intervals to the end of the line. We then ran N. 20 miles, sounding in 358 and 151 fathoms; S. 62° E., 10 miles, in 301 fathoms; N. 25 miles in 537, 78, and 161 fathoms; N. 78° E., 9 miles, in 308 fathoms; and N. 63° E., 30 miles, in 252, 109, and 92 fathoms.

Middleton Island.—Middleton Island was sighted at 2:08 p. m., bearing S. 88° E. I determined to locate it if our clear weather continued through the following day. With this object in view we ran 9 miles N. 80° E., and sounded in 43 fathoms; N. 57° E., 5 miles, in 11 fathoms, and then anchored about a mile to the northward, in 12 fathoms, near the point indicated on the Coast Survey chart, the north end of the island bearing N. 52° E., and the south end S. 27° W. We were off the outer limit of kelp, which seemed to extend the whole length of the island, from $\frac{1}{2}$ mile to $1\frac{1}{2}$ miles from the beach. We were on the weather shore, where a moderate NW. wind and strong tide caused a heavy surf, so we deferred landing until the following morning. The rock mentioned in the Alaska Coast Pilot as lying 3 miles SW. (magnetic) from the north point of the island, and NNW. (magnetic) from the anchorage, was not seen, and if it exists is below the surface, where rocks may be encountered almost anywhere around this desolate island. The swell was so heavy that no soundings were made except in the immediate vicinity of the anchorage. Observations of the tides during the night showed a velocity of 2 to 3 knots per hour, the flood setting to the northward and eastward and the ebb in the opposite direction.

August 26 commenced with a moderate breeze from the SW., veering to NW., NE., and ESE., with clear weather, except for 2 hours in the early morning. The surf was still too heavy for landing, and being anxious to get observations on shore, as well as to give the collectors an opportunity to examine the region, we got under way and steamed to the southern end of the island. We were about to anchor in 10 fathoms, when the keel came in contact with a rock, but we backed off without damage, and anchored in 15 fathoms, the northern end of the island bearing N. $\frac{1}{2}$ E. (magnetic), and the southern extremity NE. $\frac{3}{4}$ N. (magnetic).

A party of collectors, the navigator, and myself landed, and while the former were searching the island for specimens, the following observations were taken: Two sets of equal altitude of the sun for longitude, one meridian altitude and six ex-meridian altitudes of the sun for latitude, the artificial horizon being used. They were made under favorable conditions and are reliable. The observation spot is one cable to the westward of the SE. extremity of the island, and is marked by a pile of stones on the beach above high water, the mean of all the sights placing it in latitude 59° 23' 36.7" N. and longitude 146° 19' 33.4" W.

Middleton Island is between 7 and 8 miles in length, N. 22° E. and S. 22° W., with reefs extending 2 miles or more north and east of it and between 3 and 4 miles off the southern end. The anchorage is off the west side, and an approaching vessel should keep well outside the kelp, as rocks may exist anywhere near the island, which is a terminal moraine, composed of mud, clay, gravel, and huge boulders, scattered about over the surface, on the beach and on ledges above and below the water. The southern end has perpendicular cliffs of mud and clay

from 30 to 80 feet in height, the greatest elevation toward the center of the island being about 120 feet above the sea. The strata on this side dip from 30° to 40° about NW. (magnetic). The general appearance of the island is flat and, the soil being impervious to water, numerous ponds are formed by heavy rains, and the entire surface is moist, almost boggy, covered in summer with a rank growth of grass, flowers, etc., but no trees occur. Cormorants, gulls, and puffins were nesting on the cliffs, and the burrowing habits of the latter made walking near their haunts very difficult. The island is uninhabited, except by hunters, who are occasionally left there to search for seals and sea otters.

Having finished our observations, we returned to the ship and got under way at 8 p. m., and at 3:40 sounded in 22 fathoms, latitude $59^{\circ} 19' 00''$ N., longitude $146^{\circ} 23' 00''$ W.; then ran S. 53° E. 5 miles and sounded in 141 fathoms, 10 miles in 620 fathoms, and 20 miles in 2,425 fathoms. The course was then changed to N. 74° E. for Pamplona Rocks. The day ended with clear, pleasant weather and smooth sea, which continued on the 27th.

Pamplona Rocks to Departure Bay, British Columbia.—Having run 40 miles from last station, we sounded in 2,224 fathoms, 27 miles further in 2,138 fathoms, and 17 miles still further in 1,528 fathoms. Changing the course to S. 51° E., we ran 17 miles to the position assigned to the rocks, then S. 16° W. 3 miles, and sounded in 1,763 fathoms; E. 5 miles and S. 28° W. 7 miles to another reported position, where we found 1,745 fathoms. Then, changing the course to N. 70° E., we ran 9 miles and sounded in 1,675 fathoms; N. 84° E. 10 miles, in 1,500 fathoms; and S. 43° E. 10 miles, in 1,548 fathoms.

The position assigned to Pamplona Rocks on Coast Survey Charts 701 and 702, Hydrographic Office Chart No. 527, and in the Alaska Coast Pilot, is latitude $59^{\circ} 03' 00''$ N. and longitude $142^{\circ} 40' 00''$ W.; but Coast Survey Chart 960 places them in latitude $59^{\circ} 35' 00''$ N., longitude $142^{\circ} 04' 00''$ W. I consider it highly important that these dangers should be located in the interest of commerce as well as of the fisheries, and as the time would not permit an examination of both localities, we selected that which seemed to have the weight of evidence in its favor. The weather was remarkably clear and the search was made during the middle of the day with a lookout on the topgallant yard, his line of vision extending 10 miles or more on either hand, without detecting any signs of rocks or shoals. The soundings were regular and gave no indication of shoaling water, so it may be stated positively that the rocks do not exist within 20 miles of the assigned position.

Coast Survey Chart No. 960 places them nearer land, where from 40 to 50 fathoms are found in their vicinity, and where rocks, banks, or a ledge, as these dangers are called by different authorities, might be expected to exist. The snow-capped heights of Mount St. Elias were visible during the day, from 90 to 100 miles distant, and many snowy peaks of less magnitude could be seen from time to time.

The weather was overcast and rainy during the first part of the 28th, with a heavy swell from the southward, but it cleared after noon and the swell moderated. A sounding was made in 1,815 fathoms, gray ooze, 50 miles S. 43° E. from the last station, and another 50 miles further in 1,778 fathoms. Two soundings were made during the 29th, the first in 1,433 fathoms, latitude $56^{\circ} 35' 00''$ N., longitude $137^{\circ} 55' 00''$ W., and the latter, No. 2859, in 1,569 fathoms, latitude $55^{\circ} 20' 00''$ W., where a successful haul of the trawl was made. An accident, to the dynamo deprived us of the use of the electric lights, and the Sigsbee deep-sea sounding machine was partially disabled, but we used it until our arrival in port.

The soundings were made on the 30th, in 1,571 fathoms, latitude $54^{\circ} 02' 00''$ N., longitude $134^{\circ} 34' 00''$ W., and 1,601 fathoms, latitude $52^{\circ} 32' 00''$ N., longitude $133^{\circ} 05' 00''$ W. We sighted Queen Charlotte Island at 12:45 p. m., and were off Port Keeper at 6. A cast of the lead was made the following morning in 1,099 fathoms, SW. $\frac{1}{2}$ S. (magnetic) 25 miles from Cape St. James, and at 9 a. m. a successful haul of the trawl, No. 2860, was taken in 876 fathoms, green mud, latitude $51^{\circ} 23' 00''$ N., longitude $130^{\circ} 34' 00''$ W., and another at 2:50 p. m., No. 2861, in 204 fathoms, latitude $51^{\circ} 14' 00''$ N., longitude $129^{\circ} 50' 00''$ W. Soundings were made at 6:44 p. m. in 83 fathoms, latitude $51^{\circ} 09' 00''$ N., longitude, $129^{\circ} 07' 00''$ W., and at 10 p. m. in 52 fathoms, latitude $51^{\circ} 01' 00''$ N., longitude $128^{\circ} 25' 00''$ W., where we anchored for the night.

The fog shut down a few minutes later, and continued with momentary breaks until noon of September 1. We got under way at 8:10 a. m., felt our way into Goleta Channel, and made a successful haul of the trawl at 12:30 p. m., No. 2862, in 238 fathoms, gray sand and mud, Dun-trawl at 12:30 p. m., No. 2862, in 238 fathoms, gray sand and mud, Duncan Island bearing ENE. $\frac{1}{3}$ E. (magnetic), Noble Island, N. $\frac{1}{4}$ W. (magnetic). The trawl came up with a heavy load of mud, which detained us two hours or more, as we were obliged to tow it until it was relieved of sufficient weight to enable us to land it on deck. The haul proved very rich, particularly in specimens of brachiopods, among which were several rare, if not entirely new, species. We steamed ahead on our course as soon as the trawl was landed, anchoring in Albert Bay at 5:10 p. m.

We were under way at 4:30 on the morning of the 2d, the weather overcast and misty but clearing gradually during the morning. We passed Seymour Narrows at 12:45 p. m., nearly high water, and at 6:15 p. m. anchored in Tribune Harbor for the night. The sky was nearly cloudless during the afternoon, but the atmosphere was thick with smoke from forest pines, which becomes so dense at times that it is more dreaded than fog. At 6 a. m. September 3, we got under way, arriving at Departure Bay at 10 a. m. and going to the wharf an hour later. We began coaling at 1:5 p. m. and finished at 2 p. m. on the 4th, having taken on board $112\frac{3}{4}$ tons.

COASTS OF WASHINGTON AND OREGON.

Departure Bay to Seattle, Washington.—Leaving port at 7 a. m., September 5, we steamed to the southward and eastward through mist and rain, until 10:55, when the trawl was cast, No. 2863, in 67 fathoms, making a successful haul. Resuming our course, we passed Rosario Straits and at 5:25 p. m. anchored in Burrows Bay for the night. It is a good harbor, and is protected from all but southerly winds. We were under way at 6:05 the following morning, and at 7:15 cast the trawl in 48 fathoms, No. 2864, making another successful haul. A third cast was made at 8:55 in 40 fathoms, No. 2865, and a fair haul taken, although the trawl capsized and was dragged bottom up, the first time that had happened for several years. Steaming ahead as soon as the trawl was landed, we passed Point No Point at meridian and anchored off Seattle, Washington, at 2:45 p. m., September 6. I called on the mayor, Robert Moran, on the 7th, and the call was returned the following day by the mayor and city council, who inspected the vessel and her equipment and expressed great interest in our work.

Outer coast of Washington.—We left Seattle at 10:40 a. m., September 17, and anchored in Port Townsend at 3:45 p. m. I met Judge James G. Swan the following morning, and had a conference with him regarding the fisheries of Washington and other matters connected with our work. He had lived many years on the coast between Gray's Harbor and Neeah Bay, and from close observation had acquired a remarkable knowledge of the fauna of this region. His information respecting the Indian tribes and their habits has led him to believe that halibut will not be found in paying quantities south of Cape Flattery. It was, he said, a time-honored custom for the tribes living as far south as Flattery Rocks to go to Cape Flattery every spring for their winter's supply of halibut, which were taken on the well-known bank from 9 to 12 miles WNW. (magnetic) from Tatoosh Island. Halibut have seldom been taken south of Cape Flattery, and never, to his knowledge, south of Flattery Rocks. They form no part of the winter's food of tribes inhabiting that part of the coast, rock-cod, surf smelt, tomcod, salmon, etc., being the staple supply. He thinks that if halibut existed near the shore the Indians would have known it and, like the tribes farther north, would have taken them for winter use. He predicted that we would find a clean sand bottom with very little life between Cape Flattery and Gray's Harbor.

The Coast Survey steamer *McArthur* arrived during the afternoon and permitted us to copy their soundings about Cape Flattery, a saving of time and labor, as we would have been obliged to sound over a portion of the same ground.

We were under way at 5:45 p. m. September 18, passed Cape Flattery at 2 a. m. the following morning, and at 5:30 commenced a line of soundings in 82 fathoms, S. 68° W., 10 miles from the light. It was extended 65 miles S. 68° W., sounding at intervals of 5 miles, to develop

banks reported to exist 60 and 75 miles from the cape. The depths were irregular for 30 miles, then increased uniformly to 768 fathoms at the former and 1,239 fathoms at the latter position. The reports were from shipmasters who said they had sounded on the banks and knew they were there. No doubt they found 60 or 70 fathoms as reported, but they were 15 or 20 miles out in their reckoning.

The wind began blowing from the southward and eastward soon after we passed Cape Flattery, and became a moderate gale at 7 a. m., with a heavy swell, which increased during the day. At 4 p. m., when the line was finished, the sea was too rough to continue work, so we lay to several hours, then steamed in shore under low speed until we sighted Flattery Light, and lay to again until 7 a. m., September 20. The wind moderated during the night, the rain ceased, and the weather partially cleared. The sea went down also, but a heavy swell rolled in from the southward and westward, causing the vessel to tumble about badly whenever she was allowed to get in the trough of the sea. Vivid lightning was observed during the night over the land in the direction of the Olympian range.

The trawl was cast at 11 a. m in 171 fathoms, No. 2866, S. 40° W., 19 miles from Flattery light-house, and although the swell was still heavy the haul was successful. Another haul was made at 1:40 p. m. in 37 fathoms, No. 2867, S. 23° W., 17 miles from the light, and at 3 p. m. we set the trawl line in 31 fathoms, gray sand, near the last station. It was allowed to remain on the bottom 2 hours, and on hauling it 3 dogfish, 8 sharks, and 1 halibut were taken, the latter weighing about 140 pounds.

At 7:34 p. m. we sounded in 178 fathoms, gray sand, S. 34° W., 19 miles from Flattery light, and ran a line 30 miles S. 68° W. in 77, 82, 218, 90, 141, and 378 fathoms; S. 82° E., 15 miles, in 247, 462, and 522 fathoms; and N. 73° E., 25 miles, in 378, 206, 67, 52, and 31 fathoms. The trawl line was set at the last station, taking one skate (*Raia cooperi*), one dogfish (*Squalus acanthias*), two starfish, and two fish not recognized. A successful haul of the trawl, No. 2868, was made while the line was down, but the bottom was found to be comparatively barren. Trial lines were put over the side without result.

We then ran S. 36° E., 15 miles, nearly parallel with the coast, sounding in 30, 33, and 32 fathoms, the trawl being lowered at the last station, No. 2869. The bottom was composed of fine gray sand, perfectly clean, without adhering growths of any kind. A line was then run off-shore S. 73° W., 20 miles, sounding in 53, 75, 111, and 287 fathoms; then S. 17° E., 15 miles, in 535, 758, and 578 fathoms; turning in shore we ran N. 73° E., 20 miles, sounding in 386, 82, 51, and 28 fathoms; S. 17° E., 15 miles, in 28, 28, and 28 fathoms; and S. 70° W., 25 miles, in 41, 56, 74, 93, and 438 fathoms. Rocky patches alternated with fine gray sand and mud on the last line, denoting a marked change from the uniform gray sand found thus far south of Cape Flattery.

A report of Indian origin placed a bank 30 miles west (magnetic) from Shoalwater Bay. The change in the character of bottom led us to believe that the report might be correct, and a careful examination of the region resulted in the development of a bank about 20 miles in length, SW. and NE. (magnetic), and 12 miles in extreme width. Its eastern extremity, on which is 42 fathoms, rocky bottom, lies 15 miles SW. (magnetic) from Point Chehalis, the southern extremity of Gray's Harbor. The soundings are quite regular, but the character of the bottom alternates between rock, gray sand, and mud. A trawl line was set at 5:52 a. m., September 23, in 58 fathoms, rocky bottom, No. 2870, on the southern edge of the bank, 2 black cod (*Anoplopoma fimbria*), 4 sharks, and 10 red rockfish (*Sebastichthys ruber* and *Sebastichthys pinniger*) being taken. A haul of the beam trawl was made also, which developed more life on the bottom than had been found south of Cape Flattery, and indicated good feeding ground for fish. There is little doubt that at the proper season good fishing may be found on this bank. Several red rock-cod were taken with hand lines from the ship's side.

As soon as the haul was completed we ran 28 miles N. 72° W., and at 1:17 p. m. cast the trawl in 559 fathoms, brown ooze, No. 2871. The haul was successful, although made at great risk, owing to the heavy westerly swell which still rolled in. The surface net was towed as usual, but very little life was found.

We steamed ahead under low speed for Cape Flattery, and at 7:26 a. m., September 24, cast the trawl in 38 fathoms, gray sand, No. 2872, S. 40° W., 8 miles from the light-house, taking but few specimens. The trawl line was set, and 2 sharks and a starfish were the only catch, the baits being left undisturbed. Two red rockfish were taken with hand lines.

The haul finished, we steamed across the Straits of Fuca, and at 12:15 set the trawl line in 40 fathoms, No. 2873, N. 53° W., 10½ miles from Cape Flattery light-house. The trawl was lowered, but caught at once on the rough, rocky bottom, and the frame was lost, the wreck of the net coming up with the bridle. The tangles were then lowered in 27 fathoms, rock and shells, No. 2874, N. 55° W., 11.3 miles from the light-house, the results showing a rich bottom fauna, or "live bottom," as fishermen call it, which is usually found on halibut grounds. Another haul of the tangles, No. 2875, was made over the same ground with similar results. The trawl line was allowed to remain on the bottom 3 hours, and when hauled 4 halibut, 2 sharks, 4 red rockfish, and 3 starfish were found on the hooks. The operations above described were on the well-known bank where in spring and early summer halibut are found in great numbers, and where the Indians from Cape Flattery have for many years procured their winter's supply.

A heavy westerly swell still rolled in, making it rather uncomfortable on board, except when head or stern to it, the result of remote gales which did not blow home. Wishing to make a harbor for the night,

we ran for Neeah Bay, where we anchored at 5:40 p. m. A trawl line was set outside of the harbor in 25 fathoms, and when hauled next morning dogfish and skate were found to be the principal catch.

Off Barclay Sound, Vancouver Island.— We left Neeah Bay at 8 a. m. on the 25th, steamed across the straits, and at 10:07 set the trawl line and cast the beam trawl in 59 fathoms, black sand and mud, No. 2876, 14.7 miles south from Cape Beale light-house, Vancouver Island. The trawl dragged but a few yards when it caught on a rocky patch, parted the bridle stops, and came up tail first. It was a successful haul, nevertheless, many specimens being found in the net. The tow net was used on the surface and from 2 to 3 fathoms below, but the results were meager, very little life being found. The tangles were hauled over the same ground, No. 2877, with good results, showing the same rich fauna previously found on this bank. The trawl line remained on the bottom 3 hours, and when hauled 2 halibut, 9 dogfish and 1 red rockfish were found on the hooks. One specimen of the latter was taken with the hand line.

At 2:35 p. m. the trawl line was set and the dredge lowered in 66 fathoms, gravel and pebbles, No. 2878, S. 48° W., 16 miles from Cape Beale light-house. The dredge showed but little life on the bottom, except a variety of minute mollusca, and the tow net developed a limited surface life. On the trawl line were found 2 ground sharks, one of large size; 2 common sharks, 15 dogfish, and 3 black-cod. We lay to after the line was up, keeping Cape Beale in sight until 1 a. m. on the 26th, then started ahead to the northward and westward under low speed, and at 5:50 p. m. set the trawl line and lowered the dredge in 34 fathoms, rocky bottom, No. 2879, N. 79° W., 27 miles from Cape Beale. The latter brought up a variety of small mollusca, but nothing indicating live bottom. Another haul, No. 2880, was made over the same ground with similar results, and the trawl line secured 2 sharks, 3 dogfish, and 1 halibut.

We set the line again at 11:05 a. m. in 24 fathoms, fine gray sand, No. 2881, Cape Beale bearing S. 62° E., 26 miles, the result being 1 halibut, 5 dogfish, 1 shark, and 1 skate. Several dogfish were taken with hand lines, and the dredge was hauled over a rough bottom with meager results. We then ran into Barclay Sound, and at 5:55 anchored in entrance anchorage for the night. The naturalists being anxious to make collections, we remained during the 27th for that purpose and were detained on the 28th by fog. The time was utilized, however, by the naturalists, who found a rich field among the islands and rocks. The only evidence of civilization was the light-house on Cape Beale, the Indian villages being mostly abandoned, the occupants having gone to the salmon canneries in the interior. Several canoe loads were seen passing, a few came alongside, and occasionally one was seen trolling for salmon, which were very plentiful.

There was a dense fog on the 29th, until 7 a. m., when it partially

cleared, and we left the sound. It shut down at 8, soon after we passed Cape Beale, and continued until late in the afternoon. The trawl line was set at 10:20 in 60 fathoms, fine sand and rocks, S. 14° E., 22 miles from Cape Beale, and when taken up 2 hours later we found on the hooks 3 halibut, 2 black-cod, and 16 dogfish.

It became evident that sharks and dogfish had possession of the fishing banks at this season to the exclusion of food-fishes, while in the spring and early summer, when halibut are plentiful, only a few of these pests are found; there has been no fall fishing here before, and consequently no information concerning the time they leave the coast and halibut and other valuable species return.

Straits of Fuca and Puget Sound.—As soon as the trawl line was up we started for Neeah Bay, where we anchored at 4 p. m. The Coast Survey steamer, *McArthur*, was in the harbor, making preparations to go to San Francisco, having completed her season's work. Leaving the bay at 7:50 a. m. on the 30th, we arrived at Port Townsend at 4:48 p. m., and anchored for the night. Judge Swan visited the ship at 8 the following morning for a conference relative to our recent investigations, and also in regard to our future work.

Some slight repairs to the machinery being required, we left for Seattle at 10:05, October 1, anchoring off that place at 2 p. m. I called on the mayor of the city an hour later, and gave him an account of our cruise, and what we had learned concerning the coast fisheries of Washington Territory. The necessary repairs being completed we left Seattle at 10:55 a. m., October 4, and anchored in Port Townsend at 3:30 p. m. I called on Judge Swan soon after our arrival, and gave him an invitation to make a cruise with us for a week or two, which he accepted. A large party of citizens of Port Townsend visited the ship during the 5th, and at 6 a. m. the following day we got under way and steaming across the straits, anchored in Royal Roads, the outer harbor of Victoria, at 9:30. I went on shore at 10 a. m., in company with Judge Swan, and called on the United States consul and others.

Mr. Henry Saunders, an enterprising fish-dealer, having recently engaged in the development of the black-cod fishery, we called on him to make inquiries. He informed us that his schooner brought down 3,000 fish on her first trip, when she had an Indian crew. She had gone on a second voyage manned by Newfoundland fishermen, and he anticipated better results. The fish were caught off Queen Charlotte's Island, in from 200 to 220 fathoms, were very plentiful, and took the hook readily. These fish are highly prized where known, and are destined soon to occupy a leading place among the deep-sea fishes of the Pacific coast. I can testify to their excellence when fresh, salted, or smoked. We called also on Mr. George Vienna, the largest fish-dealer in the city, and gained much information regarding the local fisheries.

Leaving Victoria at 6 a. m. on the 7th, we arrived at Departure Bay at 3:30 p. m., and went to the wharf at 6 the following morning. We

commenced coaling at 7 and finished at 11 a. m. the following day, having taken on board $149\frac{1}{2}\frac{2}{10}$ tons (30 tons being in bags on deck). We were under way at 6:05 on the morning of the 10th, entering Active Pass at 10:40, and set the trawl line at 4 p. m., in 101 fathoms, sand and gravel, off Race Rocks, taking 41 dogfish.

Outer coast of Washington.—It was foggy during the night, lighting up at intervals. Made Cape Flattery light at 10:12 p. m., and passing it at 11 we stood to the southward along the coast until 3:35 p. m., October 11, when we put over the haul lines in 20 fathoms, gray sand, S. 32° W., $10\frac{1}{2}$ miles from the light-house at Shoalwater Bay. Failing to take anything after a trial of 15 minutes, we ran a line S. 78° W., 20 miles, sounding in 38, 51, 153, and 432 fathoms; S. 68° E., 15 miles, in 98, 55, and 40 fathoms, and S. 78° W., 15 miles, in 60, 78, and 260 fathoms, the last sounding being taken at 11:48 p. m. The wind was from the eastward during the forenoon, varying from light to moderate, but during the evening it hauled to SE., and at midnight it was blowing a moderate gale with rapidly rising sea, which forced us to cease work and heave to under steam, head to the wind.

Tradition places extensive banks about 50 miles off the Columbia River bar, which, if they exist, would doubtless afford valuable fishing grounds. The object of our explorations was not only to locate and examine these banks if they were found, but to ascertain the species of fish inhabiting the regions adjacent to the coast, their abundance, and the best methods of taking them. The gale continued from SW. to WNW., during the 12th, with heavy confused sea, moderating, however, during the evening. We were hove to, head to wind, until 5 p. m., when the vessel was put before it for the remainder of the day.

Coast of Oregon.—Cape Disappointment light was sighted at 2:45 a. m., October 13, Tillamook light at 3:30, and at 6:53 we cast the lead in 73 fathoms, N. 64° W., $16\frac{1}{2}$ miles from Tillamook light, and ran a line S. 72° W., 15 miles, sounding in 82, 96, and 199 fathoms; N. 15° E., 15 miles, in 174 and 601 fathoms, and N. 85° E., 16 miles, in 102, 75, and 68 fathoms at the end of the line. At 2 p. m. the trawl line was set, and a successful haul of the trawl was made, No. 2882. The trawl line came up with 1 black-cod and a number of dogfish. The swell was still heavy, making boat work as well as handling the trawl rather difficult, but both were accomplished without accident.

At 4:40 p. m. we cast the lead in 81 fathoms, N. 78° W., $12\frac{3}{4}$ miles from Cape Disappointment and ran S. 78° W., 20 miles, sounding in 231, 421, 475, and 506 fathoms. It will be seen by reference to the chart that the soundings on the last line are two or three times greater than depths found on parallel lines 7 or 8 miles distant. This great submarine trough is, probably, the ancient bed of the Columbia River.

The 14th was overcast, with rain, mist, and occasional fog banks during the morning. We took a pilot at 7:55, crossed the bar, and anchored off Astoria at 9:45 a. m. Fire was discovered in the port coal bunker

a few minutes before noon, but was extinguished in a couple of hours, after shifting several tons of coal. It was a slow and tedious process, as the fire was in the after end of the bunker, which was full of coal. It originated from an auxiliary steam pipe covered with a 3-inch manilla rope, which proved an insufficient protection under the pressure of coal stored around it.

Mr. F. C. Reed, State fish commissioner, and others interested in the coast fisheries called during the afternoon. Hon. J. H. D. Gray, Colonel Taylor, and other prominent residents of Astoria visited the ship on the 15th. In discussing the fisheries of the region it soon became evident that a belief in the existence of banks 50 to 60 miles off the Columbia River was quite general, but we were unable to trace its origin. Heceta Bank lies off the coast, in latitude $44^{\circ} 00'$ N., longitude $124^{\circ} 50'$ W., and may possibly have had something to do with it. The explorations of the *Albatross* developed over 600 fathoms in the region where the banks were supposed to lie, but they may be found further south, as the region between the Columbia River and Heceta Bank is still unexplored.

The sea fisheries off the Columbia were commenced a few years since with a small schooner which operated a 40-foot beam trawl over the ground between Cape Disappointment and Shoalwater Bay. The vessel being found unfit for the purpose, the steamer *Dolphin* was built and made 40 trips between April and October, 1887, but she also proved a failure. Her catch was fairly good, and had she been able to market her fish promptly the venture would have turned out profitably. The various fish taken by the *Dolphin* were classified as follows, viz: Sole, flounders, hake, cod, rock-cod, and halibut. Very few cod and halibut were taken, sole predominating, although at times rock-cod were abundant. Crabs and a few large clams were also taken.

Judge Swan left us on the 16th and returned to Port Townsend.

We left Astoria at 10:35 a. m., October 18, and at 2:55 p. m. set the trawl line off Tillamook Rock, where Captain Richardson of the light-house steamer *Manzanita* reported having taken red rock-cod (called grouper in Astoria) in great numbers and an occasional halibut. We found nothing but dogfish on the trawl lines, showing that the coast of Oregon as well as that of Washington is infested by them during the fall months. Three hauls of the dredge were made in the vicinity over hard sand bottom with occasional rocky patches, and although few specimens were taken there are indisputable evidences that the region about Tillamook is an excellent fishing ground at certain seasons of the year.

Heceta Bank.—At 7.30 a. m. on the 19th, the trawl line was set in 50 fathoms, rocky bottom (No. 2886), on Heceta Bank. The dredge was lowered, developing a "live bottom" similar to that found on the best fishing banks. Two attempts were made to haul the beam trawl, but the net caught on the rough, rocky bottom and was wrecked on both occasions. The trawl line when hauled contained single specimens of

halibut, black-cod, shark, and dogfish. We ran lines of soundings across the bank to the westward, then to the southward and eastward, defining its extent, and at 2:20 p. m. lowered the trawl in 277 fathoms, No. 2890, making a successful haul.

Hequeta Bank has not been fully developed, but from our present knowledge it may be said to be about 20 miles in length and 10 miles in width, its center lying in latitude $44^{\circ} 04' 00''$ N., longitude $124^{\circ} 53' 00''$ W. It has a rocky bottom, alternating with patches of clay and pebbles, and presents every requisite for an excellent fishing bank, which it will undoubtedly prove at the proper season of the year.

The weather during the 18th and 19th was all that could be desired, but indications of a change were unmistakable during the afternoon of the latter day, which ended with a moderate breeze from WNW. It increased rapidly, until at noon of the 20th there was a moderate gale from the northward and westward, with a heavy following sea. We did not feel it much, however, as we were running directly before the wind, under steam and sail. Cape Mendocino was passed at 2:12 p. m., and Point Arenas at 12:15 a. m., October 21. Point Reyes was abeam at 8:34, and, after passing it the wind died out and the sea moderated. Passing Duxberry Reef at 11 a. m., we stood down through Bonita Channel, entered the Golden Gate, and at 12:40 p. m. anchored in San Francisco Bay, off the foot of Washington street.

COAST OF SOUTHERN CALIFORNIA.

Preparations for the southern cruise.—The terms of service of many of the crew having expired, they were discharged and their places filled by new men, only a few of the old men reshipping.

The work of overhauling and refitting for the winter cruise commenced immediately after our arrival in San Francisco, and was carried on by our own crew as far as possible. We went to the Union Iron Works November 14, where such work as could not be done on board was taken in hand. It was completed December 11, and on the following day we returned to our former berth off the foot of Washington street. The specimens collected during the Alaskan cruise were forwarded to Washington on the 26th of November through the quartermaster's department, U. S. Army.

Prof. Charles H. Gilbert, ichthyologist, joined the ship on the 25th of December, in time to complete the necessary preparations for the cruise. The vessel was docked at the Union Works on the 26th, her bottom cleaned and painted, and was floated off on the morning of the 28th when we steamed to the Green street wharf for coal, took on board $122\frac{1}{2}$ tons, and then anchored in the stream. Our preparations for the southern cruise were completed by the arrival of the paymaster's stores from Mare Island, on the 2d, and at 2 p. m., January 3, 1889, we left the harbor and steamed to the southward. The weather was boisterous, and later in the day the wind increased to a moderate gale

from the southeast, with misty, rainy weather, and a heavy head sea. The ship was under half power as usual, using one boiler with the grate surface reduced to 45 square feet, and the consumption of coal being limited to 10 tons per day.

Santa Barbara Channel.—It was our intention to commence work off Point Sur, but arriving in that vicinity at meridian the following day we found it still too rough to handle the trawl with safety; so in order not to lose time we continued our cruise to the southward. At 6:45 a. m., on the 5th, we cast the trawl in 236 fathoms, Point Conception bearing N. 82° E. (true), 12 miles distant, and ran a line of dredgings across the channel to Richardson's Rocks, and thence to the west end of San Miguel Island. The trawl was set off the west end of the island on the rocky bottom, but only four rockfish were taken; the bait generally remained untouched. Several hauls of the tangles were made while the line was down, but without much success, the bottom being very barren. A heavy westerly swell which gradually increased during the day, made boat work very uncomfortable, so we lay to under San Miguel for the night.

The wind and sea moderated, and at 7:30 the following morning a successful haul of the trawl was made in 367 fathoms, S. 15° E. (true) 11 miles from Richardson's rocks. The trawl line was set at 10 a. m. in 197 fathoms on rocky bottom, a number of red rock-cod and four black-cod being taken, the first obtained so far south. A successful haul of the beam trawl was made in 158 fathoms while the line was out, and it was lowered again in 44 fathoms, but caught on the rocks and the wreck of the net only recovered.

The sea being comparatively smooth during the afternoon and the sun shining brightly, we availed ourselves of the opportunity to swing ship under steam for compass errors. Our nearest card, taken at Cape San Lucas, was found to be in error on several points. We made a harbor for the night in Becher's Bay, at the east end of Santa Rosa Island, where good anchorage was found, protected from the prevailing northwesterly wind but open to the eastward. The naturalists were on shore soon after daylight the following morning, returning at 11 a. m. with birds, a small fox indigenous to the island, and other specimens, among which were several human skulls and bones, one skeleton being nearly perfect. Professor Gilbert reported a great number of ancient human remains exposed on a strip of drifting sand 200 yards in width, extending from Carrington Point to the sea, a distance of about three-quarters of a mile. The only implements seen were stone mortars, which were scattered over the surface in great numbers, all broken, evidently by design, for they were too solid to have been fractured by accident.

Getting under way at 11:45 a. m., we ran a line of dredgings across Santa Barbara Channel, and although very many interesting specimens were found near the shores on either side, the deeper waters near mid-

channel, where the bottom is composed of soft green mud, were almost barren of life. We lay to for the night within range of Point Conception light, and at daylight set the trawl line near the shore, but caught nothing of consequence. A line of shoal-water dredgings was then run to the southward, which developed considerable life, but no "live bottom." The total absence of life on the surface was notable, and it would seem that the season alone is not sufficient to account for it. The presence of petroleum, which may usually be seen forming a thin film over the surface waters of the channel, may have something to do with it. We were enveloped in a dense fog from 7 a. m., but working along shore, where our course could be checked by soundings, it did not delay us materially, and half an hour after dark we anchored off Santa Barbara for the night.

Professor Gilbert went on shore early on the following morning and arranged with Capt. A. Larco to make a trip with us among the islands. He is the principal fisherman of Santa Barbara and has followed his calling in that vicinity for 18 years. Being an intelligent and observing man, he is probably better posted regarding the fisheries of that channel and islands than any other one on the coast. An accident to the machinery prevented the trip at this time and forced us to go to San Diego for repairs. Leaving the anchorage at 1:37 p. m., we arrived at our destination at 11:55 the following morning, January 10, when arrangements were made for immediate repairs to the disabled engine.

Alamitos Bay and Newport Harbor.—Professor Gilbert and Mr. N. B. Miller took advantage of the delay to examine some of the most promising localities on the southern California coast for the acclimation of oysters. They went first to Alamitos Bay, where they found, January 12, a surface temperature of 60° Fahr., depths 6 to 12 feet, bottom of sand and mud, the specific gravity ranging from 1.011948 to 1.023187. The presence of fresh water was apparent at all stations and the conditions would remain practically the same during the rainy season.

Newport Harbor was examined the following day and the surface temperature found to be 60° Fahr., specific gravity from 1.01520 to 1.02400, sandy bottom, with little or no mud. An examination in both the wet and dry seasons would be necessary in order to obtain a knowledge of the average condition of the waters throughout the year.

Cortez Bank.—Repairs on the engine having been completed, we left port on the 15th and ran a line of soundings from the whistling buoy, off Point Loma, to Cortez Bank, developing a series of elevations and depressions over which the depths varied from 211 to 1,047 fathoms. Arriving at the bank the following morning, we commenced investigations by sounding, dredging, and the use of hand lines. The sea was breaking heavily over Bishop's Rock, which made an excellent landmark, enabling us to locate ourselves on any part of the bank with certainty and without loss of time.

The examination was completed on the evening of the 17th, and

the general results may be stated as follows. The charts are on scales entirely too small to admit of details being shown. Bishop's Rock, on which there is but 10 or 12 feet, is the shoalest part of the bank. The sea breaks over it heavily during moderate weather, but with a smooth sea, when facing the sun, it can not be seen at any distance and is at such times very dangerous. The depths correspond generally with those on the charts, with the exception of a 6-fathom spot which was found about a mile south and east of Bishop's Rock. This might have led to a less depth, but there was a heavy swell at the time, which induced us to seek deeper water. Our soundings extended the area of the bank in a southwest direction, where it requires further examination. The bottom was composed of sand, shells, coral, and rock, the latter cropping out at short intervals over the entire surface. The fauna was very rich and varied. Fish were swarming over the bank in great numbers, and, in fact, it was found to be the richest ground we have found in the Pacific.

The trawl line was set and quite a number of fish taken, but the bottom was too rough for that method of fishing. Dangerous seas will be encountered on the bank in stormy weather, and heavy swells with moderate winds, but it is of small extent, and with the deep water surrounding it not an unusually dangerous fishing ground.

Starting from the northern end of the bank a little after dark on the evening of the 17th, we ran a line of soundings in the direction of San Nicolas Island for 12 miles, in depths less than 200 fathoms, 59 fathoms being found at 18 miles. This we marked for future investigation and continued our course to the island.

San Nicolas Island to San Diego.—We anchored off the east end of San Nicolas at 7:15 a. m., and landed a party of naturalists, who returned at noon with several additions to our collection, although the region was found to be rather barren of life. They labored under the disadvantage of collecting in half a gale of wind, the air filled with fine sand, and most of the small birds hidden from view. Evidences of a former population, in the shape of skeletons and broken stone mortars, were found in spots where they had been exposed by drifting sand.

Increasing wind and sea made boat work impracticable, so, to utilize the time, we got under way and ran a line of soundings to San Clemente, and thence to the region of Point Loma, where we arrived at daylight the following morning. The wind moderated as we approached the mainland, rain squalls ceased, and the sun rose bright and clear, revealing the snow-crowned mountains in the interior. The day was spent in deep-sea explorations, after which we steamed into San Diego and anchored. We were occupied during the 21st and 22d in overhauling the sounding and dredging gear, and some small repairs were made in the engineer's department.

Tanner Bank to San Clemente Island.—Everything being in readiness, we left the harbor at 7 a. m., January 23; made several hauls with the

trawl during the day, and finally, just before dark, anchored in Smugler's Cove, San Clemente Island. Our objective point was the locality where, on a previous trip, we unexpectedly found a depth of 59 fathoms, and our anchoring was for the purpose of waiting the most favorable opportunity for exploring what we rightly conjectured to be an entirely unknown bank.

A gill net was set soon after anchoring and taken in at 3:20 a. m. with nothing in it, although fish were frequently seen at the surface during the night. The water was unusually phosphorescent, and the net, being anchored in a slight current, "fired" badly; that is, its position was indicated by a phosphorescent glow on the water, which was probably sufficient warning for the fish to keep clear of it.

Getting under way at 4:15 a. m., we ran a line of soundings from the island, finding a maximum depth of 807 fathoms. Reaching the 50-fathom line early in the morning, we spent the day in developing the bank, which may be described as follows:*

Its greatest length inside of the 50-fathom curve is 8 miles east and west (magnetic) by 2 miles in width at its eastern extremity, narrowing to $1\frac{1}{2}$ miles at the western end. The center of the bank, on which was found 48 fathoms, is in latitude $32^{\circ} 43' N.$, longitude $119^{\circ} 10' W.$, and the least water, 28 fathoms, was found near the eastern end, in latitude $32^{\circ} 42' 30'' N.$, longitude $119^{\circ} 07' 15'' W.$ The bottom is composed of sand and shells, with numerous rocky patches, on which the fauna was found to be identical with that of Cortez Bank in similar depths. The 50-fathom curve on the east end lies north (true) 16 miles from Bishop's Rock, both being on the same submarine plateau, with intervening depths of less than 300 fathoms. The same species of fish found on Cortez were taken on this bank, and it may be considered a valuable addition to the fishing grounds of the Pacific coast.

We finished the examination at 11:20 p. m., and anchored off the southeast end of San Clemente at 7 a. m. on the 25th, when the naturalists were given a day on shore and along the beaches. A party of fishermen belonging to a San Diego sloop were encamped on the island. They fish with lines in from 30 to 40 fathoms, taking fat-heads, rock-cod, whitefish, etc., which they split and salt, large tubs being provided for the purpose. They use short trawl lines at times, but that is not their usual custom. Spiny lobsters or crayfish are taken in pots and kept alive in a car till the arrival of their sloop, which calls every week or 10 days for the catch, taking it to the San Diego market.

Los Coronados to Point Fermin.—We were under way at 10:30 p. m., and at daylight on the 26th cast the trawl in 623 fathoms off Los Coronados. Six hauls were made during the day from the above depths to 20 fathoms between the islands. Hand lines were used at several sta-

* This bank has been named "Tanner Bank" by the Superintendent of the U. S. Coast and Geodetic Survey, in honor of its discoverer. It was first designated on the U. S. C. and G. S. Chart No. 601, edition of 1889.

tions and a general examination was made of the fishing grounds in that vicinity. Later in the day we steamed into the harbor of San Diego, where we found the U. S. steamer *Ranger* and Coast Survey steamer *Hassler* at anchor. We went to National City for coal on the morning of the 29th and returned on the 31st, having taken on board 136 tons of Wellington coal.

An accident to the electrical machinery detained us until the morning of February 4, when, at 8:25 a. m., we got under way and proceeded to sea. Commencing at a depth of 45 fathoms off Point Loma, we ran a line of soundings to the vicinity of Point Fermin over ground which had not been examined and where we expected to find uneven bottom, judging from the charts of the vicinity and our own experience. Much to our surprise, however, the depths increased regularly to 464 fathoms, and then gradually decreased as we approached the latter point.

Several hauls of the trawl were made during the day. A thick fog shut down soon after midnight, and in order to verify our position we anchored until the weather cleared, about 10 a. m., when we got under way and commenced the examination of a reported shoal off Point Fermin. The day was spent in dredging, sounding, and hand-line fishing. Our own soundings and information gained from the fishermen at work on the ground led us to the belief that no shoal exists.

South Bank, so called by the fishermen, may be described as follows: It extends about 10 miles SE. by E. (magnetic) from San Pedro light-house, and is from 3 to 3½ miles in width. The depths increased regularly to 20 fathoms 2 miles from the point, and to 29 fathoms at the outer extremity. The soundings correspond generally with those of the Coast Survey chart, and the bottom was usually the same dark-gray sand; but putting the trawl over, it frequently dragged over stony patches, on which kelp, sponges, bryozoans, etc., were growing. Fish in paying quantities are found on the patches, or "spots," as they are called, red rock-cod, fat-heads, whitefish, etc., being taken at all seasons of the year.

The islands and channel off Santa Barbara.—At 5 p. m., having finished the examination of the bank, we started for Santa Barbara under low speed, arriving at 6:45 the following morning. Capt. A. Larco, the fisherman before referred to, came on board at 8 a. m., and an hour later we got under way for the islands. On heaving the cable in we found that the anchor had become unshackled, so the spot was buoyed, and we continued on our course, bending the sheet anchor for use during the trip. Steaming across the channel to the east end of Santa Cruz Island, a couple of hours were spent in the vain attempt to find a shoal spot discovered by Mr. Larco. The remainder of the day was occupied in sounding, dredging, and fishing in the channel between Anacapa and Santa Cruz. The eastern or Anacapa side had "live bottom," and is a favorite fishing ground, while on the opposite side the bottom consisted of clean sand with little or no life.

We anchored at 5:52 p. m. in Smuggler's Cove, Santa Cruz Island, where excellent protection was found from the prevailing coast winds.

There is quite an extensive ranch near the cove, with olive and fig orchards, a vineyard, large meadows, cattle, sheep, etc. We remained at anchor during the forenoon of the 7th, giving the naturalists an opportunity to investigate the shore line. The fishermen were particularly successful with the gill net.

Getting under way at 12:30 p. m. we took three hauls of the trawl off the south side of the island, and at 6:15 anchored in Becher's Bay at the east end of Santa Rosa. Two of the hauls of the afternoon, Nos. 2947 and 2948, in 269 and 266 fathoms, were among the richest of the cruise, a great variety of specimens, including 4 black cod, being obtained. The latter were rather under the medium size, but their flesh was excellent in flavor, nearly, if not quite, equal to those taken off the Oregon and Washington coasts. The deep-water sole is another excellent fish found here, and ranks among the best sea fishes on the Pacific coast, far superior to any that reach the Santa Barbara or San Diego markets.

We were under way at daylight on the morning of the 8th, and ran a line of dredging and fishing stations through the channel between Santa Rosa and Santa Cruz, and thence several miles along the crest of a submarine ridge which extends in the direction of San Nicolas. A fishing party had been sent out before we left the island, and as they were not prepared for a long absence from the ship we were obliged to return and pick them up, leaving the further exploration of the ridge to some future time.

A line of dredging and fishing stations was run along the south side of Santa Rosa during the afternoon, and at 4:40 we anchored under the southeast side of San Miguel. The character of the bottom differed from that of the previous day's investigations, it being clean hard sand, with frequent sharp rock projections, which made havoc with the nets. It was also barren of life, very few specimens being taken. A party of naturalists landed to explore the island, and a fishing party went out under the direction of Captain Larco, returning a little after dark with a good catch.

Getting under way at daylight on the morning of the 9th, we steamed towards Richardson's Rocks, which lie off the western end of San Miguel. A dense fog came rolling in before we reached there, and threatened for a time to interfere with our work, but finally passed off, and we arrived at our working ground without further delay. A line of fishing stations was occupied between the rocks and San Miguel, via Watson's Rock, and a party was sent out under the direction of Captain Larco to investigate localities inaccessible to the ship. We met with ordinary success only until passing Watson's Rock, where fish were found in great numbers, a thousand pounds or more being taken in less than 2 hours. Several successful hauls of the trawl were made

in the channel during the afternoon, and at 7:50 p. m. we anchored off Santa Barbara.

We left our anchorage at 7 a. m. on the 11th, and, piloted by Captain Larco, examined a fishing bank, the center of which lies E. $\frac{1}{2}$ N. (magnetic) about 3 miles from Santa Barbara light-house. It is about a mile in length NE. and SW., by half a mile in width, soundings regular, with depths from 12 to 20 fathoms, fine black sand, with frequent stony patches or spots, on which there is a live bottom.

Another bank was examined and found to be between 2 and 3 miles in length, E. by S. and W. by N. (magnetic), and almost 1 mile in width, its center being 5 miles ESE. from the light-house. The soundings were regular with depths from 26 to 29 fathoms, which agreed closely with the Coast Survey chart, as did those on the bank previously examined. The bottom was sandy, with frequent stony patches, as before described.

The stones were composed of hardened clay, filled with holes, easily crumbled in the hand, and strongly resembling the tosea of South American coasts. It was covered with kelp, sponges, bryozoans, and other marine growths. The lead did not give the true character of the bottom, and it was ascertained by dragging the trawl or tangles between stations, stony patches, some of them very small, being encountered every two or three ship's lengths. Kelp was found growing on all of them, much of it being brought up by the trawl, the roots still adhering to their stony ballast. It seemed to be a young growth, as none of it reached the surface. According to Captain Larco, these banks were at one time alive with fish, but being so near the harbor, they were soon fished out, and are visited now only by rowboats or sailing craft too small to go to the islands. There are no indications of these rocky or stony patches on the Coast Survey charts.

Later in the day, a small rocky patch, marked on the chart 4 miles south (magnetic) from the light-house, was partially examined, and muddy bottom, with rocks and coral patches, was found in from 50 to 60 fathoms. It was not known to the fishermen of Santa Barbara, but Captain Larco was confident that it was a spot on which, many years ago, an old Indian used to fill his canoe when others failed to catch anything on the known banks.

We anchored off Santa Barbara for the night, and at 5:30 the following morning got under way and steamed to the west end of Anacapa Island, for the purpose of extending our exploration of the fishing grounds between it and Santa Cruz, but a strong wind sprung up suddenly, with furious squalls, which obliged us to abandon boat work and confine ourselves to the use of the trawl. A line of stations was occupied along the south side of Anacapa, where the bottom was found to be rough and rocky, tearing the nets and affording but few specimens. The wind moderated before noon, and standing in for the east end of the island we put the hand lines over but caught nothing. A Chinese

junk was seen near by, standing off and on under the lee of the land, trying for fish, and as they had no better success than ourselves we left the ground, steaming 11 miles SSE., in the direction of San Nicolas, and cast the trawl in 603 fathoms, green mud, making an excellent haul. Several new species of fish besides other specimens were taken.

San Nicolas Island to San Diego.—A line of soundings was run to San Nicolas during the night, and several fishing stations were occupied early on the morning of the 13th, with the intention of carrying them around the island, but the weather became so boisterous that we were obliged to give it up. A line of soundings was then run to Santa Barbara Island, the greatest depth found being 649 fathoms, and a haul of the trawl was made *en route*, but increasing wind and sea forced us to anchor under the lee of the island. The collectors were landed and made several additions to their list of birds, in spite of wind and dust. A fishing party was sent out also, but met with indifferent success.

The prospect the following morning was not reassuring. The gale was still increasing, and, as nothing could be done where we were, a line of soundings was run to Santa Catalina Island, developing a depth of 718 fathoms. It was our intention to anchor under the lee of the island, and give the naturalists an opportunity of seining on the sheltered sand beaches of Catalina Harbor, but we found the sea rolling in too heavily and with every prospect of continued bad weather, so we started at once for San Diego under steam and sail, arriving at 7 p. m. the same day.

THE REVILLA GIGEDO ISLANDS, LOWER CALIFORNIA, AND THE GULF OF CALIFORNIA.

San Diego to Guadeloupe Island.—We took on board 121 tons of coal on the 23d and 25th, and, all preparations having been made for a trip to the southward, got under way at 1:15 p. m., February 26, and steamed out of the harbor. Standing for Los Coronados we passed between the islands, and 4 miles to the southward commenced a line of soundings in 76 fathoms, carrying it to the island of Guadeloupe. The depths increased regularly to 804 fathoms at 33 miles, and 856 fathoms at 81 miles from the first station, then to 1,856 fathoms 30 miles from the island. It will be observed that our soundings extend the submarine plateau in a southerly direction, but the rocky elevations which occur so frequently to the westward were not encountered.

The island was sighted at 9:30 on the morning of the 27th, at a distance of 60 miles, the mountain peaks being seen above the mist which enveloped the lower levels. Approaching it in the evening, the weather on western side was covered with a dense fog, while to the leeward it was comparatively clear. The water was smooth, and not caring to seek an anchorage during the night, we lay to till daylight, when we stood in for a harbor on the south end of the island. The wind was so fresh that we were forced to return to the lee side, where an anchor was dropped in 17 fathoms, and a party of collectors sent out. The fisher-

men reported very poor success, having seen but few fish about the rocks, and little or no life upon the bottom, which was covered with gulf mud. The shore collectors did not fare much better, and, in fact, the region was barren and unprofitable. The vessel got under way and made several hauls of the trawl during the forenoon in shoal water. At 12:30 p. m., the naturalists having returned, we stood further off shore and made a haul in 684 fathoms, followed by several more in shoaler depths. There was much rocky bottom, which tore the nets without giving us much in return.

The island of Guadeloupe is $14\frac{1}{2}$ miles in length, from 3 to 5 miles in breadth, and is of volcanic origin, lava cliffs and huge boulders being visible on all sides. Its greatest height is 4,523 feet. There is some wood and fresh water on the northern portion of the island, but no practicable anchorage occurs at that end. It is inhabited by people who have large flocks of goats, which they raise principally for their skins.

Guadeloupe Island to Alijos Rocks.—At 5.30 p. m. we started for Alijos Rocks, running a line of deep-sea soundings en route, and developing a maximum depth of 2,165 fathoms. Reaching the rocks on the morning of March 2, several hauls of the trawl and dredge were made over a rough coralline and rocky bottom, which made sad havoc with the nets and yielded very few specimens. The hand lines were put over without results. Los Alijos, as they are usually called, are a group of rocks surmounting a volcanic elevation, and extend about half a mile north and south, and less than a quarter of a mile east and west. There are four rocks above water, the southernmost being 112 feet in height, the northern one 72 feet, and the other two but a few feet above the sea. There was quite an area over which the sea broke very heavily. The rocks are entirely barren, their vertical sides preventing the possibility of landing, even if the surf permitted a near approach. The tops of the higher rocks were covered with sea bitds. Traditions of a large seal rookery led us to the vain hope that the practically extinct sea elephant of the California coast might have survived in this remote region. There was no sign of them, however, and in fact there were no rocks accessible to these animals that were not swept by every huge sea which constantly broke over them. The rocks are fast crumbling away through the action of the water.

Alijos Rocks to Clarion Island.—We left the Alijos at 10:30 a. m. for Clarion Island, carrying the line of deep-sea soundings, which reached a maximum depth of 2,280 fathoms, 170 miles from the rocks, nearly midway between them and the island. An occasional petrel was seen, and tropical birds, boobies, etc., were of frequent occurrence. Scattering flying fish were observed from time to time, where, in the summer, the surface is fairly alive with them.

The mountain peaks of Clarion Island were made at 9:30 on the morning of March 4, at a distance of 41 miles, and at 4 p. m. we anchored in Sulphur Bay. Collectors were landed to look over the ground and

fishing parties sent out in boats. The naturalists with large parties detailed from the ship's company were out at daylight the following morning, and explorations both ashore and afloat were vigorously prosecuted. It was virgin soil practically, and the results so important that we decided to remain another day. After the collectors had left the ship the next morning we got under way and spent between 7 and 8 hours with trawl and dredge. Lava boulders were found strewn over the bottom, making it very difficult to haul the trawl or even the dredge. There was comparatively little life found, but such specimens as we secured were of sufficient value to induce us to persevere. Returning to Sulphur Bay at 4:30 p. m., the collectors and fishing parties were taken on board, and a few minutes later we started for Socorro.

Clarion Island is uninhabited, and from its isolated position almost unknown. It is a volcanic elevation about 6 miles in length, and from 1 to 3 miles in width, rising from a depth of 2,000 fathoms to an altitude of 1,282 feet above the sea, and with minor peaks of 996 and 916 feet. The shores are steep and rockbound, with the exception of two open bays on the south side. Sulphur Bay, the westernmost, has fair anchorage, but the other has much foul ground, breakers extending beyond the outer points. A sand beach several hundred yards in length lies at the head of Sulphur Bay, but between it and deep water a rocky ledge, just below the surface or awash at low tide, causes a heavy surf and makes a landing there impracticable. Our boats landed on the rocks inside of East Head, but the best landing was found in a small cove west of West Head, not more than half a mile from the anchorage.

Fresh water was found in two small lagoons near the beach in Sulphur Bay, where thousands of sea birds lined the shores, wading along the shallow margins or skimming lightly over the surface. Sir Edmund Belcher reported these lagoons to be salt, and as fresh water was of the greatest importance in his day, and the first thing sought for in strange lands, there can be no doubt concerning the accuracy of his report. They are near the beach, but little above the sea level, and it may be possible that a southerly gale would force sufficient sea water into them to make the water brackish. That they are fresh for a considerable portion of the year is evidenced by fresh-water algæ and other forms. It rained quite heavily during the night of our arrival, and next morning small rock pools were seen, but a day or two of sun would evaporate them.

The lower portions of the island are covered with lava boulders, large and small, and between them is an impenetrable growth of cactus (prickly pear), through which a passage must be cut in order to reach the interior elevated plateaux. Quite large areas of these mesas were covered with a luxuriant growth of grass, and dense clumps of stunted bushes were seen here and there, which could be utilized as firewood in case of emergency. A vine was quite common, with blossoms resembling the wild pea, and there were about half a dozen flowering plants,

specimens of which were preserved. Both land and sea birds were very plentiful. Among the former were the raven, wren, snipe, stilt, dove, and owl. Sea birds literally covered the ground and bushes in certain localities, the man-of-war hawk, tropic bird, and three species of booby being the most numerous. A snake was seen on shore, and one or two green turtles in the surf, but none were captured. Grasshoppers, mosquitoes, and spiders were plentiful, and several species of the latter as well as many specimens of a species of lizard were secured.

The waters around the island were swarming with fish, of which 46 species were taken, 20 at least being edible, and several were seen that we failed to capture. Sharks abounded in great numbers, and whenever we lowered a boat from three to half a dozen were on hand to look it over and follow it. If a line, large or small, was thrown over from the rail they were ready to take it, and if by chance a smaller fish succeeded in capturing the bait there was a race between fishermen and shark for the prize, the latter getting his full share, including hooks and lines. Another source of loss was attributable to the fish themselves, several species having small mouths armed with powerful teeth, with which they snapped off the hooks when taking the bait. The method we found to be most successful was to fish in comparatively shoal water, where the bottom and the fish near by could be distinctly seen. Then by careful watching and dexterous manipulation of the line we were able in a great measure to select our species.

Leaving Sulphur Bay we steamed around the west end of the island, passing Monument Rock, a remarkable formation 200 feet in height. Its massive rectangular base is surmounted by a shaft, nearly square, composed of alternate strata of red and white rock.

Clarion Island to Socorro Island.—Deep-sea soundings were continued, developing a depth of 2,012 fathoms 80 miles from the island, a little more than a third of the distance to Socorro. We made the latter island on the evening of the 7th, and steaming toward it under low speed during the night, arrived in Braithwaite Bay soon after daylight, March 8. The naturalists, with large parties of volunteers and details from the crew, left the ship soon after we anchored, some of them landing, others fishing from boats and seining.

Socorro is the largest island in the group, being about $9\frac{1}{2}$ miles in length and 8 in breadth. The central peak reaches an elevation of 3,707 feet, and its general features are identical with those of Clarion Island. We found no fresh water except in small rock pools, the largest not exceeding a gallon, the result of recent rains, which would be evaporated by two or three days' exposure to the sun. Unmistakable evidences of the existence of numbers of goats were seen in tracks and beaten trails on every hand, but the animals themselves were not visible. Doubtless they were feeding in the vicinity of water, and visited the east end of the island only when heavy rains replenished the rock pools before mentioned sufficiently to furnish them a supply. The fer-

tile areas in the elevated mesas are much greater in extent than those of Clarion Island, and were covered with an equally luxuriant growth of grass, affording excellent pasturage. The surface was smooth, and walking a pleasure after toiling through the almost impassable region of bowlders and cactus on the lower levels. Dense clumps of bushes were frequently encountered, and in sheltered spots groves of cottonwoods were seen, some of the trees reaching a height of 30 feet or more.

The vine producing the bean on which Captain Colnett's men became so sick was seen in bloom. There were two species of grass, and about half a dozen flowering plants. We saw no sea birds on the island and very few on the wing, which was a surprise after our experience at Clarion. Six species of land birds were taken: a large red dove, ground robin, wren, hawk, thrush, and a night heron. Two species of lizards, from 4 to 7 inches in length, were the only reptiles seen. Flies, mosquitoes, and butterflies were found, but no beetles or spiders, both of which were plentiful on Clarion Island.

Fish were very plentiful, 44 species being taken, 14 of which were not found at Clarion; 30 were common to both of the islands, and 20 species from each place were edible. Many of them were unknown to Professor Gilbert, and nearly all were new to me. Quite a number of chub mackerel were taken with hook and line at night by the aid of the submarine light; two or three other species that would not take the hook in the daytime were captured in the same manner. Humpbacked whales were constantly in sight during our stay at Clarion Island and Socorro, quite a number of calves being seen at the latter place.

Socorro Island to San Benedicto Island and Cape San Lucas.—At 3:10 a. m., March 10, we left Braithwaite Bay for San Benedicto Island, about 30 miles distant, directly on our route to the Gulf of California. The greatest depth, 1,635 fathoms, was found about midway between the islands. Anchoring off the east side of the latter at 9:45 a. m., the collectors were landed and a fishing party sent out.

San Benedicto, like all others of the group, is of volcanic origin, about 3 miles in length, one-half to three-quarters of a mile in width, and 975 feet in height, irregular in form, concave on the east side, and, including the outlying rocks, convex on the west side. The southern end is the highest, and is the half of a volcanic cone composed of pumice stone, with an occasional mass of dark-red lava rock. The mountain has been separated in the middle, the western half left standing, while the other portion has entirely disappeared, exposing the interior of the crater. The island has usually been reported as a barren rock. Its surface is irregular, and on the lower levels there is little vegetation; but there are elevated mesas on which a luxuriant growth of grass was found, the succulent "bunch" grass, so highly prized by stock men, and a rank, woody-stalked variety, growing from 3 to 5 feet high, and so thick that it was not an easy task to walk through it. Cactus is one of the chief products of the islands of the group, yet it was not observed on San

Benedicto. It may, however, exist in small quantities. There was neither wood, water, nor even a bush seen on the island; but it was the home of thousands of sea birds, man-of-war hawks and three or four species of booby being the most numerous. A raven and rock wren were the only land birds found; and there were very few insects, grasshoppers and spiders being the only ones seen. Fish were abundant, the species being identical with those of Socorro.

The sailing directions mention a small shingle beach as the best landing, but other portions of the island are inaccessible from it, so our collectors landed on the rocks north of the beach at the foot of the bluff, from which point they had free access to the plateaus on either hand. Whales, old and young, were constantly in sight near the island. The collectors returning at 2 p. m., we got under way for the Gulf of California and carried our line of soundings to the vicinity of Cape San Lucas, the greatest depth, 1,807 fathoms, being found 22 miles from the island.

Hydrographic conclusions.—Reports of islands, rocks, and reefs in the regions recently traversed by the *Albatross* have been current from time immemorial. The U. S. S. *Narragansett's* investigations resulted in their being expunged from the charts, but she gave us no information regarding the contour of the ocean bed, which is really the only sure method of deciding the existence or non-existence of submarine elevations. This gap has been filled by the soundings of the *Albatross*, which prove definitely that these vigias do not exist in the positions assigned them.

Another important problem has been solved. The chain of islands commencing with Guadeloupe and extending to Los Alijos and the Revilla Gigedo group have been considered as a submerged mountain range, extending parallel with the peninsula, connected with it by a submarine ridge at one extremity and, previous to the submergence, inclosing a gulf similar to the Gulf of California. The *Albatross* soundings not only show this to be an error, but demonstrate the fact that the several islands are isolated volcanic elevations entirely independent of the continent and of each other, the sea reaching its normal depth between each of them, and also between them and the peninsula.

La Paz to San Josef Island.—We entered the gulf on the evening of March 11 and arrived at Pichilingue Bay, the United States coaling station, at 11:24 a. m. the following day. An officer was sent to La Paz to call on the United States consul, Mr. James Viosca, and the following morning I visited him and with him made official calls on the military governor and captain of the port. A lighter was towed from town by the steam cutter, and the work of coaling commenced immediately on our arrival. We finished coaling on the afternoon of the 15th, having taken on board 90 tons.

Getting under way at 7:30 on the morning of the 16th, we steamed to the northward through La Paz Bay, and at 11:03 cast the trawl in 112 fathoms, green mud, Balleñas Island bearing E. by S. (magnetic) 4 miles.

There were but few specimens taken, and the tow net demonstrated the entire absence of life on the surface.

The trawl was cast again at 1:26 p. m. in 211 fathoms, midway between Espiritu Santo and San Josef Islands, and as in the previous haul few specimens were taken. The lead rope was loaded with seaweed having the offensive odor of decaying organic matter. The character of the bottom in this region is represented as rocky by the Hydrographic Office chart, and judging by the appearance of the arming on the lead, which was indented without bringing up a specimen, we would have confirmed it, but the trawl showed a perfectly smooth bottom, and the presence in the net of two or three small pieces of compact sand revealed the true nature of the soil. Another haul of the trawl was made in 40 fathoms, sand and broken shells, between San Josef Island and the mainland, in which the same offensive weed was found and very little else. The tow net showed an almost total absence of life on the surface.

Arriving off Salinas Point, San Josef Island, at 4:40, we landed a fishing party, which made several hauls with the seine while the ship was engaged in dredging. The oyster dredge was used, and outside of 20 fathoms very few mollusca were found, but in from 10 to 12 fathoms the ground was literally covered with living and dead shells, having a sprinkling of pearl oysters among them. At 5:50 p. m. we came to for the night in Salinas anchorage, the fishing party returning a few minutes later.

Getting under way at daylight the following morning, we steamed to the entrance of a salt-water lagoon, near the north west end of the island, which we were informed in La Paz was the best place on the west side of the gulf for oysters. Two boats were sent in charge of Professor Gilbert to investigate the matter, and returned in about 2 hours, bringing specimens of mangrove oysters. These have small, round shells, with fluted edges, and are very salt and bitter, with a slight coppery taste. While they might be considered edible, they are inferior to the poorest wild oysters on the Atlantic coast. The temperature of surface and bottom was 71°; specific gravity, 1.027764, a little above the average of sea water.

San Josef Island to Carmen Island.—Continuing our course to the northward, a haul of the trawl was made at 12:30 p. m. in 362 fathoms, green mud. The bottom was very soft, the net taking in an enormous load of mud, which required much time and patience to get rid of before it could be landed. There was a large number of deep-sea cusk taken, the haul being remarkable for the absence of other forms of life usually found at that depth.

At 7:15 p. m. we anchored in Salinas Bay, Carmen Island, which is an excellent harbor during northerly winds, although open to the southward. The submarine electric light was put over during the evening, attracting a school of mackerel. Quite a large number were taken with hook and line, but their flesh was found to be dry and lacking in flavor.

Seining and fishing parties were sent at daylight next morning with the expectation of finding rich working ground, but to our surprise very little life was found in the bay. Scattering specimens only were taken in the seine, and the line fishermen met with no success. Long-shelled oysters have been reported, but we found none, and the inhabitants knew nothing of their existence.

Carmen Island is justly celebrated for its salt pond, which is one of the most remarkable formations of its kind on the continent and is profitably worked notwithstanding high freights to San Francisco and the duty imposed by the United States Government. The pond is oblong in form, covering an area of about 5 square miles, its nearest approach to the sea being a third of a mile. It has no surface connection with the gulf, but at high tide sufficient water percolates through the sand and shingle barrier to maintain the general level. Standing on the shores one sees before him a solid mass of pure white salt, its myriads of shining crystals glistening like a field of diamonds under the rays of a semi-tropical sun. The salt is deposited in strata from 4 to 6 inches in thickness at the surface, increasing to 12 inches at 15 feet, the greatest depth to which the bed has been examined. Between the strata are spaces of 1 to 2 inches, filled with water and black mud, which is doubtless the earthy impurity precipitated during the process of evaporation. The method of collecting the salt is simple and inexpensive. Men with crowbars break from the surface pieces of convenient size, which are loaded into mule carts, transported to the shore, and piled in large masses to dry, after which it is ready for shipment. The space from which salt is taken fills with water, and the process of evaporation begins at once, a few weeks only being required to replace the quantity extracted. In fact, so rapid is the work of reproduction carried on under the cloudless skies of the gulf that, although thousands of tons are removed annually, a small portion only of the surface is ever disturbed.

Carmen Island to Conception Bay and Guaymas.—We were under way at 3:10 p. m., and an hour later cast the trawl in 306 fathoms, soft green mud. An enormous load of mud was brought up in which was found quite a number of deep-sea cusk, but no other life. It had the same offensive odor before mentioned.

At daylight the following morning, March 19, we entered Conception Bay, and at 7:15 anchored off the north part of Coyote Bay. Seining and fishing parties were sent out among the islands, but fish were scarce and the few seen about the rocks would not take the hook. The region was so unpromising that we got under way at 1:45 p. m. for Mulegè, anchoring off that place at 2:50. A seining party met with good success in the mouth of the river, returning with a boat load of fine fish of various species. It was the first place on the west shores of the gulf where we found fish in large numbers, and the Mulegè River being the only fresh water encountered the natural inference was that fish

would be found in quantities only at or near the mouths of streams. Leaving Mulegè at 2:05 a. m. on the 20th, a line of soundings, serial temperatures, and specific gravities was run across the gulf. The trawl and surface net were put over at two stations in 857 fathoms and 1,005 fathoms, and the submarine electric light was used with success during the evening.

Cape Haro light was sighted at dark, and at 11:20 p. m. we came to in the outer anchorage of Guaymas, moving to the inner harbor on the morning of the 21st. We were boarded by the captain of the port soon after anchoring, and an hour later by the United States consul, Mr. Alex. Willard, who has ably represented the Government at that port for 22 years. A large mail awaited our arrival. Official visits were exchanged with the military governor, prefect, and others, all of whom expressed great interest in our work, and a desire to assist us in every way possible. The naturalists were busy about the shores of the bay during our stay in port, adding a number of species to our list of fishes, several varieties being procured from local fishermen and from the market.

Guaymas to the mouth of the Colorado River.—We left Guaymas at 7:40 a. m., March 23, steaming to the northward, and at 2 p. m. a haul of the trawl was made in 71 fathoms, gray sand, 16 miles WNW. (magnetic) from San Pedro Nolasco Island. Three more hauls were made during the afternoon at intervals of one to two hours over the same character of bottom, the depths decreasing to 14 fathoms. They were all very rich in the number and variety of fish taken, and other forms were more plentiful than on the western shores.

A sounding, serial temperatures, and specific gravities were taken in the channel between Estaban and Tiburon Islands in 89 fathoms, and at 5:30 a. m., March 24, the observations were repeated in 145 fathoms, Rock Point, Angel de la Guardia Island bearing WSW. $\frac{3}{4}$ W. (magnetic), 18.5 miles distant. A successful haul of the trawl was made at the last station, followed by seven casts during the day, the last one being off George Island, where at 9.30 p. m. we anchored in 13 fathoms, the south end bearing NE. $\frac{1}{2}$ E. (magnetic), about a mile distant. Collectors and fishing parties left for the island at daylight, returning at 8:50 with a few fish and sea birds. The fishermen were more successful on board, having taken a large number of squeteague and a species of sea bass, an excellent fish weighing from 60 to 160 pounds, besides other species with which I was not familiar. The island was found to be a barren, guano-covered rock, on which were many sea birds and a rookery of sea lions.

Getting under way on the return of the boats, we steamed across George's Bay, anchoring at 11:25 a. m. off the entrance to a lagoon, Rocky Point bearing WNW. $\frac{1}{2}$ W. (magnetic), 6 miles. A seining party was sent in, but returned several hours later, much disappointed at the barrenness of the region. We were more successful on board

ship, however, many fine fish having been taken, the species identical with those of George Island. The entrance to the lagoon is hidden at the distance of a few miles by low rocky ledges nearly awash at high water, the channel lying between them and the shore. Our boats found no difficulty in crossing the bar at half tide. We were under way again at 3:15 p. m., steaming to the northward. Four hauls of the trawl were made during the evening, the surface net being put over at each cast, and at 9 p. m. we came to in 19 fathoms for the night. We were in the open gulf with no immediate protection by land, yet the sea was perfectly smooth and the vessel as quiet as though she had been securely moored in the snuggest harbor in the gulf.

It was foggy from 2 to 4 a. m., on the 26th, with drizzling rain, and the land was obscured at daylight, but we felt our way with the lead, finally anchoring at 7:20 a. m. $3\frac{1}{2}$ miles below Shoal Point. Collectors and seining parties were sent on shore, returning at 1 p. m. with a few birds and fish, but they reported the region almost barren of life. We were under way again at 3 p. m., made three hauls of the trawl over a clean, sand bottom with but little life, and at 4:55 anchored in 11 fathoms, Direction Hill bearing N. W. $\frac{3}{4}$ N., 7.5 miles distant. Trial lines were put over, and large numbers of squeteague and sea bass were taken. The former averaged about 10 pounds in weight, and the latter ranged from 70 to 150 pounds. So many were taken that I was obliged to put a stop to the fishing. A gill net was set during the evening, but was soon wrecked by a shark which dashed in to secure a squeteague already enmeshed. Sharks and dogfish were found throughout the gulf in sufficient numbers to make gill-net fishing impracticable. The region about our anchorage was examined with a view of detecting the presence of shad, but the seine, beam trawl, and gill net failed to capture a single specimen.

Colorado River to Guaymas.—The fishermen having returned to the ship, we got under way at 3:20 on the morning of the 27th and steamed to the southward in the direction of Consag Rock, taking soundings, serial temperatures, and specific gravities at intervals of 8 or 10 miles. The results will be found in the table accompanying this report. Arriving off the rock at 7 a. m., three hauls of the trawl were made in the vicinity, while the naturalists were examining the shores. A soft, gray mud filled the trawl net to such an extent that much time was consumed in landing it after some of the hauls. The naturalists found but little life on or near the rocks, and the fish paid absolutely no attention to a baited hook. Consag Rock is conical in form, entirely barren, and is the resort of sea birds and sea lions.

At 8:30 we steamed to the southward, taking an occasional haul of the trawl, the mud of the bottom becoming softer and more barren as we approached the western shore. An excellent anchorage in 7 fathoms was reached at 6:15 p. m. off the south side of San Luis Island. The western portion of the island is composed of dark-red lava rock, while

its sea face and the large rock to the eastward of it are solid masses of pumice-stone. Large numbers of sea lions were seen on the rocks to the northward of our anchorage, and whales and porpoises were plentiful, but the latter seemed very wild. The collectors were out at daylight the following morning, returning at 8:10 with fish, turtles, etc. Three sea lions were brought in and skinned, and two skeletons prepared. As soon as the boats were hoisted we steamed into Willard Bay and anchored at 10:35 a. m. in 6 fathoms, sand and mud. Fishing parties and shore collectors left as soon as the anchor was down.

Willard Bay is not shown on the gulf chart, and as it is a safe anchorage, entirely protected from all winds except from the southward, and partially protected even in that direction, we made a reconnoissance of it during the day, which is sufficiently accurate for purposes of navigation. The position of the observation spot is reliable, having been located by equal altitudes of the sun for longitude, and ex-meridian and meridian altitudes for latitude, the artificial horizon being used. The lagoon mentioned in Hydrographic Notice No. 6, 1889, is a bay opening to the sea north of the island forming the north and east sides of Willard Bay, the two being connected by a narrow channel through which boats can pass at half tide. It was dry at low water. The seining parties were fairly successful, and the line fishermen found many fish about the rocks, but they would not take a hook. The collectors were out again at daylight on the 29th, returning at 9 a. m., when we got under way, skirted the southern shores of San Luis Gonzales Bay to Cape Final, thence across Balleñas Channel to Puerta Refugio, Angel de la Guardia Island, where we arrived at 3:15 p. m. and anchored in 7½ fathoms.

The sailing directions mention Puerta Refugio as being noted for iguanas and rattlesnakes. We saw none of the former, but found many lizards on the low land near the bay, the specimens procured measuring from 14 to 18 inches in length. It was early in the season for rattlesnakes, yet two were captured near the beach. The collectors returned at 5 p. m. with a variety of shoal-water specimens and a couple of seals, besides the lizards and rattlesnakes before mentioned. Whales were in sight most of the day, and about noon we passed within a mile or two of a dead one, on which thousands of birds were feasting. Getting under way, at 5:25 we steamed out of the eastern entrance en route for Guaymas. Puerta Refugio is an excellent harbor, entirely protected except from northerly and easterly winds, and Granite Island affords partial protection in that direction. The latter island, as its name implies, is a solid mass of excellent granite.

At 12:30 a. m., March 30, we entered the channel between Tiburon and San Estaban Islands, doubled Cape Haro at 3 p. m., and came to in the inner harbor of Guaymas at 3:55 p. m. The United States consul visited the ship, and in the evening General Julio M. Cervantes, military governor, with a large number of gentlemen, came on board and examined

specimens, apparatus, and the vessel itself. They were particularly interested in our explorations in the gulf, and examined the various specimens with great interest, expressing surprise at the variety of marine fauna which they had never seen nor heard of before. The submarine electric light attracted much attention.

Guaymas to Cape San Lucas; study of oyster beds.—The naturalists were out at daylight on the 31st, returning at 7 a. m., and half an hour later we left the harbor for the oyster grounds about the Yaqui River. At 9:45 a haul of the trawl was made in 20 fathoms, mud, and an hour later we came to off the entrance to Algodones Lagoon, from which most of the oysters sold in the Guaymas market are obtained. There was about 5 feet of water on the bar at low tide, and from 5 to 20 feet in the lagoon. The temperature of the water was 69° F., specific gravity 1.026508.

Oysters of excellent quality were found in abundance on banks, and in clusters scattered about the bottom, which was composed of sand and mud, most of them being exposed at ordinary low water, and all of them at spring tides. The oysters were about the size of those found in Chesapeake Bay, perhaps a little smaller, plump, and fat, of excellent flavor, and compared favorably with the wild Raccoon oysters of the Atlantic Coast. Indians collect them by hand, transport them to Guaymas in canoes, and sell them for \$1 per 1,000.

San Juan Lagoon lies between Algodones and the Yaqui River. The depth of water is about the same, the temperature 70° F., and specific gravity 1.026808; bottom, sand and mud. The beds were more extensive than at Algodones, and the oysters ran about the same size, but were not so fat or of as fine a flavor.

An examination of the Yaqui River was made on the afternoon of April 1. Fresh water extended to the bar and flowed into the gulf in large volumes. There were no indications of oysters inside of the bar, not even dead shells. Myriads of sea birds were gathered on the beaches and extensive sand bars. A couple of Indian fishermen anchored in the brackish water just outside of the bar and, with the crudest fishing gear, in less than 2 hours, loaded their canoe with jewfish and large sea bass. Trial lines were put over from the ship at her anchorages off the lagoons and river mouth, taking many catfish. The collectors returned at 5:15 p. m., when we got under way and steamed to the southward, anchoring at 8:53 a. m., the following day, off a lagoon or estero, about 3 miles north of Rio del Fuerte. Fish were found in great abundance, squeteague, Spanish mackerel, and mullet being among the most numerous.

The naturalists returned to the ship at 4 p. m., and the time allotted for explorations in the gulf having expired, we got under way for La Paz, where we arrived at 8:30 on the morning of April 3. The United States consul visited the ship, and with him I called on the military governor, who, with his staff, returned the visit during the afternoon.

The ship was thrown open to visitors and large numbers availed themselves of the opportunity to see a vessel of which they had heard so much. We left the harbor at 6:15 the following morning with two coal lighters in tow, arriving in Pichilique Bay at 7:40. Coaling commenced soon after and continued with slight interruptions until the morning of April 6, when we had received 95 tons, sufficient for the return trip to San Francisco. Getting under way at 9:05, we returned the lighters to La Paz, made final preparations for sea, and left the harbor at 1:25 p. m. for Cape San Lucas, arriving at 12:10 p. m. the following day. Fishing and seining parties went out as usual, returning at 4 p. m., having met with little success. A few fish were taken with the seine, and great numbers were seen around the Frailes, but they refused the hook. The run from La Paz to Cape San Lucas was made with one boiler, using the coal recently taken from the naval station at Pichilique Bay, and although the sea was smooth we found it impossible to make more than six or seven knots an hour. This speed would have been reduced to four or five knots after reaching the Pacific, with the coast winds and swell to contend with, so time being an important element, we lighted all fires for the first time since our arrival in Bahia, December 19, 1887.

Cape San Lucas to San Francisco.—We left San Lucas Bay at 4:20 p. m., and encountered a moderate head wind and sea after rounding the Frailes into the Pacific. Two hauls of the trawl were made off the entrance to Magdalena Bay the following morning in 31 and 47 fathoms, and at 12:46 p. m. we anchored in Man-of-War Cove, off the village of Magdalena. The collectors went out at once, returning at dark fairly successful, although the variety of fish was not so great as we were led to expect from various reports. Information was received that excellent oysters could be found in the bay, but on investigation it was ascertained that they were the mangrove oysters, growing about 40 miles to the northward, near Boca del Soledad.

The collectors were out at daylight on the 9th, and at 1 p. m. we got under way, picked up one of our seining parties, and made several hauls of the trawl, in which many flounders and other species of fish were taken, finally anchoring again at 4:30. The collectors returned an hour later after a successful day's work, when we got under way and proceeded to sea. The U. S. Coast Survey steamer *Gedney*, en route from the Atlantic to San Francisco, was sighted as we left the bay. Moderate head winds and seas were encountered during the night and following day. Three hauls of the trawl were made in 74, 58, and 184 fathoms.

At 7:15 a. m., on the 11th, we anchored in San Bartolome Bay, where we found the U. S. S. *Ranger*, which had arrived from San Diego the previous evening. Fishing and seining parties were sent out during the day, but met with indifferent success, although the bay is reported to be an excellent fishing ground. The officers and crew of the *Ranger* made three hauls of the seine, the first being practically a water haul,

the second resulting in the capture of a half-dozen green turtles and a few fish, the third and last haul surprising all hands by bringing in 162 green turtles, some of them of enormous size, besides two or three dozen fish of various species.

Seining parties were out at daylight on the 12th, returning at 8 a. m. The *Ranger* left the harbor at 5, and at 8:50 the *Albatross* got under way, steamed through Dewey Channel, and at 1:30 p. m. came to in an open bay to the northward of Marro Redondo, Cerros Island. Shore collectors and a seining party left the ship, returning at 3:45, when we got under way for San Quentin. The usual coast wind and swell were encountered during the night, and at 11:30 the following morning we anchored off Entrada Point. A seining party was sent into the bay, and hand lines were put over the rail, taking large numbers of smelt, some of them measuring 14 inches in length. The boats returned at 3:55, and we left immediately for San Martin Island, anchoring off Hassler Cove at 5:50. A seining party left the ship, returning at 7:45, after several successful hauls on the beach. We left San Martin at 8 p. m. and steamed to the northward during the night. The dry, clear weather of the Southern Peninsula and Gulf of California was succeeded by frequent squalls and drizzling rain, which continued at intervals until meridian on the 14th, when we passed Los Coronados, and at 2:45 p. m. arrived in the harbor of San Diego.

The Coast Survey steamer *Gedney* arrived on the morning of the 17th. Mr. C. H. Townsend left for a trip to the mountain regions of the peninsula of Lower California, and on the following day Prof. C. H. Gilbert and Mr. A. B. Alexander left the ship under orders from the Commissioner to proceed to Yuma, and from that place as a base, to make explorations in the Colorado and Gila Rivers for the purpose of ascertaining the existence of shad in those streams. The specimens taken during the winter's cruise were shipped through the Quartermaster's Department, U. S. Army, to the Fish Commission in Washington. We remained in San Diego several days to paint ship and attend to other work that could be advantageously executed in that excellent harbor.

COASTS OF WASHINGTON AND OREGON.

Preparations for the cruise.—At 3:45 p. m., April 22, we left San Diego for San Francisco, arriving at 2:10 a. m. on the 25th, after a moderately smooth and uneventful trip. The Russian corvette *Kreysser* and Coast Survey steamers *Hassler* and *Gedney* were lying in port, and joined this vessel in dressing ship in honor of the centennial of Washington's inauguration on the 30th of April. The *Kreysser* fired a national salute of 21 guns at meridian.

Senators Hale and Allison visited the ship May 8, and inspected her quarters with a view to accepting her services for the purpose of transporting to Sitka the Senate committee, of which Senator Hoar was chairman. They seemed favorably impressed with the vessel and promised to report to the committee at once.

The *Albatross* remained at anchor, the crew being busily engaged in giving her a general overhauling, until the afternoon of the 9th, when we got under way and steamed to the U. S. light-house station, where, through the politeness of the inspector, Commander Nicoll Ludlow, U. S. Navy, we were allowed to stow a number of spare articles, which we were desirous of getting out of the vessel in order to give us a much-desired increase of room in the holds. From the light-house station we went to the Union Iron Works to put new boilers, just received from the Herreshoff Manufacturing Company, in the gig and cutter; to dock and paint the ship's bottom, and make necessary repairs which could not be effected by our own crew.

The Senate committee formally accepted the services of the vessel on May 11 to take them to Sitka. It was stipulated that we would meet them at Victoria, British Columbia, on May 28, and return to Seattle or Tacoma June 7, the committee to pay the expenses of the trip. The early departure of the vessel in order to reach Victoria at the appointed time necessitated the utmost dispatch in our preparations for sea. She was docked and painted on the 14th and 15th. Paymaster's stores were received from Mare Island on the 18th, and the installation of new boilers in the steam cutters was completed the same evening. Other repairs were sufficiently advanced for our own men to complete them. We left the iron works at high tide on the 19th, anchoring in the harbor until the following morning, when we went to the wharf, took on board 69½ tons of coal besides various stores, and at 5 p. m. anchored in the stream. Professor Gilbert and Mr. Alexander returned to the ship on the 21st from their expedition up the Colorado and Gila Rivers.

San Francisco to Seattle.—We were ready for sea on the morning of the 21st, and at 12:50 p. m. got under way and left the harbor en route for Departure Bay, British Columbia. Passing Point Bonita at 2 p. m. we reached Point Reyes at 6:27, the wind and sea increasing until at midnight there was a moderate gale from NW., with a heavy head sea. This moderated during the 22d and 23d, and on the 24th the wind was light and variable, with a smooth sea. We passed the Columbia River during the forenoon of the 24th, and at 12:30 a. m. on the 25th doubled Cape Flattery and entered the Straits of Juan de Fuca. The weather was overcast and foggy, lighting up at intervals until 4 a. m., and then a dense fog shut down till 7 a. m., when we ran out of it and had clear, pleasant weather during the remainder of the day. Passing Race Island light at 6:10, we steamed through Haro Strait, Swanson Channel, Active Pass, and the Gulf of Georgia, arriving at Departure Bay at 2:25 p. m. Going to the wharf at 3:15 we commenced coaling at once. Work was resumed at 5:30 the following morning, and we left the wharf at 3:15 p. m., having received 144½ tons. Leaving the harbor half an hour later we entered Active Pass at 9:17, and at 10 anchored in 10 fathoms in Miners' Bay. The weather was overcast at midnight, with moderate southerly winds and frequent showers of rain. We were under way at

4:15, and at 8:10 a. m. anchored off the steamer wharf in the outer harbor of Victoria. An officer was sent to call on the U. S. consul, who visited the ship at 10:30 a. m.

Final preparations were made, and at 4 p. m. the vessel was ready for sea. The Senate committee arrived at 6 p. m., and when called upon informed us that it had become necessary to change their plans and abandon the contemplated trip to Alaska. Having nothing further to detain us we left Victoria at 5:30 on the morning of the 29th and anchored in Port Townsend at 9:45, when inquiries were made concerning supplies ordered to meet us there, but they had not arrived. We went to Seattle the following morning and remained until June 6, waiting for alcohol, making some repairs in the engineer's department, and attending to other matters which were left unfinished on our hurried departure from San Francisco. The consignment of alcohol failing to arrive, a small quantity was purchased in open market, and we left port for a cruise off the coasts of Oregon and Washington Territory. We called at Port Townsend on our way down the sound to get a dory for fishing purposes, but could find none for sale.

Coast of Washington.—Getting under way from the latter place at 11:30 a. m., we entered the Straits of Juan de Fuca an hour later, encountering a fresh head wind and chopping sea, which reduced the speed considerably, as we were using only one boiler. We passed Cape Flattery at 10 p. m. and, although the wind had moderated, a heavy swell still rolled in from the westward, knocking the ship about uncomfortably, our course placing her in the trough of the sea.

At 9:10 a. m. on the 7th we cast the trawl in 48 fathoms on the bank off Shoalwater Bay, and spent the remainder of the day in exploring the bay, the beam trawl, trawl line, and hand lines being used. Flounders and red rock-cod were the principal fish taken and they were fairly abundant, although not sufficiently so to warrant an attempt to take them on a large scale. Scattering dogfish and skates were taken on the trawl line and many of the baits were covered by starfish. Whales were seen on the bank during the day.

Coast of Oregon.—At 4 p. m. we started to the southward, passed within range of Cape Disappointment and Tillamook Lights, and at 3:18 a. m., on the 8th, were abreast of Yaquina Light. Taking our departure from the point, we ran for Heceta Bank, where we arrived at 8:50 and sounded in 46 fathoms, rocky bottom. A trawl line was set and the beam trawl put over, but it caught on the rocky bottom and wrecked the net. The tangles being substituted, several hauls were made, bringing up gorgonian corals, sponges, bryozoans, erinoids, pennatulas, ophiurans, starfish, sea-urchins, etc., which indicated live bottom. In addition to the trawl line, which was set as soon as we reached the bank, trial lines were used from the ship at intervals, and boats were anchored at different parts of the bank, from which hand lines were used. Each method was fairly successful, large numbers of red rock-cod and orange

rock-cod being taken, besides scattering specimens of yellow-tails, dog-fish, etc. The red rock-cod are plentiful, and a well-conducted fishing vessel could take them in large numbers.

Leaving the bank at dark, a line of soundings was run to Yaquina Head, developing a maximum depth of 78 fathoms. At 6.55, on the morning of the 9th, we cast the trawl in 28 fathoms, fine gray sand, Yaquina Head bearing east (magnetic) 27 miles, seven species of flounders being taken, besides crabs, shrimps, etc. A fishing party was sent out in a boat, but met with no success. We then steamed off shore, keeping the light-house on the same bearing, east (magnetic), and repeated the trials in 43 fathoms, coarse gray sand, taking large numbers of flounders in the trawl, the line fishermen being equally successful with orange rock-cod. Wind and sea increased during the morning, finally becoming too rough for boat work, so to utilize the time we ran in and anchored under Yaquina Head, where the ship was partially protected, and sent a fishing party out in a boat to examine the shore line to leeward of the rocks. The party returned after several hours' work without a fish, and no better success attended the use of hand lines on board ship.

Leaving our anchorage at 2:30 p. m., we made two hauls of the trawl in 38 and 77 fathoms, the trial lines being put over at the former station without result. The trawl was landed on deck at 8 p. m., and we then started for Tillamook Rock, our next point for investigation. The wind and sea were so heavy that we did not reach the rock till 10:20 the following morning, and then it was too rough for boat work; in fact, the indications were so unfavorable that we ran for Astoria, where we anchored at 3 p. m. the same day. We learned on our arrival of the burning of the business portion of Seattle, the fire having occurred on the afternoon of the 6th, a few hours after we left the harbor.

The light-house steamer *Manzanita* made an ineffectual attempt to land supplies at Tillamook on the 11th, and left the harbor again at 3:30 a. m., June 13, in company with this vessel. Arriving at the rock, the former made fast to her moorings and commenced landing supplies for the light-house, while we set a trawl line across the channel inside of the rock, made three hauls of the trawl, and used the hand lines from the rail. The trawl line, with 700 baited hooks, remained on the bottom four hours, taking one halibut and one large skate. Many of the hooks were covered by large starfish, but the majority of the baits remained untouched. Three halibut and a ground shark were taken with hand lines from the *Manzanita* while lying at her moorings. Specimens taken with the beam trawl included eight species of flounders, hake, tomcod, sculpins, shrimp, smelt, crabs, an octopus, etc., while a few red rockfish were caught with the trial lines.

We left Tillamook at 11:15 a. m. for Cape Flattery. Three hauls of the trawl were made during the afternoon in 46, 27, and 55 fathoms between the rock and Cape Disappointment, the character of the fauna being similar to that found off Tillamook in the same depths. Trial lines were put over at each station without result.

Coast of Washington.—A sudden and marked change in the color of the water was observed after we passed Cape Disappointment, the light green of the region off Columbia River giving place to a dark olive-brown strongly resembling the cypress water of the Virginia and Carolina swamps. It became somewhat lighter as we approached the coast near Cape Flattery, but off shore and on the banks south of Vancouver Island it still retained the peculiar tint described, which seemed to indicate its northern origin.

The weather became overcast and misty after dark, and at midnight we were enveloped in a dense fog, through which we groped our way to the halibut bank off Cape Flattery, where, at 10:27 a. m., on the 14th, we sounded in 31 fathoms, gravel and broken shells, and set a trawl line. Trial lines were put over the side whenever the vessel was lying still, taking several red rock-cod and a halibut weighing 93 pounds. The trawl line was allowed to remain on the bottom about 3 hours, taking 8 halibut, 10 red rock-cod, 1 cultus-cod, and a few scattering specimens of other fish. This result, considering that the line was set without previous trials, indicated the presence of large numbers of halibut and rock-cod and very few dogfish, only 3 or 4 having been taken.

The boats returned at 2 p. m. and, the fog being still very thick, we felt our way into Neeah Bay for a harbor, intending to continue our work as soon as the weather favored us. The 15th brought no improvement, the indications being so unpromising that we considered it advisable to return to the sound, and leaving our anchorage at 4.20 a. m. we arrived at Port Townsend at 2 p. m., where we found a quantity of supplies awaiting us. After taking them on board we steamed to Seattle, where we arrived at 6:40 p. m. The city front presented a most desolate appearance, nearly 100 acres having been burned over. The hundreds of busy men seen clearing the wreck next morning, preparatory to rebuilding, is an evidence of the push and enterprise of the people of this young and promising city.

We remained at anchor until the afternoon of the 18th, when we got under way and made a couple of hauls of the trawl in 82 and 135 fathoms off Dwamish Head. Among the specimens taken were several chimæras, three species of flounders, hake, skate, starfish, sea-anemones, shrimp, shells, etc., none of them in large numbers. Having finished dredging we anchored off Point Orchard and sent out a seining party, but they met with indifferent success. Fishing and seining parties were away during the forenoon of the 19th, and at Meridian we got under way and returned to Seattle.

A consignment of 6 barrels of alcohol reached Port Townsend, and on receiving information of its arrival we went there immediately and took it on board, intending to make a short cruise off the coast before going to the mines for coal. We were detained by unfavorable weather until 10:50 a. m., on the 27th, when we got under way and proceeded to sea.

Passing Cape Flattery at 10 p. m., we steamed offshore until 7:45 a. m. on the 28th, when the trawl was cast in 760 fathoms, green mud. A heavy westerly swell caused the ship to tumble about so much that it was difficult to carry on our work, and finally resulted in parting the bridle stops, causing the net to come up tail first, and practically empty. There were, however, a few pennatulæ, starfish, holothurians, etc., adhering to the net. Four more hauls were made during the day in 636, 685, 584, and 477 fathoms, the bottom being uniformly of green mud. The wind and sea increased with heavy rain squalls, making it necessary to use the small trawl the latter part of the day, the weather being too boisterous to handle the large one with safety. The results were very satisfactory and, it being practically new ground, many unrecognized specimens were taken besides others that were familiar, among them being several species of flounders, deep-sea sole, Norway haddock, red rock-cod, macruri, chimæras, hag-fish, *Antimora*, and other small species. Among the invertebrates were shrimp, sea-urchins, holothurians, ophiurans, starfish, sea-anemones, crinoids, pennatulæ, hermit crabs, annelids, etc.

The weather was partially overcast on the 29th, with moderate winds and heavy westerly swells. Three hauls of the trawl were made in 877, 859, and 178 fathoms, green mud, with excellent results. Among the fishes recognized were Norway haddock, flounders, sole, red rock-cod, and a single specimen of black cod taken in 859 fathoms, the greatest depth in which they have been found. Among the invertebrates were holothurians, sea-anemones, starfish, ophiurans, hermit crabs, an octopus, shrimp, annelids, sea-urchins, pennatulæ, etc., the greatest amount of life being found in about 200 fathoms.

The stations occupied on the 28th and 29th extended our explorations from the shore to 877 fathoms, and gave us a very good representation of the marine fauna occupying the various depths. A notable feature in the hauls made during the trip was the absence of mud in the trawl net when it reached the surface, although soft green mud was reported at every station. This would seem to indicate that the bottom was composed largely of very fine sand, rather than mud, or at least the absence of clay. A few whales were seen, but with this exception no surface life was observed. The brown albatross and an occasional petrel were the only birds seen, except near the land, where gulls were plentiful.

The last haul of the trawl was finished at 5:28, when we steamed for Cape Flattery, en route for Departure Bay, British Columbia, for coal. Passing the cape at 10 p. m., we entered the Straits of Juan de Fuca, through which we steamed to Haro Strait, Active Pass, and the Gulf of Georgia, arriving at the coaling station at 3 p. m., June 30, where arrangements were made for coaling preparatory to taking the U. S. Senate committee on Indian Affairs to Alaska.

PERSONNEL.

The following officers were attached to the vessel June 30, 1889: Lieut. Commander Z. L. Tanner, U. S. N., commanding; Ensign Marbury Johnston, U. S. N., executive officer and navigator; Ensign Henry E. Parmenter, U. S. N.; Ensign Edward W. Eberle, U. S. N.; Ensign C. M. McCormick, U. S. N.; Passed Assistant Surgeon James E. Gardner, U. S. N.; Assistant Paymaster C. S. Williams, U. S. N.; Passed Assistant Engineer C. R. Roelker, U. S. N.

The civilian staff was constituted as follows: Prof. Charles H. Gilbert, naturalist; Charles H. Townsend, assistant naturalist; A. B. Alexander, fishery expert; N. B. Miller, assistant; H. C. Fassett, clerk to commanding officer.

REPORT OF A. B. ALEXANDER, FISHERY EXPERT.

[From January 1 to June 30, 1889.—Abstract.]

COAST OF SOUTHERN CALIFORNIA.

Santa Barbara Channel.—The second cruise of the steamer *Albatross* on the Pacific coast began January 3, 1889, but no work was done until the morning of the 5th, when the trawl was put over in the vicinity of Point Conception, California, in 225 fathoms. Among the specimens collected were 1 black cod or beshowe (*Anoplopoma fimbria*), 2 specimens of octopus, and 7 red rockfish. About 11½ miles farther southeast, the beam trawl was lowered in 284 fathoms and, while the dredging was going on, a cod trawl was baited with salt herring, 2 barrels of which were purchased in San Francisco. When fresh bait can not be obtained this salt fish is generally used by the fishermen at that place. At 1.15 p. m. the dingey left the ship's side and the trawl was set in 53 fathoms of water; bottom, broken shells and sand; Richardson's Rock bearing east, about 1 mile distant. After setting, we lay to and began fishing with hand lines, the ship dredging in the meantime. Several species of fish were taken in the beam trawl, but nothing was caught on the hand lines.

At the end of an hour we began to haul the trawl. The tide, which was running to windward, against a fresh northerly breeze, caused the dingey to "hawse up" considerably, however, and on several occasions large quantities of water were taken on board. It requires very little wind or sea to render the dingey unsuited for hauling a trawl, as boats of this class are so deep in the water that it generally takes the united strength of two men to pull it in. We had hauled but a short distance when the ground line parted, compelling us to row to windward and pick up the other buoy. We arrived on board the steamer at 3 p. m. with only four red rockfish.*

* This name is used to designate indiscriminately a large number of species of *Sebastes*.

Early on the following day a trawl line of 500 hooks was set in 197 fathoms, Point Bennett, San Miguel Island, bearing NE. by N. $\frac{1}{2}$ N., $3\frac{1}{4}$ miles distant. The tide was running to the SE. at the time and it was slack water when it was hauled. It was taken up after being down about an hour, and 4 black-cod or beshowe, 1 red rock-cod, and 2 ratfishes (*Chimæra*) were found on the hooks. We had had no information of the occurrence of the black-cod so far south, but judging from the short time the trawl was on the bottom, it is probable that the species might be captured in considerable numbers in this vicinity.

At 5:15 p. m. on the same day the *Albatross* anchored in Becher's Bay, Santa Rosa Island, and a cod trawl was immediately set in 20 fathoms of water, out in the bay towards Santa Cruz Channel. It remained down over night, and when examined the next morning had on it only 1 puffer shark (*Cephaloscyllium ventriosum*), 3 sea-anemones, and 1 crab. I had intended making a landing with the naturalists on Santa Rosa Island for the purpose of seining along the beaches, but as the surf was too heavy the project was abandoned.

On the morning of January 8, while dredging was going on, a trawl line was tried in a depth of 20 fathoms, rocky bottom, about 7 miles to the southward of Point Conception. Hand lines were also used from the ship and from the small boat at the same time, but no fish were taken with either kind of gear.

About 4 miles to the southward of Santa Barbara Light we ran into extensive "slicks" on the surface, caused by petroleum bubbling up through the water. Oil is frequently reported by the fishermen and sea captains in this vicinity, sometimes in small patches and at others covering large areas. Its prevalence in this region probably prevents migratory fishes from schooling in this part of the channel, and possibly may tend to influence their movements over a considerable distance both up and down the channel.

Cortez Bank.—January 16 we sounded in 60 fathoms on Cortez Bank (dredging station No. 2911, latitude $32^{\circ} 27' 30''$ N., longitude $119^{\circ} 05' W.$), where hand lines were put over, taking two red rock-cod and one whitefish (*Caulolatilus princeps**) in the course of about 15 minutes. A second trial was made soon after at hydrographic station 1621, latitude $32^{\circ} 25' 30''$ N., longitude $119^{\circ} 05' W.$; depth 17 fathoms; bottom rocky. Fishing was carried on with hand lines for 45 minutes, during which time the vessel drifted into 5 fathoms of water. The results were as follows: 17 fat-heads (*Trochocopus pulcher*), 10 yellowtails (*Sebastes flavidus*), and 2 sea bass (*Serranus clathratus*). The strong and sharp teeth of the fat-heads played sad havoc with hooks and gangings, stripping the former from the snoods nearly as fast as they could be put on. These fish would be very destructive to trawl lines set across the rocky patches they frequent. The yellowtail rockfish would fol-

* I am indebted to Prof. C. H. Gilbert, naturalist of the *Albatross* during this cruise, for most of the scientific names of the fishes mentioned.

low to the surface any struggling captive at the end of a line; their movements somewhat resemble those of the Atlantic Coast pollock.

Having baited a trawl while the hand-line fishing was going on, we set it at 12:40 p. m. in 26 fathoms, hard bottom. It was allowed to remain down one hour, after which no little difficulty was experienced in hauling it, because many of the hooks caught on the bottom and it was necessary to break the hooks or part the gangings to recover it. When within about 10 fathoms of the end the ground line broke, and we were obliged to haul the remainder of the trawl from the other buoy. The result of the trial was 18 fish, as follows: 2 red rock-cod, 3 whitefish, 1 treefish (*Sebastes serripes*), and 12 fat-heads. We arrived on board the steamer at 3:55 p. m. While the trawl was down, dredging and hand-line fishing were carried on from the ship, the following species being taken by the latter: 39 fat-heads, 37 yellow-tails, 1 whitefish, 3 red rock-cod, 2 black rockfish (*Sebastes mystinus*), 1 scorpion (*Scorpena guttata*), and 2 jewfish (*Stereolepis gigas*). The two specimens of the last-named species weighed 155 and 190 pounds respectively. The fat-heads averaged 10 pounds each in weight. Fishing began in 25 fathoms and was carried into 8½ fathoms.

Cortez Bank was found to be the most promising offshore fishing ground on the California coast south of San Francisco. It has an area of 51 square miles, with depths less than 50 fathoms. The deeper parts of the bank have been surveyed to a slight extent only, but it is probable that good fishing will also be found outside of the 50-fathom line. The shoal part of the bank is about 15 miles long (WNW. and ESE.), its center being in about latitude 32° 26' 30" N., longitude 119° 08' W. Bishop's Rock, which reaches to within 2½ fathoms of the surface, lies in latitude 32° 25' 40" N., longitude 119° 06' 30" W. A fishing vessel at anchor on the bank to windward of this rock would probably find it extremely uncomfortable if caught out in a heavy gale; but as the rock is small, a staunch schooner could work out by it into deep water, if not anchored too near it when the storm began.

Previous to the investigations of the *Albatross* nothing was known respecting the food-fishes inhabiting this bank. The demand for fish along this part of the coast is so limited at present that the fishermen do not find it necessary to venture outside of a few headlands in search of new grounds. They can give but little authentic information respecting the fishing grounds 25 to 30 miles off the coast. The fishing areas adjacent to San Diego and Santa Barbara are sufficient for the immediate requirements of those places, but with a considerable increase in population, more distant and deeper grounds will have to be sought for, necessitating the building of a larger and better class of fishing boats.

As ice is so expensive on the Pacific coast as to prevent its use by the fishermen to any great extent, it would be desirable, when an innovation is made in the fishing vessels of this part of the coast, to build small smacks of 15 to 25 tons burden. If constructed on the model of

the eastern well or smack boats, they could make quick and safe passages to and from Cortez Bank. A week or a fortnight could be spent, if necessary, in obtaining a fare, and by the end of that time fish would still be in good preservation, whereas the present methods compel the fishermen to market their fish daily to prevent their becoming unfit for sale. Several of the fishermen of the region have been interviewed on the subject, but they are not yet ready to make any change in their long-established customs. They now consider it only necessary to keep their fish protected from the sun, and to throw water on them occasionally. One fisherman asserted that he had tried a well smack unsuccessfully, as the fish invariably died soon after coming to anchor in a harbor; but upon being further questioned he acknowledged that he never bailed out the well at such times, an operation which is considered indispensable on the Atlantic coast. The water changes naturally in the well, when the vessel is under way, but there is no appreciable change when its progress is stopped, and frequent bailing is necessary to maintain its purity.

The abundance of edible fishes on Cortez Bank, of the same species which now find a sale in San Diego, Santa Barbara, and Los Angeles, indicates that the resources of this bank are sufficient to supply the southern California markets for some time. The deeper unexplored waters about the bank will probably also add to its importance as a fishing region, but the fishermen are not yet prepared to fish in depths over 100 fathoms, having no knowledge of hurdy-gurdies and other conveniences of the Atlantic coast.

Seventeen and one-half miles NNW. from Bishop's Rock is another small fishing ground discovered by the *Albatross*, which has been called "Tanuer Bank" by the Superintendent of the Coast Survey. It has an area of about 17 square miles, and between it and Cortez Bank depths of 150 to 250 fathoms have been found.

January 17, sounding, dredging, and fishing were carried on continuously over Cortez Bank. Seven trials with the hand lines, from a quarter to half an hour in duration, were made during the day, resulting in the capture of 95 fish. The first was at hydrographic station 1631, 47 fathoms, where 1 white fish and 1 yellow-tail were caught. The second was at hydrographic station 1632, 26 fathoms, where 15 whitefish, 5 red rock-cod, and two fat-heads were taken. These fish ejected their food in coming to the surface, and their stomachs were empty when examined. One cultus-cod, 1 yellow-tail, 2 red rock-cod, and 1 whitefish were the total results of about 20 minutes' fishing at hydrographic station 1633, depth 43 fathoms. The fish took the bait less eagerly than on the preceding trials, and we observed that the vessel had drifted from places where we were hauling them "pair and pair" into others where not a single bite would be felt. The bank seemed to have many spots or ridges where all the species mentioned occurred in great abundance,

but on leaving these places good fishing stopped. The fishing greatly resembled that for red snappers in the Gulf of Mexico.

At hydrographic station 1636, 45 fathoms, no fish were taken. We were possibly drifting in a little gully, and a slight change of position to either side might have brought us over good ground. It frequently happens that in fishing for rock-cod off Cape Ann, Massachusetts, some boats may have excellent success while others only a few feet away will be unable to secure a bite. Twenty-two whitefish, 11 red rock-cod, and 3 fat-heads were subsequently secured in 20 minutes at hydrographic station 1639, 30 fathoms; and 11 fat-heads, 4 yellow-tails, 1 black rock-cod, and 1 scorpion (*Scorpena guttata*), in a few minutes, at hydrographic station 1640, 11 fathoms. The last trial of the day was made shortly after dark at hydrographic station 1641, 51 fathoms, for the purpose of determining the effects of darkness upon the fishing. The results seemed to prove that the fish will not bite after dark, as we were in a good locality and could feel the fish constantly striking against our leads and lines. Not a single specimen was taken on the hooks, however.

San Nicolas Island to San Diego.—We arrived at San Nicolas Island early on the morning of January 18 and anchored a short distance off shore on the southern side. Soon after breakfast a seining party landed, but only two hauls were made on the beaches, a heavy sea filling the boats and tearing the seine on the second trial. An interesting collection of fishes, however, was obtained. While preparing to leave, a Chinese fishing boat rounded the point and anchored near us. This Oriental-looking craft was in search of abaloue shells, which are found in great abundance on San Nicolas Island. The Chinese fishermen of San Diego and neighboring places do a lucrative business in gathering these shells and shipping them to the various markets of the Pacific coast.

The ship returned to San Diego January 19, and the following day numerous seine hauls were made in Spanish Bight, a small sandy bay on the southern side of the harbor. Nothing was taken worthy of special notice, although the net was tried in every available spot. The scarcity of fish may have been due to the state of the tide, which was ebbing at the time.

Tanner Bank; San Clemente Island.—On the morning of January 23 the ship again went to sea, and for 4 days dredging, sounding, fishing, and shore collecting were carried on without interruption. A line of stations was first run to San Clemente Island, an anchorage being made for the night in Smuggler's Cove on the south side of the island. During the evening a herring and a mackerel net were set a short distance from the ship. While doing so we noticed close by what appeared to be a small school of young herring, but on hauling the nets at 5:30 the next morning they were to our surprise entirely empty. It is possible that the school of fish observed was the only one that entered the cove that night, and the fish may have been too small to mesh in the

nets. The only reason that can be assigned for our obtaining no specimens was the exceeding phosphorescence of the water which caused the entire net, even to the foot line, to glow as with a bright flame, thus bringing it out into bold relief, and each time that the float rose and fell with the waves brilliant sparks would be emitted over a considerable distance. Phosphorescence always tends to warn fish against meshing in the gill nets at night, but in night seining, especially with mackerel, it is often of great assistance to the fishermen in locating the schools.

From Smuggler's Cove the ship proceeded to Tanner Bank. The shallow part of the bank was reached early in the day, and dredging and hand-line fishing were begun. The results were practically the same as on Cortez Bank, the species of fish being identical in the two localities, and not differing materially in their relative abundance. Fair fishing was obtained at hydrographic station 1679, 28 fathoms, rocky bottom, the catch consisting of 9 red-rock cod, 6 whitefish, 2 yellow-tails and one fat-head. Several other successful fishing trials were made during the day.

Early on the morning of the 25th the steamer anchored under the southeast end of San Clemente Island, and two parties were landed for the purpose of seining and shore collecting. One party, consisting of Professor Gilbert, six seamen, and the writer, landed on a long smooth sand beach, about 2 miles from the ship's anchorage. It was an excellent place for working the net, without a single rock in sight for a distance of at least a mile and a half, but the surf running somewhat heavily caused us a little trouble. Repeated hauls were made with the seine, and it is safe to say that we probably obtained representatives of nearly all the species of fish that were congregated along the beach at that time. In nearly every haul there were large numbers of the viviparous perch (*Holconotus argenteus*), together with a few "smelts." After the seining had been finished, the party made a brief examination of the island, securing, however, only two lizards as a result of the natural-history collecting.

Fisheries about San Diego.—On the morning of January 26 investigations were begun in the vicinity of Los Coronados Islands. The first trial for fish was made with hand lines at hydrographic station 1706, latitude $32^{\circ} 25' N.$, longitude $117^{\circ} 18' W.$, 51 fathoms, 5 red rock-cod and 1 fat-head being taken. The next fishing was done at dredging station 2931, 34 fathoms, latitude $32^{\circ} 25' 30'' N.$, longitude $117^{\circ} 16' 45'' W.$, and was a failure. These stations were between the North and South Coronados. A small Italian fishing boat was anchored close by where the last trial was made. She was on a favorite spot, but had met with poor success, the catch for the previous 24 hours having amounted to only about 50 pounds of red rock-cod, whitefish, and fat-heads. During the summer months these species are sometimes very abundant.

Such fish as are taken in the vicinity of Los Coronados and San Diego bring from 3 to $4\frac{1}{2}$ cents per pound. Very few are salted by

the Italian fishermen, the salt-fish trade being monopolized by the Chinese. The Italians fish with both hand lines and line trawls, but chiefly with the former on account of their cheapness. Trammel nets are frequently used among the rocks close inshore, and fish that will not readily take the hook are often caught with them. A trammel net 30 fathoms long and $2\frac{1}{2}$ fathoms or 40 meshes deep costs \$25. A trawl of 500 hooks, completely rigged, and including the basket in which it is coiled, is valued at \$5. Baskets are used on this coast for the storage of the trawls in preference to the tubs of the Atlantic coast.

The trawl hooks used by these fishermen are the same as those employed by the French fishermen on the Grand Bank and by the fishermen on the coast of Spain. The gob-stick is unknown, and when the fish swallows the hook, or is otherwise hard caught, a quick jerk of the ganging causes the hook to straighten out and it is then readily extracted. All such hooks have to be bent again to the proper shape before they can be used, but this is readily done during the baiting of the trawl by means of a knife, or of two small nails driven into a board about half an inch apart. By the latter method the point of the hook is placed against one of the nails and the bow over the other, when the bending is easily accomplished. A device of this kind is kept ready for use at all times, and the fishermen claim that it takes much less time to bend a hook than to replace it with a new one.

The best fishing about the islands is found between the Northern and Southern Coronados in 25 fathoms. Close to the southern side of the northern island the water is deeper, having an average depth of 45 fathoms. In this latter place red rock-cod are the principal fish taken. About 5 miles south of the southern island is a small shoal ground sometimes resorted to by San Diego fishermen. These two "spots" are the only offshore fishing grounds known in the immediate vicinity of San Diego.

The Italian fishing boat previously referred to was a primitive affair about 18 feet long, 7 feet wide, and 2 feet deep, with a flat bottom. The greatest breadth was at the stern. The sleeping and eating quarters were very wretched, consisting of the bottom of the boat, among nets, trawls, hand lines, buoy lines, old anchors, rusty iron kettles, and other implements. An iron kettle was used as a stove, somewhat after the manner of the French Canadian fishermen of the Gulf of St. Lawrence. The hand lines employed were as rudely constructed as some of those made by the Alaskan Indians. Many sizes of lines were noticed with pieces of lead attached. Each line is generally provided with from 3 to 5 hooks, fastened to short snoods arranged one above the other about 18 inches apart. This style of gear is found about Kadiak, Alaska. Demijohns of various sizes, tied to the buoy lines by their handles, serve in place of keg buoys. The reason for using the former, as well as many other inconvenient devices, is their greater cheapness.

Mackerel.—While in San Diego several fishermen were consulted who

were more or less acquainted with the habits of the species of mackerel belonging to that part of the coast. According to their statements these fish strike the coast in the vicinity of San Diego in April and May, on their way north. They are invariably poor at that season, and, in fact, during most if not all of the year, although some claim to have seen a few fat mackerel in October. Their migratory habits are similar to those of the Atlantic mackerel. The fishermen assert that they have seldom seen them schooling at the surface, notwithstanding the many reports of steamers and other vessels respecting large schools of mackerel along the coast. It is probable that many of the schools of fish so reported are not mackerel, but herring, the appearance of these two species, when at a distance, being readily confounded by those who are not familiar with them.

It is very doubtful if mackerel approach this coast in sufficient numbers to warrant the fitting out of vessels for their capture, after the manner followed on the New England coast. Many persons have thought that it would be a paying investment to do so, in order to compete with the New England fishermen for the Pacific coast markets, supplying both the salt and fresh fish. Any such venture would be precarious, however, until the habits and abundance of the species have been positively determined, and certainly not more than two vessels should be fitted out in the beginning. All the evidence goes to prove, moreover, that the Pacific mackerel (*Scomber colias*) is greatly inferior in quality to its Atlantic relative (*Scomber scombrus*), and those eaten on the *Albatross* were pronounced insipid.

The fishermen of San Diego, Santa Barbara, and San Pedro resort almost wholly to trolling for the capture of mackerel. The practice of heaving to and raising them with troll bait seems to be unknown in this region. A few are caught in gill nets, but large quantities are never taken at a time by either method. The greater part of the catch is sold in San Francisco.

Barracuda and Bonito.—During the summer barracuda are abundant about San Diego and along the coast toward Santa Barbara, but after September they become scarce, although scattering individuals are taken the year round. Ten or 12 schooners and sloops, of from 10 to 28 tons each, belonging to San Diego, follow down the coast of Lower California a distance of about 170 miles in search of both barracuda and bonito. The latter species is also sometimes called Spanish mackerel. They are caught by trolling, and, after being split down the back like mackerel, are salted in bulk in the hold of the vessel, the same as codfish. The catch is chiefly landed in San Diego, where the fish are dried on flakes and then shipped to the Sandwich Islands and China by way of San Francisco.

San Pedro region.—The third trip out from San Diego began on the morning of February 4, and fishing with hand lines was commenced the next afternoon in San Pedro Channel. The first trial was made at

dredging station 2939, 27 fathoms, latitude $33^{\circ} 36' N.$, longitude $118^{\circ} 09' 30'' W.$; the second in 26 fathoms, Fermin Point bearing NW. by W. (magnetic) and the south end of Catalina Island S. $\frac{1}{2}$ W. (magnetic). In both of these localities the bottom consisted of sand and broken shells, and consequently no fish were taken on either trial.

A short distance from the latter position a few small boats were noticed, some at anchor, the others under easy sail. They were employed in fishing on South Bank, which extends SE. by E. (magnetic) from Fermin Light. This bank is $3\frac{1}{2}$ miles wide and covers an area of about 30 square miles; the good fishing-spots are confined to a much smaller area, however, being generally in depths of 20 to 28 fathoms. About 25 small fishing boats are engaged in fishing on this bank the year round. Flounders, red rock-cod (called groupers locally), herring, bonito, mackerel, and smelt are caught in their proper seasons. Red rock-cod are taken during the entire year and are in greatest demand. Herring, mackerel, and smelt are caught in gill nets and drag seines, and frequent chiefly the shoaler water close to the shore. Mackerel are often trolled for as in the San Diego region.

Los Angeles is the principal market for all fish taken on this bank, a uniform price of 5 cents per pound being paid for all the species except mackerel. The price of the latter fluctuates according to the supply and demand; 200 pounds of fish is considered a fair day's work with hand lines.

The fishing for red rock-cod is carried on in a manner not unlike that for grouper in the Gulf of Mexico. When the ground is reached, the boat is luffed up into the wind and a sounding made with a baited hook attached to the lead. If no fish are found on two trials, the boat is again given headway, and a new berth taken a short distance from the first one. This operation is repeated until a place is found where the fish are abundant, when the jib is hauled down, the main boom guyed out, and the boat allowed to drift a short distance. If the fish continue to bite, the anchor is lowered. The fish feed upon small spots and ridges covered with kelp, and, as they can not be tolled away from their feeding ground, an anchorage has to be made as nearly as possible over these localities; otherwise very poor results may be expected. Fishing is actively continued until the place is exhausted, when a new berth must be sounded out. Frequently one or two boats will have excellent fishing while a dozen or more may meet with no success. These fish appear to move about from place to place, and the good fishing grounds of one day may be entirely deserted the next.

Most of the boats belonging to San Pedro that fish on South Bank and vicinity are sloop-rigged and keeled. They average 20 feet long and $6\frac{1}{2}$ to 7 feet wide. Their accommodations are as good as could be expected on boats of their size, and are far better than on similar boats farther south. Herring and salt-water crayfish or rock-lobster (*Panulirus*) are used for bait.

The fishermen of San Pedro and adjacent places are mostly Scandinavians, Portuguese, and Italians, with the Scandinavians in the majority. Many of the Italians fish about San Clemente and Santa Catalina Islands, while those of other nationalities pay little attention to those islands, resorting chiefly to South Bank. The Italians have a few fish-houses and a flake-yard on Santa Catalina, where they dry fish in summer. No attempt is made to split and dry fish in the winter, and during that season the fishermen remain mostly on the inshore grounds. A favorite spot for summer fishing lies $1\frac{1}{2}$ miles from the eastern end of Santa Catalina Island. Large quantities of red rock-cod are taken there, and also whitefish (*Caulolatilus princeps*) and fat-heads (*Trochocopus pulcher*) at certain seasons.

Hand-lines only are used for bottom fishing in this region. Trawl lines would be of little service on the rocky patches, as the fishing areas are of small extent and much of the trawl would be spread out over barren ground. The gear is rigged in the same manner as that of the hand-line fishermen of San Diego.

The San Pedro fishermen state that bonito strike this part of the coast the first of March and mackerel a month later. The method of catching them here, as previously explained, is by means of troll lines and gill nets. The fishermen also affirm that they have never seen mackerel schooling in the vicinity of South Bank, although herring and sea bass frequently school in large bodies. This is, however, the region from which most of the schools of mackerel have been reported by passing vessels. These reports are not unnatural in view of the fact that even an experienced eye is often deceived in attempting to distinguish between schools of mackerel and herring, and it is sometimes impossible to determine the species until specimens have actually been taken in the nets. Both mackerel and herring vary somewhat in their movements at different times. In the majority of cases, mackerel, when frightened, will "rush," as it is called, splashing the water with their tails in their haste to get away, but frequently they sink quietly below the surface. Herring, when schooling, on the contrary, often make a noise like falling rain upon the surface, which gives the fishermen a clew to the species, but this habit is far from universal. These deceptive appearances, misleading at times even to old fishermen, make it difficult to distinguish the composition of a school of fish from the deck of a rapidly passing vessel, and, until more authentic information is obtained, little credence can be given to the numerous reports concerning the abundance of mackerel off the southern part of California.

Santa Barbara Islands and Channel.—After leaving South Bank the ship was headed for Santa Barbara, where she arrived on the morning of February 6. At this place we took on board Mr. A. Larco, an experienced fisherman, as a guide to the region, and immediately proceeded to Santa Cruz Island. A short time was spent in trying to locate a shallow spot of fishing ground off the eastern end of the island near

San Pedro Point, but without success, probably on account of its small extent. Soon afterwards I accompanied Mr. Larco in the dingey for the purpose of testing the various grounds about Anacapa Passage and vicinity. Crayfish and fresh sardines were taken as bait. We commenced fishing in 30 fathoms, the SE. end of Anacapa Island bearing E. by N. $\frac{1}{2}$ N., San Pedro Point NW. $\frac{3}{4}$ W. After remaining there about 15 minutes we shifted to the south and west into 27 fathoms, the above-mentioned points bearing E. by N. $\frac{3}{4}$ N. and NW. $\frac{1}{2}$ W., respectively. In these two drifts of short duration, 20 red rock-cod and fatheads were captured.

Two other trials were subsequently made on the following bearings: In 28 fathoms, San Pedro Point, NW. by W. $\frac{1}{2}$ W.; south and eastern end of Anacapa Island, E. by N. In 27 fathoms, the former point bearing NW., the latter ENE. The result of these trials was as follows: Twenty-two whitefish (*Caulolatilus princeps*), 4 fat-heads (*Trochocopus pulcher*), 26 red rock-cod, 8 black rockfish (*Sebastes mystinus*). A short distance to the eastward of Anacapa Passage the bottom is sandy and comparatively barren.

Early in the evening an anchorage was made by the ship in Smuggler's Cove, where a large-mesh gill net was set for 2 hours among the rocks and kelp close by the shore. This was done about dark, a little too late to expect a large catch, such species as are generally taken in a gill net usually meshing just before dark or before sunrise. Only one crayfish was secured. The next morning the net was set in the same place and at the time several sea lions were observed upon the rocks, apparently watching our movements. The net was hauled after breakfast and contained 90 fish, of which the greater number were viviparous perch. The sea lions had been there before us, however, as was made manifest by the number of large holes in the net caused by their efforts to steal the fish. Sea lions are still found scattered about the Santa Barbara Islands, where they greatly annoy the fishermen, not only by devouring the fish taken but also by injuring and often entirely destroying their nets.

The remainder of the morning was spent in seining along the sandy beach of Smuggler's Cove, an excellent locality for that purpose, as there are no sharp rocks or other obstacles in the way. Notwithstanding its advantages, however, only a few perch, sharks, etc., were collected.

During the afternoon several hauls of the beam trawl were made off the southern side of Santa Cruz Island, one of which yielded several black-cod from a depth of 264 fathoms. These specimens were found to be nearly equal in flavor to those taken in more northern waters, and they were far superior to any fish which now find their way to the markets of Santa Barbara and Los Angeles. As the black-cod is an active fish, the capture of several in the slow-moving beam trawl would seem to indicate their abundance in this region in suitable depths, but further observations are necessary to prove the fact. This could probably

be done by making several trials with trawl lines. Many specimens of a species of flatfish (*Glyptocephalus zachirus*), sometimes called "sole," were collected with the black-cod. It is an excellent food-fish and would bring a high price in the southern markets; but, as it could only be taken in paying quantities by means of the beam trawl or some similar appliance, it will probably not become an article of trade for some time.

Anchoring over night in Becher's Bay, Santa Rosa Island, dredging was begun early in the morning of February 8. At station 2953, latitude $33^{\circ} 47' N.$, longitude $119^{\circ} 58' 15'' W.$, depth 82 fathoms, the dingey was lowered for the purpose of testing the bottom with hand lines. A short distance from the above station the bottom suddenly dropped off into 100 fathoms and a fair trial failed to give us any results. We shifted our berth several times in the direction of the shore, gradually shoaling the water to 60 fathoms, in which depth we obtained two red rock-cod. The position where we left the ship was about 10 miles from Santa Rosa Island. In changing berths we probably worked a mile in towards shore. Adding this to the distance steamed by the ship in going over this ground and we have a rocky ledge about 5 miles long and with a depth of 65 to 90 fathoms developed during the morning, on which red rock-cod, whitefish and fat-heads will probably be abundant at certain seasons. The extent of the ledge, however, may be much greater. The results of dredging indicate a rich bottom.

Late in the afternoon an anchorage was made on the south side of San Miguel Island, and just before sundown Captain Tanner and Mr. Larco rowed close inshore among the kelp and rocks, where, in a very short time, they caught 28 specimens of red rock-cod, whitefish, and rock bass. Nothing was taken over the ship's side, although repeated trials were made, the fish appearing to hover near the shore. During the summer crayfish (*Panulirus*) are numerous about the shores of San Miguel, where they are taken both for bait and for the market.

The next morning, getting under way at daylight, we steamed for Richardson Rock, which lies off the western end of San Miguel Island. A dense fog came rolling in from seaward, threatening to interfere with work; but it soon cleared away and we began a line of fishing stations from the rock to the northern side of the island by way of Wilson Rock. The first fishing was done in 44 fathoms, Richardson Rock bearing WSW. $\frac{1}{4}$ W. (magnetic), distant $1\frac{1}{2}$ miles. Ten red rock-cod and 10 yellow-tails were caught in a few minutes' time. The next berth was in 41 fathoms, Wilson Rock bearing E. by S. (magnetic) 2.3 miles distant, only one small flounder being taken during a 10-minute trial. The last trial made between Richardson and Wilson Rocks was in 36 fathoms, the latter rock bearing ESE. (magnetic), distant 1.6 miles; 4 red rock-cod and 3 rock bass were captured.

From the above station the ship ran E. $\frac{1}{2}$ S. 1.2 miles, and hove to in 42 fathoms, Wilson Rock bearing S. by E. $\frac{1}{4}$ E. and close to. Fifteen

lines were soon over the ship's side and fishing began. Mr. Larco and the writer went out in the dingey to try for fish around the rock. Seven or eight trials were made in depths varying from 25 to 35 fathoms, but we did not meet with as good success as was expected by Mr. Larco. He had frequently anchored over the same ground where we were fishing and had loaded his boat in a few hours, but this was late in the season. Many trials were also made to the southward of the rock, where large numbers of whitefish generally feed in summer, and still our efforts were only poorly rewarded. The total catch was 4 red rock-cod, 3 whitefish, 1 cultus-cod, 1 sculpin, 1 rock bass, 1 scorpion, and 1 black rock-cod. On returning to the ship we found the deck covered with fish. It had drifted but a few minutes when they were encountered in great abundance, every line hooking at once, and those who participated had keen enjoyment for 2 hours. Fishing began in 34 fathoms and was continued into 23 fathoms. The total number of fish taken was 555: 481 yellow-tail rockfish (*Sebastes flavidus*), 49 red rock-cod, 1 cultus-cod, and other species.

Yellow-tail fishing very much resembles pollock fishing on the New England coast. The former species will invariably follow the lines to the surface, and frequently bites at the hook just before reaching the ship's side. Another peculiarity in which these fish resemble the pollock is that as soon as they begin to bite they swim up in the water, and more can be caught on short lines than on the bottom. After a few have been taken they will rise to within a few fathoms of the surface and dart in schools at the lines. They then immediately disappear, soon to repeat the same performance.

Dredging was carried on during the afternoon and several black-cod were taken in the beam trawl. In the evening the ship anchored off Santa Barbara.

February 11 was occupied in developing a small fishing bank which extends in an ESE. $\frac{1}{4}$ E. (magnetic) direction from Santa Barbara Light. The WNW. end of this bank is about 5 miles from the light-house. Its length is between $2\frac{1}{2}$ and 3 miles and its width about $1\frac{1}{2}$ miles. The depth ranges from 26 to 29 fathoms, and the bottom is chiefly sandy, with many rocky patches. This inshore bank was at one time a favorite fishing ground for the few fishermen of Santa Barbara. Fish were abundant and there was always a certainty of obtaining full fares; but, like most small banks upon which fishing is constantly prosecuted, it finally ceased to satisfy the demands, and for the past 7 or 8 years little or no attention has been paid to it. Since then the fishermen have resorted to the Santa Barbara Islands, which will, in all probability, meet their needs for many years. There is another small bank off Santa Barbara, the center of which lies about 3 miles E. $\frac{1}{2}$ N. (magnetic) from the light. It is about a mile in length, NE. and SW., by one-half mile in width. The least depth upon it is 12 and the greatest 20 fathoms. It is covered with sandy and rocky spots, supporting a "live bottom."

On the morning of February 12 many hauls were made with the beam trawl in Anacapa Passage and off the southern end of Anacapa Island. A haul 11 miles south of the island in 603 fathoms (station 2980) was one of the richest made in this region. Two trials were also made for bottom fish on the southern side of Anacapa. The first was in 52 fathoms, $1\frac{1}{4}$ miles south of Arch rock; the second was in 36 fathoms, 1 mile north of the same rock. Six red rock-cod were captured. A strong breeze was blowing at the time, which caused the ship to drift rapidly, and consequently a large catch could not be expected, but a sufficient number were secured to demonstrate the presence of fish in this position, and they might have been taken in abundance under more favorable circumstances. Mr. Larco states, however, that, while they are numerous one day, the next day, and perhaps for a week following, not a bite may be obtained. These sudden changes may be due to the smaller fish on which they feed moving from spot to spot.

During the night the *Albatross* lay to off San Nicolas Island, and the next morning fishing was begun with hand lines. Two trials were made before good grounds were discovered. The third trial gave better results, as 17 red rock-cod, 3 whitefish, 2 yellow-tails, 1 fat-head, 1 cultus-cod, and 4 jacks (*Sebastes paucispinis*) were landed in 10 minutes. This spot was 2 miles WSW. from San Nicolas Island; depth, 21 fathoms. We soon drifted, however, into depths where no fish could be obtained. Returning to the first position in $22\frac{1}{2}$ fathoms, the biting began at once, and we secured 4 red rock-cod, 1 yellow-tail, 1 white fish, 3 fat-heads, and 1 cultus-cod.

An anchorage was made in the afternoon on the northern and eastern side of Santa Barbara Island, where the naturalists were landed. A crab net, baited with fresh whitefish, was put over the side, but nothing was captured in it. The hand lines did better, although during the first hour no bites were felt. Towards evening, however, a school of red rock-cod and whitefish passed under the ship, and between 40 and 50 of them were caught. The longer we fished the more plentiful they seemed to become. The dingey, with Captain Tanner and the writer, was rowed to a point about half a mile to the westward of a reef of sharp rocks which makes off from the shore, where we fished for about an hour, making several changes in our position during that time. The catch consisted of 3 red rock-cod and 1 fat-head. One large flounder (*Paralichthys californicus*), of the kind called halibut by the fishermen of San Diego, was hauled to the surface of the water, but owing to its being "lip-hooked" it managed to free itself, greatly to our disappointment.

The following morning, after running a line of soundings to Santa Catalina Islands, the ship was headed for San Diego, where we arrived at 6:20 p. m.

General remarks on the fish and fisheries about the Santa Barbara Islands and Channel.—Mackerel strike in at the Santa Barbara Islands and Channel about the first of March and remain until October. Mr.

Larco has never seen any fat mackerel on the coast and doubts if they ever become fat. They sometimes school in small "pods" during the summer months in Santa Barbara Channel, but he has never seen them school in the vicinity of San Pedro or farther south. They are caught by trolling and in gill nets, but chiefly by the former method.

The herring accompany the mackerel, but remain much longer in this region. Strong westerly winds drive them offshore, where they remain until the wind changes. They are taken in gill nets and drag seines.

Sardines (*Clupea saggax*) are found here the year round in considerable numbers, and are captured in gill nets and drag seines, chiefly for bait. They are affected by westerly winds in the same manner as the herring.

Bottom fish bite best in the morning and on slack tide. Fat-heads, yellow-tails, red rock-cod, black rockfish, and whitefish are similar in their habits to the shore cod and pollock of the Atlantic coast.

Rock-lobsters or crayfish, sardines, and herring make the best bait, although whitefish and perch are very good. Squid are sometimes caught in great numbers in nets and drag seines, but, strange to say, it is stated that the fish will not bite at them, and they are not considered worth the trouble of attaching them to the hooks.

Sea bass, of which no specimens were taken by the *Albatross*, are said by Mr. Larco to be first seen sometime in March. After remaining upon the coast about two months they suddenly leave, reappearing in July and August. They have been known to strike the coast three times during a season, but as a rule they appear only twice. The customary method of fishing for them is with gill nets. The net is 40 fathoms long and 3 fathoms deep, with a 6-inch mesh. A southeast wind causes them to seek deeper water, and very few are taken at such times.

Sharks and dogfish give the fishermen much trouble in the summer, when they are very abundant, playing sad havoc with the nets and all other kinds of fishing appliances. There are many excellent places on the Santa Barbara Islands where try works could be built at slight expense in localities where these species might be captured in large numbers within half a mile of the shore.

During January, February, and March only hand-line fishing is resorted to. Through the four succeeding months no attempt is made to catch any fish but barracuda and mackerel. During the last months of summer but little attention is given to fishing of any kind, there being little demand for this kind of food. The poor demand for fish at that season arises from the fact that the fishermen have not the means of preserving and marketing their catch in suitable condition. The price of ice is so high that its use would increase the cost of fish beyond the means of the majority of the people. Most of the fish are now sold at from 10 to 15 cents per pound in the Santa Barbara market, but 18 cents is sometimes paid for fat-heads, whitefish, red rock-cod, and yellow-tails.

Nearly every spot about the Santa Barbara Islands where rocky

bottom is found may be considered a fishing ground. Red rock-cod and fat-heads are found from close to the rocks out into depths of 90 fathoms, but they are most abundant where the water is from 15 to 25 fathoms deep. Some places are much more favorably regarded than others. Anacapa Passage is one of the best grounds, and can generally be relied on throughout the entire year. In the vicinity of Richardson Rock is another good ground, and Wilson Rock is considered the most prolific spot about the islands during the first three months of the year. Between these rocks and the northern end of San Miguel Island red rock-cod, fat-heads, and whitefish occur in considerable numbers in the summer, but during winter these species are more abundant about the rocky patches off the shores of Santa Rosa, Santa Cruz, and Anacapa. The best ground for yellow-tails is in close proximity to Wilson Rock.

The best season for fishing is during the winter months, when the winds are variable and gentle. In summer the northwest trades sweep down the coast, often with great velocity. At such times the fishermen resort to the northern end of the group, thereby receiving the benefit of a fair wind to Santa Barbara when a full load has been secured.

Rainy weather affects the movements of both surface and bottom fish. Mr. Larco states that he seldom finds anything in his nets during a rainy spell, and long experience has taught him to resort to some other method of fishing during such times.

The salt-water crayfish (*Panulirus interruptus*) is caught in trammel nets and in small net traps. The latter are very much like the traps used by the boat fishermen along the shores of Long Island Sound and Massachusetts Bay for catching cunners. They are somewhat smaller, however, and have two iron hoops instead of one, to which the net is fastened. One is at the top and measures about 2 feet in diameter; while the second, at the bottom, is only 10 inches across. They are placed $2\frac{1}{2}$ feet apart, that being the length of the trap. A wire cage about the size of a saucer is attached at the bottom and serves to hold the bait. The bridle, to which the line for lowering and hauling the trap is fastened, consists of four lines tied to the upper hoop. These lines are rove through a small piece of wood which acts as a float to prevent their settling down over the cage and covering the bait. When resting on the bottom the top hoop falls in such a manner as to fully disclose the bait.

Mr. Larco's boats are all carvel-built and with keels; they are open and have a wash rail, small deck forward, and lateen rig. They are about 25 feet long, 7 feet wide, have a straight stem and sharp stern, with the rudder hung outside. The accommodations for sleeping and cooking, as in all other boats of this class, are very poor. The fish are thrown into the bottom of the boat as soon as caught, and covered with sea-weed to protect them from the sun.

THE REVILLA GIGEDO ISLANDS, LOWER CALIFORNIA, AND THE GULF OF CALIFORNIA.

San Diego to the Revilla Gigedo Islands.—Having made the necessary preparations, the ship left San Diego, February 26, for a cruise to the southward, including a visit to the Gulf of California. Soundings were carried to Guadeloupe Island, where we lay to during the night of the 27th. The following morning, while a party landed on the island, Professor Gilbert and the writer went in a small boat to look for fishes near the shore. We were well provided with lines and bait, and also had five torpedoes with a Farmer electric machine for exploding them. The torpedoes were used in depths of 4 to 6½ fathoms close by the shore, where the bottom was plainly visible, but we did not succeed in killing any fishes by this means, and only a few specimens were seen among the rocks. Hand lines were tried with poor success. Several "Garibaldi" (*Pomacentrus rubicundus*) were observed swimming gracefully about, their red color contrasting strongly with the black bottom. A small school of smelts was tolled around, and two were caught, the sole result of our day's work. Hand lines were also used from the ship, while dredging in depths of 19 to 26 fathoms, but without success.

Alijos Rocks, in latitude 24° 58' N., longitude 115° 52' 36" W., were reached on the morning of March 2. They consist of three large rocks cropping out from the sea, and at a distance appear like three square-rigged ships sailing before the wind. A short trial with hand lines in 34 fathoms on the northeast side of the rocks and close to them gave no results. A few starfish were brought up by the tangles, but the beam-trawl net was badly torn on the rough bottom. Sea elephants have been reported from time to time about the Alijos Rocks, but none were seen by the *Albatross*, and it seems impossible for them to exist there, as the sides of the rocks are nearly perpendicular from base to summit and between the rocks is a solid wall of breakers even with a comparatively smooth sea. The reports were undoubtedly erroneous.

The following morning at 10 o'clock Clarion Island was sighted. Several soundings were made during the day, and at 4 p. m. the ship anchored in Sulphur Bay in 10 fathoms of water. Just before dark a menhaden net was set in 4 fathoms a short distance from the shore. A number of sharks were observed swimming about, and it was thought best not to allow the net to remain out too long for fear of its being torn to pieces. We therefore started out to haul it at 9:30 p. m. The water was phosphorescent, and on arriving at the spot we were met by numerous sharks patrolling up and down each side of the net. The latter was empty, but there were unmistakable indications that some fish had meshed in it, as the net contained several large holes near the middle, evidently made by sharks in seizing their prey.

Early the next morning I accompanied Professor Gilbert in one of the small boats to do some fishing in shallow water. We anchored in

about 3 fathoms a short distance off a high volcanic promontory on the eastern side of the bay. The water was perfectly clear and presented a beautiful sight. Volcanic rocks and corals composed the bottom, which was cut with winding caverns running in all directions and sheltering many fishes of brilliant colors. No sooner was a line thrown into the water than hundreds of fishes would dart toward the bait. Only a few of the species would take the hook, and great care had to be exercised in pulling them up to prevent their escaping with both hook and sinker. They were very active, and several times succeeded in parting the lines. We had been fishing only a short time when many sharks appeared about us and did much damage to our gear. Returning to the ship we found the crew had taken several hundred fish, including a number of large sharks; Captain Tanner, who had been fishing in a small boat in another part of the bay, was also very successful. After lunch the fishing was continued and many additional species captured.

On the morning of the 4th a landing was made on the beach and, although the shore was very rough from coral growth, several successful hauls were made with the small seine. Two large specimens of eels were collected in the tide pools, and the seine was also used in a fresh-water lagoon, a short distance back from the beach. There are two of these lagoons on the island, which appear to serve as watering-places for the birds of the region. After returning to the ship late in the afternoon, she steamed around the western end of the island and along the northern shore to ascertain if there were any sea lions or sea elephants about, but none were observed. A course was then laid for Socorro Island, which was reached at midnight the next day, and the following morning an anchorage was made in Braithwaite Bay on its southern side. Fishing and other collecting were carried on unremittingly throughout the day. The same fishes were found as at Clarion Island and several additional species were collected; their surroundings were also the same, and through the clear water we could plainly see their bright and many-colored iridescent forms, combining to produce a brilliant scene such as can be observed only within the tropics. Anchoring near the rocks, we made use of a water glass in connection with our hand-line fishing. A few species would not take the hook and the bait was frequently stolen by other forms. While the mouths of many kinds were so small that they could be caught upon a small hook only, a large wire hook would have been required to hold them, and but few of these were brought to the surface. The next morning a crab net was included in our outfit and by its use we managed to entrap many of the coveted species. Sharks were exceedingly abundant and troublesome, and the utmost care had to be exercised to prevent their carrying away our gear.

Each evening the electric light was used at the surface, tolling many fishes around the ship. About two-thirds of a barrel of small fry were captured, and also 8 chub mackerel. I split and gibbed a few of the

latter, and found their ovaries about as far advanced as are those of the common Atlantic mackerel in the latter part of March and the first of April. Sixty species of fish were secured at Socorro and Clarion Islands, and of these Professor Gilbert considered that about one-fifth were edible. Those eaten upon the *Albatross* were pronounced superior to any taken off the Santa Barbara Island and on Cortez Bank. The region is too far distant for California fishermen, however, although it might hold out inducements to the Mexican, but the grounds are small and only a few vessels could fish at a time. Whales were abundant around both islands, and a few porpoises were seen.

March 10 we reached San Benedicto Island and two collecting parties were sent off from the ship. Fishing was practically a failure, however, owing to the abundance of sharks and horse-mackerel, and nothing new was obtained. This island, like the other two of the group, is of volcanic origin. Close to our anchorage was an extinct volcano, of which half of the crater had been broken away, leaving the interior exposed to view. The top of San Benedicto is covered with high, coarse grass, but no cactus was found on the part examined. Sea birds and whales were numerous.

San Benedicto to La Paz.—The ship left San Benedicto on the afternoon of the 10th, and on the morning of the 12th she arrived at Pichilique Bay, where a supply of coal was to be obtained. We fished with hand lines, seines, and gill nets in the different parts of the bay, but without much success. A menhaden gill net, set close to the ship's anchorage in the evening and hauled in the morning, was badly torn by sharks. But little fishing is carried on at La Paz. There are three or four Italians who occasionally visit the islands in the bay for that purpose, and bring a few fish to market. Their trips are made with no regularity, but only when they have need of a little money. They use dugout canoes, and the fish that are not disposed of fresh are split and salted, and afterwards exposed for sale in a very uninviting condition. The markets are very simply arranged. A common table set on the side of the street and covered with half a dozen dirty and bad-smelling fish compose the fish dealer's stock in trade. All the fish, both large and small, are split down the back, and the heads are left on. In the case of the salted ones the flesh is gashed crosswise in order that it may absorb the salt quickly, which is essential to its preservation. Several years ago a French fisherman supplied the town with fish, but he has since gone to Guaymas.

La Paz to Conception Bay and Guaymas.—Having finished coaling ship, we left La Paz on the morning of March 16 and proceeded northward on the peninsular side of the Gulf of California. Before anchoring for the night off the western side of San Josef Island four hauls were made with the seine on the adjacent shores and a few fish were captured. Pearl oysters and other interesting shells were dredged by the steamer close by. The next morning the seine was hauled several

times in a salt-water lagoon on the western side of the island, securing about a barrel of anchovies and some other species. A large fish was also attracted by the fish thrown back in the water, but it evaded all attempts at capture. About 25 miles south of Carmen Island we sighted a school of fish which had the appearance of mackerel, but they were too far distant to determine their character. A little after dark we anchored off the southern side of Carmen Island. The electric light was displayed at the surface and light fishing lines were thrown over. A number of chub mackerel and other species were caught by this means, the largest of the mackerel measuring $13\frac{3}{4}$ inches in length. The most of them were split and gibbed, and it was discovered that nearly all were males. The milt was about as far developed as in the specimens taken at Socorro Island. The spawning season probably occurs sometime during the latter part of the spring or the first part of summer. A portion of the following day was occupied in hauling the seine on a beautiful beach in Salinas Bay where we were at anchor, and many kinds of fish were taken. Hand-line fishing proved a failure.

Our next stopping-place was Conception Bay where hand-line fishing and seining were carried on during the morning. Only two sharks were captured with the hand lines, but several interesting species were collected with the seine on a coral and shelly beach at the northern side and near the entrance of the bay. In the afternoon we anchored off the mouth of Mulege River, and two seining parties were kept at work on the shore during the remainder of the day. Mullet and red snappers were taken in considerable numbers. Three miles up the river there is a mining town with about 4,000 inhabitants. Two small schooners and a sloop were anchored at the mouth of the river. They make regular trips to La Paz and Guaymas. The largest schooner was of 33 tons register; she was built in San Francisco at a cost of \$4,500. She was of fair model and neatly rigged, being the best fitted and rigged schooner I had yet seen on the Pacific coast, but like most of the schooners on this coast she carried no gaff to her mainsail. Her beam was 18 feet, depth $5\frac{1}{2}$ feet, draft $6\frac{1}{2}$ feet. The other two vessels were of Mexican build. March 20 we arrived off Guaymas Harbor, and the next morning steamed up to the city.

Guaymas.—The fish market at Guaymas is but little superior to that at La Paz. The French fisherman formerly resident at La Paz and several Italians supply the town with fish. Three-fourths of a cent per pound was the standing price for all kinds of fish during our stay at the place. Shipments are sometimes made to the interior of the State and frequently to the southern part of Arizona. Generally 3 and 4 cents a pound are realized from such shipments.

All fish taken during the winter months are caught with hook and line, but in summer seines only are used. This change is made to avoid the destruction of the gear by sharks. Many sea bass (*Cynoscion macdonaldi*) are obtained with lines; they are of large size, sometimes reach-

ing 150 pounds. Although tough and thick-skinned, they are split and cured in the manner of the other species described above. The fishing boats, of which there are half a dozen in all, do not differ materially in their rig from those used by the fishermen of San Pedro, California.

Guaymas to the head of the Gulf and return.—Leaving Guaymas on the morning of March 23, we proceeded up the coast on the east side of the Gulf, past Tiburon Island and Angel de la Guardia Island, doing some dredging on the way. In the evening of the 24th we anchored in 13 fathoms off George's Island. The next morning we did some collecting upon the island and also tried the hand lines from the dingey a short distance from the rocks. Fish were scarce, and although we shifted our position several times, only two groupers and two trigger-fish were caught during an hour's time. The scarcity of fish was undoubtedly due to the abundance of sea lions about the island, which set up a fierce howling as we approached the rocks, scampering from their resting places and jumping or tumbling into the sea. Later in the afternoon we anchored in Adair Bay, and the different kinds of collecting were engaged in. Hand-line fishing proved more successful than seining. Several large sea bass and another large fish were caught from the ship. A turtle was also captured with a trolling line while rowing to shore.

A night anchorage was made about 5 miles south of Shoal Point at 9:30 p. m. Hand lines were put over, and in a few minutes they were cutting and sheering through the water in a most lively manner. It was a hard job hauling the fish to the surface and a far more difficult one pulling them over the rail. Finally, however, three large bass were landed on the deck, weighing 79, 82, and 140 pounds each. Sea bass are abundant along the eastern shore of the Gulf and good fares could be obtained if there were a market for them. Our next fishing station was at Shoal Point, where two seines were kept in operation on the sandy beach during the forenoon with good results. One Spanish mackerel was taken. Returning on board, the ship worked northward, finally anchoring at the mouth of the Colorado River, Direction Hill bearing NW. $\frac{3}{4}$ N. At 9 p. m. Professor Gilbert and the writer with two seamen set a shad gill net, but only a few sharks were obtained. The next morning the ship crossed the head of the Gulf, touching at Consag Rock on the way. The bottom was tested with hand lines in several places among the rocks, but as in all other localities where sea lions occur the fishing was exceedingly poor. From Consag Rock the beam trawl was used every 15 miles, but the material was not so rich as on the eastern side of the Gulf. Fishing was carried on in San Luis Gonzales Bay, and on the afternoon of March 30, we again arrived at Guaymas.

The following day we proceeded southward, fishing and collecting in the lagoons and along the beaches as far as the Yaqui River. Oysters were abundant in several places; they were of excellent quality and compared favorably with those of Chesapeake Bay. The Yaqui River

Indians monopolize the oyster business, supplying the inhabitants of Guaymas and of the neighboring region. An oyster cannery was established at Guaymas several years ago, but the enterprise did not turn out successfully. On one of the beaches in the vicinity of the Yaqui River we obtained mullet, red snapper, alewives, and flounders in considerable numbers, and also captured one Spanish mackerel.

We crossed the Gulf April 2, and reached La Paz early the next morning. The ship then ran down to Pichilique Bay for the purpose of coaling. The pearl fishery is the principal industry of La Paz, giving employment to 500 men. About \$100,000 worth of pearls are secured yearly in this vicinity; the bulk of these are shipped to Germany. Leaving Pichilique Bay on the 6th we sailed down the coast and anchored at noon the next day off Cape San Lucas, where part of the afternoon was given to seining and hand-line fishing.

Cape San Lucas to San Francisco.—Steaming northward along the outer coast of the peninsula, we made our first stop at Magdalena Bay, anchoring in Man-of-war Cove. Seines were used on all suitable beaches within 4 or 5 miles of our anchorage, and also near the mouth of the bay close to Belcher Point. Food-fishes were plentiful in both localities, and among the specimens taken were mullet, perch, anchovies, smelts, and flounders. When off the entrance to the bay, about a mile northward of Entrada Point, we ran past several schools of fish. A pelican dived into one of them, whereupon there was the unmistakable "rush" of mackerel. This was the first school of that species which had given us positive proof of their identity by their movements. These bodies were working northward, but as it was nearly dark when we came upon them, we were unable to continue the observations. At Port San Bartolome both seines and hand lines were tried. Nothing was taken on the latter, which were used in several places among the submerged rocks and ledges off the mouth of the harbor, the bottom seeming to be destitute of life. Mullet, smelts, anchovies, and flounders were plentiful on the beaches. The U. S. S. *Ranger* arrived at this point at the same time as the *Albatross*, and with her large seine 167 turtles were captured in a single haul. As turtles are scarce on the western coast of the United States, it might pay a vessel to visit this region once or twice a year for the purpose of obtaining supplies for the California markets. A concession would be necessary from the Mexican Government, but it could be obtained without difficulty.

Stops were subsequently made at San Quentin Bay, Cerros and San Martin Islands, and on April 14 the *Albatross* reached San Diego. By direction of the Commissioner of Fisheries, Professor Gilbert and the writer were temporarily detached from the ship at this port, in order to make an investigation of the Lower Colorado and Gila Rivers with reference to the shad planted in them several years before. In the meantime the *Albatross* proceeded to San Francisco, where we joined her May 21, just as she was starting northward on her summer cruise.

COASTS OF WASHINGTON AND OREGON.

San Francisco to Departure Bay and Frazer River.—Leaving San Francisco on the same day, we proceeded directly to Departure Bay, Vancouver Island, for the purpose of coaling, arriving there May 25. During the stay in port I was occupied in obtaining additional information respecting the fisheries of the region.* A visit was paid to Mr. Vozza, an Italian fisherman, who conducts a small fishing business on one of the islands in the bay. He said that the past winter had been exceptionally mild and consequently the fishing for dogfish much poorer than usual. These fish would visit the bay in large numbers during cold spells, but every time the weather moderated they immediately sought deeper water. It is not probable that the temperature had a direct effect upon the dogfish, but it influenced the presence of the herring on which they feed. The herring usually resort to Departure Bay during the winter in incredible numbers, and the dogfish follow them about from place to place. Several thousand herring were smoked by Mr. Vozza during the preceding winter, but he found no demand for them in Nanaimo or elsewhere. Three thousand gallons of dogfish oil were put up between December 1 and the last of March by two men. The usual yield for the same time is about 5,000 gallons.

Mr. Vozza says that the spring run of salmon strikes that river in March and remains there until the latter part of June. In July the suk-kegh salmon enter the river and continue in it until sometime in August, after which the spring salmon return and are plentiful for three or four weeks. A form called "cohoes" by the natives predominates during September, and in October there are several species running.

There are now fifteen canneries on the river, three having been built during the present season. The sizes of mesh in the salmon nets are 6, 7 $\frac{1}{2}$, and 8 inches. The 6-inch mesh is used for the suk-kegh salmon. About 2,000 men are engaged in the fishery this year.

Halibut fishing, Washington to Sitka, Alaska.—From Departure Bay we proceeded to Seattle, Washington. In this city Messrs. Louch and Johnson started a wholesale and retail fish establishment in the fall of 1888, investing \$20,000 in buildings and equipment. The yacht *C. H. White*, of San Francisco, was chartered by them, and has made three trips to Cape Flattery Bank, taking in all 100,000 pounds of halibut. About 60,000 pounds were shipped fresh to New York, but transportation rates were so high that nothing was realized from the venture. The remainder were smoked and put up in boxes of 30 pounds each. Mr. John Crosgrove, of Gloucester, Mass., superintended the shipping and smoking of these fish. Hickory and alder wood and corn cobs were employed as fuel for the smoking, and the prepared fish were equal in appearance and flavor to those treated in the same manner in Gloucester. There is said, however, to be one defect in the halibut taken on this coast for the

* For the account of a former visit see U. S. F. C. Bulletin for 1888, pages 51, 52.

purposes of drying and smoking, and that is that they have numerous white "gelatinous" streaks through the flesh. This is considered to impair their value for preparation in these ways. The same peculiarity was noticed in the fletched halibut taken off Queen Charlotte Islands by Capt. S. Jacobs, in 1888, and shipped to Gloucester.

The schooner *Rose Oleson*, of Astoria, chartered by parties in Port Townsend has made one trip to Cape Scott this season for halibut. She sailed the first part of April and was gone five weeks, bringing back 15,000 pounds, of which 1,800 pounds were smoked and the remainder sold fresh.

January 3, 1889, the schooner *Oscar and Hattie*, Captain Silas Calder, sailed from Port Townsend for Alaska on a fletched-halibut trip. She proceeded directly to Sitka, and began fishing on the inshore grounds adjacent to Baranoff Island, where halibut had been reported to be most abundant. Work was carried on continuously whenever the weather permitted until March 1, but halibut were very scarce, and not enough were caught to keep the lines baited. Captain Calder stated that while there may be enough fish on these grounds to furnish fishing for a few Indians in their small canoes, a large vessel could not expect to meet expenses here. Subsequently he changed his position to the deeper waters offshore, but met with no better success. He also thinks it would not pay to follow the halibut to the inclosed waters among the islands of the archipelago during the summer months for vessel fishing, as the fish are not known to resort very abundantly to any one place. During his stay off Sitka, he encountered many heavy gales, doing much damage to the rigging and fishing gear, but they had no snow or ice to contend against as would have been the case in the same latitude on the north Atlantic coast.

In the early part of March, having met with no success off Sitka, he proceeded southward and fished in the neighborhood of the Queen Charlotte Islands, Cape Scott, and Hecate Channel. Halibut were more common in these localities but not abundant. They seemed to be easily caught up, and frequently he was obliged to shift his position twice a day. Fishing was continued until the first week in June, and by dint of hard and persevering work he managed to obtain a fare of 140,000 pounds. The halibut were much larger this year than last. Captain Calder estimated the average weight of those taken by him at about 65 pounds each. None could be caught in water over 45 fathoms deep.

In my last report* I stated that it would be possible for vessels on the northwest coast to obtain two fares of fletched halibut a year, and to that extent these vessels would have an advantage over those of the Atlantic. This statement may require modification, in view of Captain Calder's experience of the past season, but until the grounds have been more fully investigated, and their position, extent and

resources more satisfactorily determined, it will not be safe to predict the future of this fishery. The outlook for the fresh-halibut fishery is also not promising for the immediate future, chiefly on account of the lack of markets. The local markets are not sufficiently large to take the catch of more than one vessel, and the expense of shipping halibut to Eastern cities is so high as to preclude any profit to the fishermen. The cost of ice has been greatly reduced during the year, however, and artificial ice can now be purchased in Port Townsend at \$8 per ton.

Bank off Gray's Harbor, Washington.—Leaving Seattle June 6, we passed out by Cape Flattery and began fishing the next morning on the bank off Gray's Harbor. A trawl line was set at dredging station 3048 (latitude $46^{\circ} 45' 30''$ N., longitude $124^{\circ} 33'$ W.), 52 fathoms, extending in a southwesterly direction into 60 fathoms. We lay to in the dingey at the leeward end and put over hand lines, but found that the tide was running too strongly toward the southeast to do anything at that kind of fishing. The day was fine, with a gentle breeze from the WNW., accompanied by a moderate swell. After about 2 hours the trawl was hauled and yielded us 4 dogfish (*Squalus acanthias*), 2 skates, 4 orange rock-cod, and several starfish. The ground line and ganging of the trawl indicated that there were many slimy depressions on the bottom. A few red rock-cod were taken with hand lines from the ship, and also 1 ratfish (*Chimara*).

Heceta Bank, Oregon.—In the afternoon there was a stiff breeze from the northwest, which assisted us on our course toward Heceta Bank, where we arrived the next morning. The trawl line, baited with fresh red rock-cod and salt herring, was set for over 2 hours, at dredging station 3050 (latitude $43^{\circ} 01' 15''$ N., longitude $124^{\circ} 57'$ W.), 46 fathoms, bottom very rocky. There was a strong tide running to the southeast at the time, and as far as the eye could see the surface was covered with Portuguese men-of-war sailing before the gentle breeze. The trawl line yielded 11 red rock-cod, 1 orange rock-cod, 1 sea trout, and 1 ratfish; the hand lines used from the ship gave 26 red rock-cod, 2 orange rock-cod, 4 yellow-tails, and 1 cultus-cod. Hand lines, therefore, seemed better adapted to the locality than trawl lines.

At 2:30 p. m. the same day three small boats were dropped at hydrographic station 1839 (latitude $44^{\circ} 59' 30''$ N., longitude $124^{\circ} 50' 30''$ W.), 43 fathoms, for the purpose of testing the bottom on Heceta Bank in several places at the same time, and with the special view of determining the presence of halibut, if possible. The boats anchored within half a mile of each other and fished only with hand lines. The trial lasted an hour, several lines being also used from the ship at the same time. Twenty-two red rock-cod, weighing 192 pounds, were caught by the small boats, and 12 of the same species from the ship. As only three lines were put over from the ship, it may be considered that they had the greater success. In each trial made on the bank the ship seemed to meet with better results while drifting than did the small

boats at anchor, the fish apparently congregating on detached rocky spots or ledges. Good fishing would continue for a time and then suddenly cease, making it necessary to seek a new place. The last fishing for the day was done at dredging station 3054 (latitude $44^{\circ} 13' N.$, longitude $124^{\circ} 44' 30'' W.$), 53 fathoms, beginning just before sundown. Eleven lines were put over, but we captured only 1 yellow-tail. It has been our experience that red rock-cod do not as a rule bite well in the evening.

The tangles were used many times during the day, the bottom being too rough in most places for the beam-trawl. The fauna is as rich as on Flattery Bank at the mouth of the Straits of Fuca, affording good feeding grounds for fish. The scarcity of halibut at this place can not therefore be due to the quality of the bottom, and we were greatly disappointed in obtaining no trace of them. A single specimen, weighing $10\frac{1}{2}$ pounds, was taken by the *Albatross* in October, 1888, a season of the year when they might be the least expected, and it was thought that they would prove to be more abundant earlier in the year while they are most plentiful on the Flattery grounds. Our investigations tended to disprove the supposition, for had they been at all common it is more than likely we should have succeeded in capturing some of them during our many trials. This was the season of their greatest abundance on Flattery Bank, but it is possible, though not probable, that the season is different in the two regions. Mr. William T. Radir, of Yaquina Bay, Oregon, has recently constructed a steam schooner furnished with all the modern fishing appliances, with which he intends to make a thorough trial for halibut on Heceta Bank. His plans are not based upon the *Albatross* reports, but this bank has long been regarded by Oregon people as holding out special inducements for salt-water fishing, the value of which has never been determined.

Off Yaquina Bay, Oregon.—The next morning hand-line fishing was begun from the dingey about 7 o'clock at dredging station 3055 (latitude $44^{\circ} 41' 30'' N.$, longitude $124^{\circ} 09' 15'' W.$), 28 fathoms. This was in the vicinity of Yaquina Bay, Oregon. The wind was blowing fresh from the northwest, producing a choppy sea which caused the boat to pitch about considerably. The bottom was sandy and the results were negative. In the mean time, however, the beam trawl had been used from the ship, capturing a large quantity of flounders and several other species, seven in all. The bottom was again tested with hand lines a short distance from the last position, at dredging station 3057 (latitude $44^{\circ} 43' 41'' N.$, longitude $124^{\circ} 15' 45'' W.$), 43 fathoms. It had been reported that this was one of the localities where the true cod abounded, but we found there only the so-called red rock-cod, specimens weighing 7 and 8 pounds being fairly abundant. The inhabitants of this part of the coast are not familiar with the cod (*Gadus morrhua*), and readily mistake for it the many species of red rock-cod. common

on the coasts of Oregon and Washington. The *Albatross* has thus far found no trace of the *Gadus morrhua* on the Oregon coast.

Soon after the last trial we ran under the lee of Yaquina Light and came to anchor, making a series of trials with hand lines along the rocky shore, but we obtained no fish.

At 3 p. m. we got under way and proceeded 8 miles to the northward, heaving to in 38 fathoms of water, dredging station 3058 (latitude 44° 48' N., longitude 124° 10' W.). No bites were felt during the drift, although a fair trial was made. Many flounders, 1 herring, and several small specimens of *Octopus* were subsequently taken in the beam trawl, some 7 or 8 miles farther offshore.

Astoria, Oregon.—Returning northward, we reached the mouth of Columbia River June 10, anchoring at 3 p. m. off Astoria. Salmon have been exceptionally scarce in the Columbia River this season, the largest catch made by one man in a day having been 37. There is considerable talk among the cannery owners of abandoning gill-net fishing next season and resorting to traps. Many shad have been taken in the gill nets this season. They were mostly shipped to Portland.

Tillamook Rock Grounds.—June 14 we proceeded to Tillamook Rock, south of the Columbia River, and set cod and halibut trawls. Acting upon information obtained from the captain of the Light-House steamer *Manzanita*, the outer trawl buoy was thrown over close to Tillamook Rock, and the inner one near the main shore, thereby covering the entire ground from which halibut have been reported. Hauling the trawl at the end of 2 hours, we secured one halibut weighing 25 pounds, one skate, one red rock-cod, and hundreds of starfishes. During the same time three halibut and two ground sharks were taken on hand lines from the *Manzanita*. Hand-line fishing would be the most profitable here at this season. The starfishes were a great source of annoyance and gave as much trouble as the dogfish on other grounds. Nearly every hook on our trawl had been seized by a starfish, and some had two clinging to them. On the south side of the rock, flounders, tomcod, and crabs were obtained in the beam trawl, but nothing was caught on the hand lines, although they were tried at every station. The grounds about Tillamook Rock cover a very small area suitable for boat fishing, but they can never become the resort of large bodies of fish, and offer no inducements to vessel fishermen. Scattering halibut may be found here during a large part of the year.

From Tillamook Rock we ran 3 miles offshore, SW. by W. $\frac{1}{2}$ W. (magnetic), and fished with hand lines in 46 fathoms, capturing one red rock-cod. A second trial was made in 42 fathoms, the rock bearing NE. $\frac{1}{2}$ E. (magnetic) 2.6 miles, with no results, very little material also being taken in the beam trawl at the same place. No better success was had in 27 fathoms off the mouth of the Columbia River, Cape Disappointment bearing NE. $\frac{1}{2}$ E. (magnetic) 6.8 miles; nor again 15 miles

from this position in a NW. by W. $\frac{1}{4}$ W. direction, although flounders and skates were taken in the beam trawl.

Flattery Bank, Washington.—Leaving the Oregon coast we proceeded to the halibut bank off Cape Flattery, arriving there June 14. The cod and halibut trawl was immediately set in 31 fathoms, very rocky bottom, Cape Flattery bearing E. by S. $\frac{1}{2}$ S., and Cape Beall NW. by W. The tide was running ebb, but not strong, and a dense fog prevailed. At the end of 2 hours the following fish were taken from the hooks: 8 halibut, 10 red rock-cod, 1 sea trout, 1 cultus-cod, 1 skate, and 45 dogfish. The halibut averaged 35 pounds each in weight, and the red rock-cod 10 pounds. The cultus-cod weighed 19 pounds. The bottom was so rough that many of the hooks caught upon it while hauling, and when within about 10 fathoms of the outer end the ground line parted, having come in contact with a sharp or ragged edge of rock. No gear was lost, however, as we soon picked up the outer buoy and hauled from it. While tending the trawl one small halibut and about a dozen dogfish were caught on hand lines from the small boats. We arrived on board the *Albatross* about 2:05 p. m., and found that they had taken one halibut from the ship, the largest captured during the day. It weighed 93 pounds, and increased the average weight of our entire catch of halibut to 42 pounds each.

A native canoe containing four Indians came alongside about the time we had finished hauling the trawl. They had been fishing with hand lines, using the primitive wooden hook, with which they had captured 15 small halibut.

After completing the investigations on Flattery Bank we steamed to Neeah Bay, arriving there about 3 p. m. the same day, and June 15 we proceeded to Seattle. The Indians of Neeah Bay visit Flattery Bank daily during the halibut season, whenever the weather permits, and bring in considerable quantities of halibut, cultus-cod, and red rock-cod. Herring, smelt, and squid are used as bait, in their respective seasons, and halibut and red rock-cod are also used for the same purpose.

In the fall of 1888, several fishermen, well equipped with dories, trawls, etc., established a camp in the vicinity of Neeah Bay, and fished continuously throughout the following winter on Flattery Bank and directly off Cape Flattery. They consider that they have given these grounds a thorough trial. Mr. Moor, one of the members of this party, came to the Pacific coast in the schooner *Mollie Adams* and remained with her during the trips made by that vessel in the summer of 1888 to Flattery Bank and to the Queen Charlotte Islands and Sound. He has furnished a synopsis of last winter's fishing. They first set trawls November 23, 1888, and from that date up to January 7, 1889, succeeded in landing 2,076 pounds of halibut and 244 pounds of cultus-cod. The average weight of the halibut was 37 pounds and of the cultus-cod 24 pounds. After January 7 little was done, owing to the scarcity of fish and bait and the prevalence of stormy weather.

Mr. Moor does not think it advisable to send vessels to Flattery Bank earlier than the 1st of March nor later than the 1st of September. He thinks that halibut are abundant from March to June, but do not occur in incredible numbers, as has been reported from time to time.

In November, 1888, Capt. Silas Calder, then of the schooner *Mollie Adams*, made a series of trials for halibut on Flattery Bank, but did not secure a single specimen. He is of the opinion that vessels could obtain good fares during a few months of each year, and might find the business profitable if there were a market for the catch. But as there are now no markets on the northwest coast that can take more than a few hundred pounds of the fish at a time, there is no incentive for vessel fishermen to engage in the industry.

Straits of Fuca.—There are a few fishermen about Port Townsend and Victoria, who fish for halibut and dogfish the greater part of the year. One of these, Mr. Isaac Bakman, with whom I conversed, stated that he did not think that halibut were ever abundant enough in the Straits of Fuca to warrant vessels of large size engaging in the business. In April, 1888, Mr. Bakman secured in different parts of the straits 4,500 pounds of halibut, for which he received from 2 to 3 cents per pound. These spring fish have been very scarce, and not enough have been caught to pay expenses.

Puget Sound.—During the winter of 1888 and 1889 three men were occupied in Puget Sound in fishing for cod with gill nets and trawl lines. No large quantities of these fish were obtained, but many flounders and a few halibut were taken on the trawls. The fishermen claim that on the "dark" of the moon cod work inshore, and as it begins to grow they move off again into deeper water. They are captured in depths of 5 to 100 fathoms. The deepest water in which cod gill nets have been set is 150 fathoms, off Quartermaster Harbor, near the head of Puget Sound.

None of the salmon canneries had commenced operations at the time of our arrival at Seattle. Salmon are not expected to run before the latter part of July or the 1st of August. Messrs. Felton and Kirkwood, constituting the King County Packing Company, intended to put down this coming season from 8 to 12 traps, costing from \$400 to \$800 each, according to size, including the boats and all other gear. They also have two purse seines valued at \$1,200 each.

Beshowe or Black-Cod Fishery.—In the fall of 1888, several merchants of Victoria, Vancouver Island, talked of fitting out and sending vessels to the black-cod grounds off the west coast of the Queen Charlotte Islands. I have received information of only one such vessel, which has been fishing since November, 1888, in the vicinity of Gold Harbor, Queen Charlotte Islands. It was stated that she had shipped about 70 barrels of black cod to Victoria since she began fishing. These fish were caught in 250 fathoms. The manner of dressing the black cod has not been changed during the year; they still split them

down the back, leaving the head and backbone attached, which causes the fish to rust very quickly. This method of preparation undoubtedly retards their sale in the markets; if cured like cod, or even mess mackerel, this delicious fish would be in far greater demand.

June 18, while at anchor in Port Orchard Bay, Puget Sound, we made several hauls with the seine, securing among other species a small quantity of herring.

REPORT OF ENSIGN MARBURY JOHNSTON, U. S. N., NAVIGATOR.

During the year ending June 30, 1889, the cruising of the *Albatross* has been comprised between the parallels of 17° and 59° north latitude and the meridians of 110° and 167° west longitude. The following table gives the number of days under way, together with the distances run and the object of each trip:

Dates.	Miles.	Object.
July 4 to July 8..	739	San Francisco, Cal., to Esquimalt, British Columbia.
July 9	79	Esquimalt to Departure Bay, British Columbia.
July 11 to July 23..	1,001	Departure Bay to Unalaska, sounding and dredging.
July 28 to July 31..	417.5	Unalaska to Popof Island, sounding, dredging, and fishing.
Aug. 2 to Aug. 10..	1,012	Popof Island to Old Harbor, Kadiak Island, sounding, dredging, and fishing.
Aug. 12 to 14	266.5	Old Harbor to St. Paul, Kadiak, sounding, dredging, and fishing.
Aug. 21 to Sept. 3 ..	1,780.5	St. Paul to Departure Bay, British Columbia, sounding, dredging, and fishing.
Sept. 5 to Sept. 6 ..	139	Departure Bay to Seattle, Wash., sounding, dredging, and fishing.
Sept. 17 to Sept. 26 ..	851.5	Seattle to Barclay Sound, British Columbia, sounding, dredging, and fishing.
Sept. 29 to Sept. 30 ..	149.5	Barclay Sound to Seattle, Wash., sounding, dredging, and fishing.
Oct. 4	38	Seattle, Wash., to Port Townsend, Wash.
Oct. 6	35	Port Townsend, Wash., to Victoria, British Columbia.
Oct. 7	75	Victoria to Departure Bay, British Columbia.
Oct. 10 to Oct. 14 ..	531.4	Departure Bay to Astoria, Oregon, sounding, dredging, and fishing.
Oct. 18 to Oct. 21 ..	575.5	Astoria to San Francisco, Cal., sounding, dredging, and fishing.
Jan. 3 to Jan 10	546.4	San Francisco to San Diego, Cal., sounding, dredging, and fishing.
Jan. 15 to Jan. 19 ..	344.8	Sounding, dredging, and fishing.
Jan. 23 to Jan. 26 ..	303.1	Sounding, dredging, and fishing.
Feb. 4 to Feb. 9	384.6	Sounding, dredging, and fishing.
Feb. 11 to Feb. 14 ..	249.9	Sounding, dredging, and fishing.
Feb. 20 to Mar. 4	936	San Diego to Clarion Island, sounding, dredging, and fishing.
Mar. 6 to Mar. 8	241.5	Clarion Island to Socorro Island, sounding, dredging, and fishing.
Mar. 10 to Mar. 12 ..	385.6	Socorro Island to Pichilique Bay, Lower California, sounding, dredging, and fishing.
Mar. 16 to Mar. 21 ..	303.4	Pichilique Bay to Guaymas, Mex., sounding, dredging, and fishing.
Mar. 23 to Mar. 30 ..	679.3	Cruising in Gulf of California, sounding, dredging, and fishing.
Mar. 31 to Apr. 3	270.9	Guaymas to La Paz, Lower California, sounding, dredging and fishing.
Apr. 6 to Apr. 8	338.7	La Paz to Magdalena Bay, Lower California, sounding, dredging, and fishing.
Apr. 9 to Apr. 11	272.5	Magdalena Bay to San Bartolome Bay, sounding and dredging.
Apr. 12 to Apr. 14 ..	345.5	Bartolome Bay to San Diego, Cal., sounding and dredging.
Apr. 22 to Apr. 25 ..	454	San Diego, Cal., to San Francisco, Cal.
May 21 to May 25	813.5	San Francisco, Cal., to Departure Bay, British Columbia.
May 26 to May 27 ..	70.	Departure Bay to Victoria, British Columbia.
May 29	33.	Victoria to Port Townsend, Wash.
May 30	38.	Port Townsend to Seattle, Wash.
June 6 to June 10	628.	Seattle to Astoria, Oreg., sounding, dredging, and fishing.
June 13 to June 15 ..	338.	Astoria to Seattle, Wash., sounding, dredging, and fishing.
June 18 to June 19 ..	22.5	Cruising in Puget Sound, sounding, dredging, and fishing.
June 24	38	Seattle to Port Townsend, Wash.
June 27 to June 30 ..	437	Port Townsend to Departure Bay, sounding and dredging.
168 days	17,124.6	

The total number of days at sea was 168, and the distance traveled 17,124.6 miles. During this time 965 soundings were taken, of which number 237 were also dredging stations.

The deviation of the standard compass was found to increase rapidly on easterly and westerly courses with an increase of latitude, the points of no deviation remaining constant at about N. by W. and S. $\frac{1}{2}$ E.

The ship was swung for compass observations on the following dates:

Date.	Position.			
	Lat. N.		Long. W.	
	°	'	°	'
July 7	45	38	124	00
August 3	55	00	160	15
August 22	58	00	151	30
January 6	34	00	120	20

Compass cards showing graphically the amount of deviation on each point are appended.

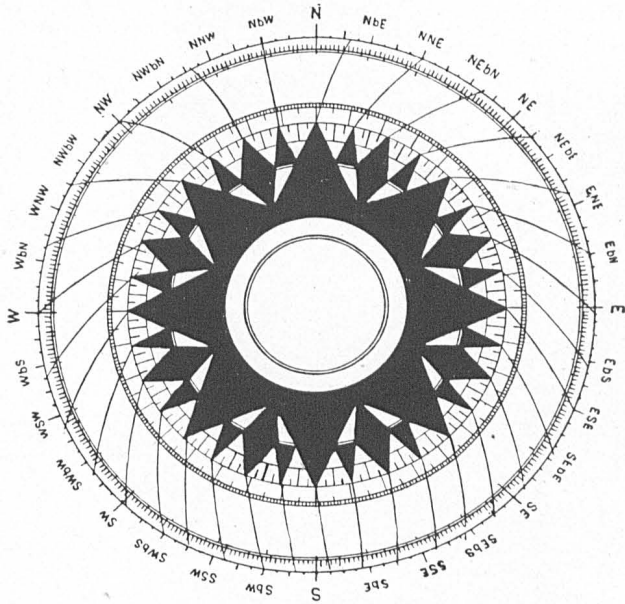
On March 28 a survey was made of Willard Bay, on the west side of the Gulf of California. The base line was obtained in the following manner: The two extremities of the line were occupied by observers, who measured simultaneously the angle subtended by the foremast of the *Albatross*. One observer also measured the horizontal angle between the foremast and the other observer. The height of the foremast being known, the distance from the ship of each observer was computed. Then with the measured horizontal angle and the two computed distances, the third side of the triangle—the base line—was computed. From the two stations at the ends of the base line cuts were taken on all the prominent points. Willard's Point, the northern point of the bay, was also occupied, and a third round of angles taken as a check.

The astronomical bearing of the base line was obtained by two methods, the results agreeing very closely. The first was by compass bearing, applying the local variation as taken from the chart. The second by measuring the angle made by the intersection of the base line and a true north and south line. The latter was obtained by observing the shadow cast by a perpendicular stake 10 feet high at apparent noon. The latitude was obtained by observing the meridian altitude of the sun with a sextant and artificial horizon; the longitude, by equal altitudes of the sun observed before and after noon. The mean of four chronometers, rated at San Diego 32 days previously, was taken in making the computation.

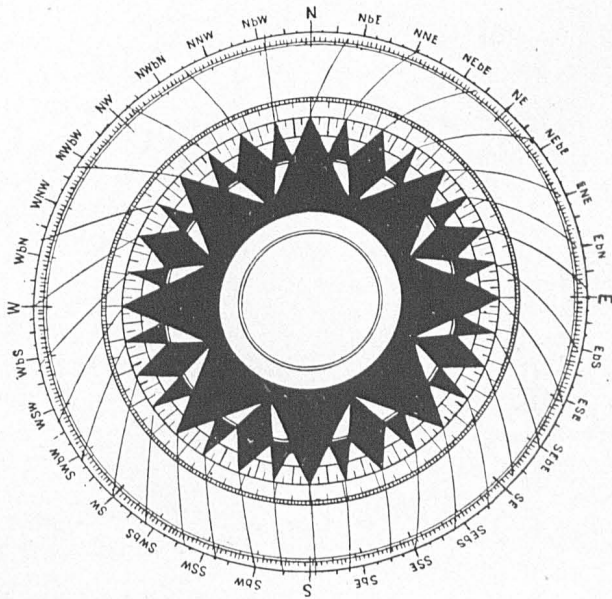
Several zigzag lines of sounding were run in the northern portion of the bay, but lack of time prevented a thorough examination of the bottom.

The angles were all measured with a sextant, the ship having no theodolite on board.

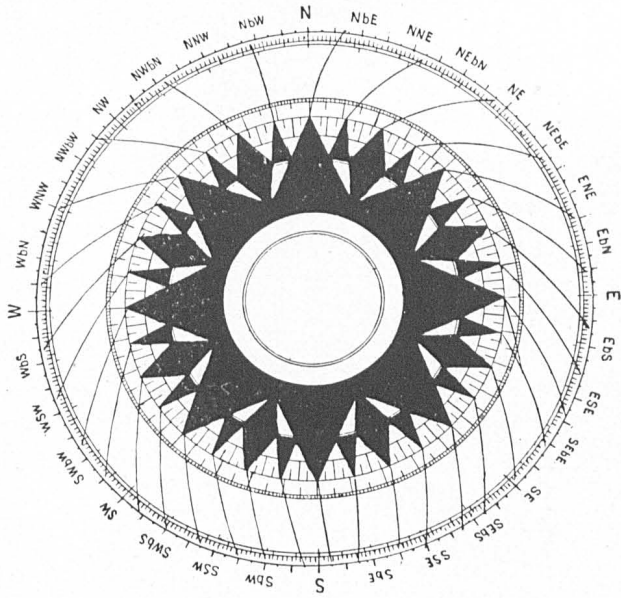
The four chronometers in use on board this vessel were last cleaned and overhauled in August, 1887. They run well together, and as yet show no indications of needing attention.



STEERING CARD.
Latitude 45° 38' N.; Longitude 124° 00' W.

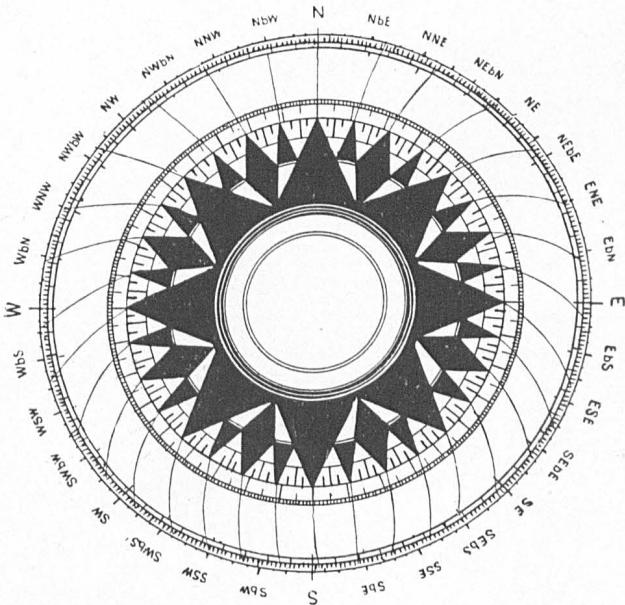


STEERING CARD.
Latitude 55° 00' N.; Longitude 160° 15' W.



STEERING CARD.

Latitude $58^{\circ} 00' N.$; Longitude $151^{\circ} 30' W.$



STEERING CARD.

Latitude $34^{\circ} 00' N.$; Longitude $120^{\circ} 20' W.$

482 · REPORT OF COMMISSIONER OF FISH AND FISHERIES.

Record of hydrographic soundings of the U. S. Fish Commission steamer Albatross from July 1, 1888, to June 30, 1889—Continued.

Serial No.	Date.	Time of day.	Position.		Depth.	Character of bottom.	Temperature.			Kind of reel.	Weight of sinker.
			Lat. N.	Long. W.			Air.	Sur- face.	Bot.		
			° ' "	° ' "	Fms.		° F.	° F.	° F.		Lbs.
1199	July 29	6:20 p. m.	54 22 00	164 01 00	55	bk. S.	51	49	41.2	Tanner	25
1200	do	8:30 p. m.	54 20 00	163 41 00	72	bk. S.	51	49	40.2	do	25
1201	do	10:40 p. m.	54 18 00	163 21 00	44	bk. S. G.	51	50	40.2	do	25
1202	do	11:19 p. m.	54 18 00	163 18 00	32	rky	51	50	42.2	do	25
1202a	do	do	54 16 00	163 19 30	28	No specimen	51	50	.....	do	25
1202b	do	do	54 15 00	163 21 00	25	No specimen	51	50	.....	do	25
1203	July 30	12:44 a. m.	54 14 00	163 21 30	39	gy. S. bk. Sp	51	50	40.2	Tanner	25
1204	do	2:12 a. m.	54 10 00	163 24 00	42	gy. S. bk. Sp	51	51	42.3	do	25
1205	do	4:48 a. m.	54 09 00	163 14 00	44	bk. S. G.	50	50	42.2	do	25
1206	do	5:33 a. m.	54 09 00	163 04 00	43	G.	51	50	42.2	do	25
1207	do	5:58 a. m.	54 09 00	162 58 00	40	bk. S.	51	50	.....	do	25
1208	do	6:18 a. m.	54 08 00	162 54 00	41	gy. S. bk. Sp	51	50	42.2	do	25
1209	do	8:59 a. m.	54 03 00	162 43 00	51	G.	51	50	41.2	do	25
1210	do	9:49 a. m.	53 58 00	162 42 00	404	rky	51	50	42.2	do	25
1211	do	10:55 a. m.	54 03 00	162 33 00	265	rky	51	50	39.2	do	25
1212	do	11:55 a. m.	54 08 00	162 22 00	60	crs. S. P	51	50	40.2	do	25
1213	do	12:40 p. m.	54 12 00	162 17 00	47	bk. S. fne. G.	51	50	42.2	do	25
1214	do	2:06 p. m.	54 09 00	162 10 00	07	rky	51	51	40.2	do	25
1215	do	2:52 p. m.	54 12 00	162 02 00	51	rky. fne. G.	51	50	41.2	do	25
1216	do	3:40 p. m.	54 16 00	161 53 00	37	rky	51	50	42.2	do	25
1217	do	4:28 p. m.	54 20 00	161 46 00	38	P.	51	50	40.7	do	25
1218	do	5:14 p. m.	54 26 00	161 45 00	80	gr. M.	52	50	39.8	do	25
1219	do	5:56 p. m.	54 31 00	161 44 00	82	gr. M.	52	50	40.2	do	25
1220	do	6:49 p. m.	54 34 00	161 48 00	58	rky	52	50	41.2	do	25
1221	do	7:57 p. m.	54 27 00	161 53 00	81	gr. M.	51	49	40.2	do	25
1222	do	9:32 p. m.	54 32 00	161 39 00	81	rky	51	49	40.2	do	25
1223	do	11:51 p. m.	54 37 00	161 27 00	59	bk. S.	51	49	41.7	do	25
1224	July 31	12:13 a. m.	54 42 00	161 13 00	64	bk. S.	51	49	42.2	do	25
1225	do	1:40 a. m.	54 47 00	161 00 00	47	bk. S. G.	51	49	42.2	do	25
1226	do	4:55 a. m.	54 51 00	160 47 00	45	gy. S. P.	51	49	.....	do	25
1227	do	6:17 a. m.	54 56 00	160 33 00	52	gy. S.	51	50	41.8	do	25
1228	do	7:25 a. m.	54 50 00	160 26 00	60	gy. S.	51	51	41.7	do	25
1229	Aug. 2	9:14 a. m.	55 08 00	160 05 00	18	fne. Gy. S.	51	49	40.9	do	25
1230	Aug. 3	6:37 a. m.	55 04 00	160 26 00	34	brk. Sh.	58	51	45.7	do	25
1231	do	7:46 a. m.	55 05 00	160 42 00	38	rky	54	51	44.2	do	25
1232	do	9:03 a. m.	55 00 00	160 50 00	71	dk. M.	53	52	40.2	Tanner	25
1233	do	10:18 a. m.	54 52 00	161 17 00	74	dk. M.	54	51	41.7	do	25
1234	do	11:36 a. m.	54 47 00	161 20 00	41	rky	54	51	43.2	do	25
1235	do	11:57 a. m.	54 44 00	161 27 00	45	rky	52	51	.....	do	25
1236	do	1:13 p. m.	54 38 00	161 30 00	40	bk. S. G.	52	51	43.2	do	25
1237	do	2:32 p. m.	54 32 00	161 53 00	75	bk. S.	52	51	41.2	do	25
1238	do	3:53 p. m.	54 25 00	162 05 00	63	bk. S.	52	51	40.2	do	25
1239	do	4:45 p. m.	54 23 00	161 56 00	34	P.	51	51	43.5	do	25
1240	do	5:55 p. m.	54 20 00	162 02 00	30	Sh.	51	50	43	do	25
1241	do	6:39 p. m.	54 16 00	162 08 00	40	brk. Sh. G.	52	50	42.2	do	25
1242	do	8:33 p. m.	54 07 00	162 07 00	435	dk. M.	51	50	38.2	Sigsbee	38
1243	do	9:55 p. m.	54 10 00	161 54 00	50	rky	52	50	39.7	do	38
1244	do	10:21 p. m.	54 13 00	161 47 00	52	bk. S. P.	52	51	40.2	Tanner	25
1245	do	11:04 p. m.	54 17 00	161 40 00	44	crs. S.	52	51	41.2	do	25
1246	do	11:44 p. m.	54 18 00	161 34 00	42	S. R.	52	51	42.2	do	25
1247	Aug. 4	1:05 a. m.	54 22 00	161 22 00	61	R. G.	52	51	41.2	do	25
1248	do	2:17 a. m.	54 27 00	161 08 00	59	bk. S.	52	50	41.2	do	25
1249	do	3:31 a. m.	54 31 00	160 54 00	71	bk. S.	52	50	40.2	do	25
1250	do	4:48 a. m.	54 35 00	160 41 00	72	bu. M.	52	51	40.2	do	25
1251	do	6:04 a. m.	54 39 00	160 28 00	62	gy. S. P.	52	50	40.4	do	25
1252	do	7:24 a. m.	54 43 00	160 14 00	50	fne. gy. S.	53	51	40.6	do	25
1253	do	8:34 a. m.	54 47 00	160 00 00	43	gy. S. bk. Sp	53	51	42.2	do	25
1254	do	9:21 a. m.	54 49 00	159 54 00	40	fne. gy. S.	53	51	43.7	do	25
1255	do	12:08 p. m.	54 57 00	159 55 00	25	gy. S.	51	50	48.3	do	25
1256	do	12:48 p. m.	55 00 00	159 54 00	27	rky	51	50	45.2	do	25
1257	do	1:24 p. m.	54 59 00	159 45 00	26	bk. S. P.	51	50	45.2	do	25
1258	do	2:15 p. m.	55 02 00	159 41 00	37	gy. S. brk. Sh.	53	50	44.7	do	25
1259	do	3:00 p. m.	55 00 00	159 39 00	57	S. brk. Sh.	53	48	44.2	do	25
1260	do	3:30 p. m.	55 10 00	159 40 00	39	S. brk. Sh.	53	48	44.2	do	25
1261	do	5:13 p. m.	55 15 00	159 28 00	23	R. C.	53	48	42.0	do	25
1262	Aug. 5	4:49 a. m.	55 03 00	159 15 00	27	brk. Sh.	51	49	45.7	do	25
1263	do	5:29 a. m.	55 01 00	159 08 00	44	G.	51	49	43.2	do	25
1264	do	6:05 a. m.	54 59 00	159 00 00	48	gy. S.	51	49	42.2	do	25
1265	do	6:42 a. m.	54 57 00	158 52 00	43	gy. S. G.	51	49	42.2	do	25
1266	do	7:13 a. m.	54 55 00	158 46 00	46	gy. S. brk. Sh.	51	49	42.2	do	25
1267	do	8:13 a. m.	54 53 00	158 38 00	70	gy. S.	52	51	40.2	do	25
1268	do	9:01 a. m.	54 49 00	158 42 00	56	gy. S. P.	51	51	49.9	do	25
1269	do	9:46 a. m.	54 51 00	158 49 00	40	gy. S. brk. Sh.	51	51	42.2	do	25
1270	do	10:07 a. m.	54 52 00	158 54 00	45	rky	51	51	.....	Basnet	25
1271	do	10:31 a. m.	54 53 00	158 57 00	41	S. R.	51	51	42.7	Tanner	25
1272	do	10:55 a. m.	54 54 00	159 01 00	45	rky	51	52	.....	Basnet	25

490 REPORT OF COMMISSIONER OF FISH AND FISHERIES.

Record of hydrographic soundings of the U. S. Fish Commission steamer Albatross from July 1, 1883, to June 30, 1889—Continued.

Serial No.	Date.	Time of day.	Position.			Depth.	Character of bottom.	Temperature.			Kind of reel.	Weight of sinker.
			Lat. N.	Long. W.	Fms.			Air.	Sur. face.	Bot.		
1805	Mar. 4	1:24 p. m.	18 33 30	114 44 00	1,732	gy. S. G.	69	71	35	Sigsbee	35	
1806	..do	2:45 p. m.	18 25 30	114 41 00	281	bk. S.	72	71	40.4	..do	35	
1807	Mar. 6	6:32 p. m.	18 23 00	114 30 00	651	bk. & Co. S. G. Glob.	71	70	39.8	..do	35	
1808	..do	8:44 p. m.	18 23 00	114 18 15	1,987	br. M.	71	74	35.3	..do	60	
1809	Mar. 7	1:00 a. m.	18 23 30	113 48 00	2,008	br. M.	70	72	35.1	..do	60	
1810	..do	5:23 a. m.	18 21 30	113 15 00	2,012	br. M.	69	72	36.7	..do	60	
1811	..do	9:41 a. m.	18 25 00	112 44 00	1,951	br. M.	71	73	35.3	..do	60	
1812	..do	1:44 p. m.	18 28 30	112 12 00	1,854	br. M.	75	74	35.4	..do	60	
1813	..do	5:52 p. m.	18 32 00	111 41 00	1,829	br. M.	70	72	..do	..do	60	
1814	..do	8:50 p. m.	18 35 00	111 21 00	1,786	br. M.	70	71	35.3	..do	60	
1815	..do	10:35 p. m.	18 38 00	111 11 00	1,823	R.	70	70	35.3	..do	60	
1816	..do	11:54 p. m.	18 39 00	111 07 00	1,610	rky	69	70	35.5	..do	60	
1817	Mar. 8	5:51 a. m.	18 39 45	111 02 00	1,101	rky	70	70	36.2	..do	35	
1818	..do	0:47 a. m.	18 40 45	110 58 30	651	rky	70	70	39.4	..do	35	
1819	Mar. 10	4:49 a. m.	18 53 09	110 51 00	1,204	br. M. bk. S.	70	70	35.8	..do	35	
1820	..do	6:35 a. m.	19 03 00	110 50 30	1,635	br. M.	71	70	35.6	..do	60	
1821	..do	8:21 a. m.	19 12 00	110 50 00	910	br. M.	71	72	37.5	..do	35	
1822	..do	9:18 a. m.	19 15 30	110 49 15	210	rky	71	73	50.3	..do	38	
1823	..do	3:05 p. m.	19 21 30	110 47 00	375	bk. S.	73	73	44	..do	35	
1824	..do	3:55 p. m.	19 20 15	110 45 30	665	R.	72	73	39.2	..do	35	
1825	..do	5:57 p. m.	19 40 15	110 41 15	1,807	br. M.	72	73	35.5	..do	35	
1826	..do	10:11 p. m.	20 09 00	110 32 30	1,643	br. M.	70	70	35.5	..do	35	
1827	Mar. 11	4:44 a. m.	20 55 15	110 18 30	1,781	dk. br. M.	69	70	36.5	..do	60	
1828	..do	10:58 a. m.	21 41 00	110 04 30	1,694	gn. M.	72	74	35.4	..do	60	
1829	..do	5:10 p. m.	22 25 30	109 42 15	1,711	gn. M.	69	71	35.5	..do	60	
1830	Mar. 20	6:24 p. m.	27 37 15	111 09 00	601	gn. M.	70	66	39.8	..do	35	
1831	Mar. 24	12:22 a. m.	28 44 15	112 32 15	89	S. brk. Sh.	64	61	64.2	..do	38	
1832	Mar. 27	4:41 a. m.	31 23 00	114 25 00	10	M. S.	66	65	65	Tanner	25	
1833	..do	6:06 a. m.	31 13 30	114 27 15	18	M.	66	63.0	63.9	..do	26	
1834	June 7	11:57 a. m.	46 45 30	124 36 00	55	fine gy. S.	56	56	45.7	..do	25	
1835	..do	12:24 p. m.	46 44 45	124 32 45	58	rky	56	50	45.1	..do	25	
1836	June 8	8:27 a. m.	44 04 00	124 53 30	48	bu. M.	54	52	48.0	..do	25	
1837	..do	1:07 p. m.	43 54 30	124 47 30	95	M.	59	57	43.9	..do	25	
1838	..do	1:40 p. m.	43 57 30	124 49 00	61	M. & G.	59	57	47.3	..do	25	
1839	..do	2:00 p. m.	44 50 30	124 50 30	43	M. & G.	57	56	52.1	..do	25	
1840	..do	5:55 p. m.	44 00 30	124 51 30	95	fine bk. S.	57	56	43.6	..do	26	
1841	..do	6:32 p. m.	44 11 15	124 48 15	68	G.	57	56	..do	..do	25	
1842	..do	8:40 p. m.	44 16 00	124 42 00	70	G.	56	56	45.9	..do	25	
1843	..do	9:43 p. m.	44 19 00	124 40 00	61	G.	57	55	46.4	..do	25	
1844	..do	10:40 p. m.	44 22 15	124 38 00	60	M. & G.	57	55	..do	..do	25	
1845	..do	11:35 p. m.	44 25 30	124 36 00	73	fine gy. S.	57	55	47.2	..do	25	
1846	June 9	12:35 a. m.	44 28 30	124 34 00	78	fine bk. S.	57	55	45.6	..do	25	
1847	..do	1:30 a. m.	44 31 15	124 31 45	75	G1	56	56	46.1	..do	25	
1848	..do	2:22 a. m.	44 34 30	124 29 15	60	rky	56	56	45.8	..do	25	
1849	..do	3:21 a. m.	44 37 30	124 27 00	50	fine P. and bk. S.	57	57	46.6	..do	25	
1850	..do	4:00 a. m.	44 40 15	124 25 00	57	fine bk. S.	57	57	46.6	..do	25	
1851	..do	5:03 a. m.	44 43 30	124 22 30	65	fine gy. S.	50	57	46.0	..do	25	
1852	..do	5:48 a. m.	44 41 00	124 16 15	45	fine gy. S. bk. Sp.	50	57	46.1	..do	25	
1853	..do	6:25 a. m.	44 39 00	124 11 00	34	fine gy. S.	55	57	46.1	..do	25	
1854	June 13	10:06 a. m.	45 55 30	124 01 15	25	fine gy. S.	50	54	48.0	..do	25	
1855	June 14	10:12 a. m.	48 29 00	124 55 15	45	rky. & G.	56	54	46.6	..do	25	
1856	..do	10:26 a. m.	48 29 30	124 56 30	31	G. & brk. Sh.	56	54	47.1	..do	25	
1857	June 29	4:55 a. m.	47 23 00	125 44 00	860	gn. M.	57	54	36.7	Sigsbee	85	

Record of dredging and trawling stations of the U. S. Fish Commission steamer Albatross, July 1, 1883, to June 30, 1889.

Serial No.	Date.	Time.	Position.			Depth.	Character of bottom.	Temperature.			Drift.		Instrument used.
			Latitude, N.	Longitude, W.	Latitude, N.			Longitude, W.	Air.	Surfaces.	Bottom.	Direction.		Distance.
2841	1883 July 23	9-05 a. m.	54 18 00	165 55 00	0 1 58	Fm. s.	P.	63	46	41	WNW	0.2	S. B. T.
2842	do	10-27 a. m.	54 15 00	166 03 00	0 1 59	P.	50	50	41	SW	SW	0.3	S. B. T.
2843	July 26	12-37 p. m.	53 56 00	165 58 00	45	brk. Sh. & P.	52	50	43.5	ENE	ENE	1.5	S. B. T.
2844	do	9-17 p. m.	53 56 00	165 40 00	42	G. bk. S.	51	48	42	E by S	E by S	1.5	L. B. T.
2845	July 29	6-30 a. m.	54 05 00	165 00 00	54	G. bk. S.	53	51	42	SW	SW	0.8	L. B. T.
2846	July 30	7-45 a. m.	54 06 00	162 44 00	44	G. bk. S.	51	51	42	S by E	S by E	0.8	L. B. T.
2847	July 31	8-00 a. m.	55 01 00	160 12 00	48	fine gy. S.	51	51	42	SSW	SSW	0.8	L. B. T.
2848	do	9-40 a. m.	55 10 00	160 18 00	160	gn. M.	51	49	41	S	S	0.3	L. B. T.
2849	do	7-30 a. m.	55 16 00	180 28 00	69	gn. M.	54	51	43	S	S	0.7	L. B. T.
2850	Aug. 4	10-30 a. m.	54 52 00	159 46 00	21	brk. sh.	53	51	48.2	W by N	W by N	0.5	L. B. T.
2851	do	11-13 a. m.	54 55 00	159 59 00	35	ky. s. brk. sh.	53	51	44.8	W by N	W by N	1.0	L. B. T.
2852	do	4-06 p. m.	54 55 00	159 37 00	58	bk. s.	46	46	41.8	NNW	NNW	0.7	L. B. T.
2853	Aug. 9	2-54 p. m.	54 55 00	159 20 00	150	bk. s.	55	55	42.8	SW	SW	1.0	L. B. T.
2854	Aug. 10	9-35 a. m.	56 55 00	153 13 00	60	bk. s.	57	55	44	SW	SW	1.0	L. B. T.
2855	do	11-53 a. m.	57 07 00	153 26 00	68	br. sh. bk. Sp.	58	56	44	XNW	XNW	1.0	L. B. T.
2856	do	0-30 p. m.	58 07 00	151 46 00	68	ky. s. bk. Sp.	55	54	41.6	SE	SE	0.5	L. B. T.
2857	do	11-41 a. m.	58 05 00	151 36 00	50	brk. sh. gy. S.	68	57	41.6	SE	SE	0.5	L. B. T.
2858	Aug. 24	11-40 a. m.	58 17 00	149 26 00	270	br. sh. gy. S.	61	59	39.8	W. S. W	W. S. W	0.2	L. B. T.
2859	Aug. 29	2-00 p. m.	55 20 00	136 30 00	1,589	br. sh. gy. S.	61	60	31.9	SE	SE	2.5	L. B. T.
2860	Aug. 31	9-30 a. m.	51 23 00	130 54 00	1,589	br. sh. gy. S.	61	58	36.5	SE	SE	1.5	L. B. T.
2861	do	12-52 p. m.	50 49 00	129 56 00	970	gn. M.	60	60	41.7	E. N	E. N	1.0	L. B. T.
2862	Sept. 1	12-52 p. m.	50 49 00	129 36 30	228	No specimen in cap.	61	58	41.7	ESE	ESE	0.8	L. B. T.
2863	Sept. 5	10-58 a. m.	48 58 00	125 10 00	47	fine S. brk. Sp.	60	62	48.1	SSW	SSW	0.8	L. B. T.
2864	Sept. 6	7-16 a. m.	48 22 00	122 51 00	48	br. brk. sh. S.	59	59	47.7	SSW	SSW	0.6	L. B. T.
2865	do	8-56 a. m.	48 12 00	122 49 00	47	br. brk. sh. S.	59	59	51.7	S by E	S by E	0.6	L. B. T.
2866	Sept. 20	11-10 a. m.	48 09 00	125 05 00	171	gy. S.	59	59	43.2	SE by E	SE by E	0.8	L. B. T.
2867	do	1-47 p. m.	48 07 00	124 55 00	37	fine gy. S.	58	58	40.9	SE	SE	0.6	L. B. T.
2868	Sept. 21	1-27 p. m.	47 52 00	124 44 00	61	gy. S.	63	60	46.9	W	W	1.5	L. B. T.
2869	do	4-09 p. m.	47 56 00	124 39 00	52	brk. S.	64	58	46.5	W by S	W by S	1.5	L. B. T.
2870	Sept. 23	9-04 a. m.	46 44 00	124 32 00	65	fine S.	62	62	56.4	E by E	E by E	1.3	L. B. T.
2871	do	1-32 p. m.	46 55 00	125 11 00	539	br. Oz.	60	69	43.5	E by E	E by E	0.4	L. B. T.
2872	Sept. 24	10-09 a. m.	48 17 00	124 52 00	60	br. S.	62	62	47.8	SE	SE	0.5	L. B. T.
2873	do	12-45 p. m.	48 30 00	124 57 00	27	R. & Sh.	55	52	50.3	SE	SE	0.2	Tangles.
2874	do	1-25 p. m.	48 30 00	124 57 00	40	R. & Sh.	55	52	47.8	WSW	WSW	0.4	Tangles.
2875	do	1-58 p. m.	48 33 00	124 57 00	59	bk. S. & M.	49	49	45.5	WSW	WSW	0.4	L. B. T.
2876	Sept. 25	10-34 a. m.	48 33 00	124 53 00	60	bk. S. & M.	58	49	45.5	SE by S	SE by S	0.2	Tangles.
2877	do	10-59 p. m.	48 37 00	125 32 00	60	P.	60	57	45.5	W by S	W by S	0.3	Tangles.
2878	do	3-02 p. m.	48 53 00	125 53 00	34	R.	56	54	50.3	W by S	W by S	0.2	S. D.
2879	Sept. 26	8-49 a. m.	48 53 00	125 53 00	84	R.	54	54	50.3	E by S	E by S	0.2	S. D.
2880	do	11-44 a. m.	49 09 00	125 48 00	24	gy. S.	63	57	52.3	SE by E	SE by E	0.2	S. D.
2881	do	11-44 a. m.	49 09 00	124 22 30	68	gy. S.	64	60	45.8	N	N	1.0	L. B. T.

Record of dredging and trawling stations of the U. S. Fish Commission steamer *Albatross*, July 1, 1888, to June 30, 1889—Continued.

Serial No.	Date.	Time.	Position.		Depth.	Character of bottom.	Temperature.		Drift.		Instrument used.
			Latitude, N.	Longitude, W.			Air.	Surface.	Bottom.	Direction.		Distance.
2883	1888, Oct. 18	3-01 p. m.	45 56 00	124 01 30	Fms.	fne. gy. S.	62	60	SSE		S. D.
2884	do	3-16 p. m.	45 55 00	124 02 00	29	fne. gy. S.	62	60	WNW, by N		S. D.
2885	do	3-44 p. m.	45 56 00	124 02 00	30	fne. gy. S.	62	60	NW		S. D.
2886	Oct. 19	9-05 a. m.	43 58 00	124 56 30	40	rky	57	57	SSW		S. D.
2887	do	9-28 a. m.	43 58 00	124 57 00	42	C. & P.	60	60	NW		L. B. T.
2888	do	10-01 a. m.	43 58 00	124 57 30	41	C. & P.	60	59	W		L. B. T.
2889	do	10-42 a. m.	43 59 00	124 56 00	46	C. S.	50	57	SSW		L. B. T.
2890	do	2-58 p. m.	43 46 00	124 57 00	277	gy. S.	62	59	SSE		L. B. T.
2891	Jan. 5	6-36 a. m.	34 25 00	120 42 00	233	M.	56	57	F. by S.		L. B. T.
2892	do	9-10 a. m.	34 12 00	120 36 00	284	vl. M.	56	56	SSE		L. B. T.
2893	do	11-11 a. m.	34 12 30	120 32 30	145	fne. gy. S. M.	60	59	SE, E		L. B. T.
2894	do	12-41 p. m.	34 07 00	120 33 30	63	brk. Sh. S.	62	60	NNE		S. D.
2895	do	1-15 p. m.	33 57 30	120 33 30	53	brk. Sh. S.	62	60	NNE		S. D.
2896	Jan. 6	6-49 p. m.	33 50 30	120 28 00	376	vl. M.	59	59	NNE		Tangles.
2897	do	9-35 a. m.	33 50 30	120 29 30	197	rky	66	61	L. B. T.		Tangles.
2898	do	11-02 a. m.	33 00 00	120 29 00	158		66	62	L. B. T.		Tangles.
2899	do	1-08 p. m.	34 00 00	120 23 00	44	gy. S. brk. Sh.	62	59	L. B. T.		L. B. T.
2900	Jan. 7	11-59 a. m.	34 01 30	120 01 30	13	S.	59	58	0		S. D.
2901	do	12-40 p. m.	34 05 00	120 02 00	48	gy. S. M.	59	58	WNW		0.8
2902	do	1-04 p. m.	34 06 00	120 02 00	53	fne. gy. S. M.	60	59	W		0.6
2903	do	2-22 p. m.	34 11 30	120 03 00	322	G. M.	60	59	NW, by W		0.5
2904	do	4-29 p. m.	34 18 30	120 04 30	314	G. M.	61	59	NW, by W		1.5
2905	Jan. 8	6-41 a. m.	34 23 00	120 20 00	95	rky	61	59	NW, by W		1.3
2906	do	7-15 a. m.	34 23 30	120 19 30	96	S. M.	57	58	NW		S. B. T.
2907	do	7-48 a. m.	34 24 30	120 20 00	44	fne. gy. S.	57	58	NW		S. B. T.
2908	do	8-29 a. m.	34 25 25	120 20 00	31	gy. S. brk. Sh.	57	58	N, by W		S. B. T.
2909	do	12-15 p. m.	34 22 00	120 06 30	205	gn. M.	57	58	E, by S		L. B. T.
2910	do	2-51 p. m.	34 20 00	119 54 00	60	gn. M.	60	61	E, by S		S. B. T.
2911	Jan. 16	9-42 a. m.	32 27 30	119 05 00	220	R. S.	59	59	S		S. B. T.
2912	do	11-57 a. m.	32 25 15	119 04 30	10	rky	56	59	S		S. D.
2913	do	3-23 p. m.	32 25 30	119 03 30	28	brk. Sh.	60	60	ESE		Tangles.
2914	do	12-14 p. m.	32 25 00	119 03 15	20	brk. Sh.	60	60	WNW		S. D.
2915	do	3-22 p. m.	32 23 00	119 02 15	58	gy. S.	58	60	WNW		Tangles.
2916	do	3-45 p. m.	32 23 00	119 02 00	55	gy. S.	58	60	W, by S		Tangles.
2917	do	4-10 p. m.	32 22 30	119 02 00	88	fne. gy. S. brk. Sh.	58	59	0		L. B. T.
2918	do	4-41 p. m.	32 22 30	119 03 30	90	fne. gy. S.	58	59	0		S. D.
2919	Jan. 17	6-28 a. m.	32 17 00	119 03 30	67	fne. gy. S.	58	59	N, E		S. D.
2920	do	12-37 p. m.	32 27 00	119 17 00	87	gy. M.	55	59	N, E		L. B. T.
2921	do	1-13 p. m.	32 27 00	119 15 00	87	vl. S. brk. Sh.	59	60	N, E		L. B. T.
2922	do	5-10 p. m.	32 27 15	119 05 15	147	fne. gy. S.	60	59	NNE		S. D.
2923	Jan. 19	6-30 a. m.	32 40 30	117 31 30	822	fne. gy. S.	59	59	NNE		S. D.
2924	do	10-00 a. m.	32 34 30	117 25 30	455	br. M.	57	59	SE		L. B. T.
2925	do	12-10 p. m.	32 32 30	117 24 00	339	M.	56	59	E, S		L. B. T.

2926	do.	1:43 p.m.	32	34	30	117	18	45	69	inc. gy. S.	63	62	54.4	NE. by N	1.5	L. B. T.
2927	Jan. 23	1:25 a.m.	32	43	00	117	51	00	312	gn. M.	58	58	43.3	W. by S.	1.0	L. B. T.
2928	do	2:24 p.m.	32	47	30	118	00	00	417	dk. S. G.	58	59	41	by S.	0.7	L. B. T.
2929	Jan. 26	6:25 a.m.	32	47	30	117	26	30	623	gn. M.	56	58	41	S. by W.	1.6	S. B. T.
2930	do	9:09 a.m.	32	23	30	117	18	45	30	gy. S. Sh.	59	59	52.9	E. by N	0.5	S. B. T.
2931	do	10:19 a.m.	32	23	30	117	16	45	61	gy. S. Sh.	58	59	53.9	E. by N	0.5	S. B. T.
2932	do	10:30 a.m.	32	28	15	117	16	15	36	gy. S. brk. Sh.	58	59	57.3	E.	0.4	S. B. T.
2933	do	11:45 a.m.	32	28	45	117	16	15	36	inc. gy. S.	58	59	57.3	E.	0.5	S. D. T.
2934	do	12:40 p.m.	32	44	30	117	16	00	36	gy. S.	53	59	58.2	N. W. by W.	1.3	L. B. T.
2935	do	11:00 a.m.	32	44	30	117	23	00	124	inc. gy. S.	63	59	49.2	N. W. by W.	0.8	L. B. T.
2936	do	12:22 p.m.	32	49	00	117	27	30	359	Al.	61	61	48	N. W. by W.	1.0	L. B. T.
2937	do	4:09 p.m.	33	04	30	117	42	00	464	gn. M.	65	62	46.5	West	1.5	L. B. T.
2938	Feb. 5	12:58 p.m.	33	53	15	118	08	30	47	inc. gy. S. St.	56	58	58	V. N. W.	0.5	L. B. T.
2939	do	1:45 p.m.	33	36	00	118	09	30	27	inc. gy. S. St.	58	59	58	W. by S.	0.5	L. B. T.
2940	do	2:47 p.m.	33	36	00	118	11	00	28	inc. gy. S. St.	58	59	58	W. by S.	0.2	L. B. T.
2941	do	3:11 p.m.	33	37	15	118	12	00	26	Sub. St.	59	59	59	W. by S.	0.2	L. B. T.
2942	do	3:58 p.m.	33	38	45	118	13	45	20	gy. S. brk. Sh.	59	59	59	W. by S.	0.3	S. B. T.
2943	Feb. 6	1:10 p.m.	34	00	00	119	28	30	31	gy. S. brk. Sh.	58	59	58	W. by W. by W.	0.4	S. B. T.
2944	do	1:26 p.m.	34	00	00	119	28	30	30	P.	58	59	58	W. by W. by W.	0.4	S. B. T.
2945	do	2:31 p.m.	34	00	00	119	29	30	30	P.	58	59	58	W. by W. by W.	0.4	S. B. T.
2946	do	3:20 p.m.	33	58	00	119	30	45	150	Cre. gy. S.	59	59	56.5	W. by W. by W.	0.2	L. B. T.
2947	Feb. 7	1:44 p.m.	33	55	30	119	40	30	269	gy. S. G. brk. Sh.	59	59	58	W. by S.	0.3	S. B. T.
2948	do	2:27 p.m.	33	55	30	119	41	30	266	gy. S. G. brk. Sh.	59	59	58	W. by S.	0.2	L. B. T.
2949	do	4:34 p.m.	33	57	00	119	53	30	155	inc. gy. S.	59	59	58	W. by S.	0.7	L. B. T.
2950	Feb. 8	6:26 a.m.	34	00	30	119	59	00	21	gy. S. brk. Sh.	57	57	55.4	W. by S.	1.0	L. B. T.
2951	do	7:41 a.m.	33	65	30	119	55	00	48	inc. gy. S.	57	56	55.4	W. by S.	0.8	L. B. T.
2952	do	8:50 a.m.	33	50	00	119	57	00	57	brk. Sh. R.	57	57	57	W. by S.	0.1	L. B. T.
2953	do	9:40 a.m.	33	47	00	119	58	15	62	brk. Sh. R.	57	57	57	W. by W.	0.5	L. B. T.
2954	do	10:45 a.m.	33	42	30	119	59	30	65	G. Sh. R.	60	59	48.2	WSW	0.3	S. D. T.
2955	do	12:19 p.m.	33	48	00	120	03	15	121	inc. gy. S. brk. Sh.	58	58	53.1	SW. by W.	0.1	S. S. T.
2956	do	3:13 p.m.	33	57	30	120	18	30	52	inc. gy. S. R.	58	58	54.9	SW. by W.	0.1	S. S. T.
2957	Feb. 9	12:39 p.m.	34	04	00	120	19	30	62	gy. S. rky	58	58	54.9	SW. by W.	0.5	L. B. T.
2958	do	12:49 p.m.	34	04	00	120	19	30	26	gy. S.	63	58	64.9	WSW	0.3	S. D. T.
2959	do	1:49 p.m.	34	06	45	120	18	00	55	gn. M. gy. S. brk. Sh.	63	59	51.9	WSW	0.1	S. S. T.
2960	do	2:47 p.m.	34	10	45	120	16	45	267	gn. M. gy. S. brk. Sh.	63	59	48	WSW	0.3	S. S. T.
2961	Feb. 11	7:35 a.m.	34	22	45	119	40	30	21	gn. M.	53	56	48	N. by S.	1.0	L. B. T.
2962	do	8:04 a.m.	34	23	30	119	39	30	165	S. St. Co	62	59	48	N. by S.	0.4	L. B. T.
2963	do	8:17 a.m.	34	23	45	119	39	40	20	S. St. Co	62	59	48	N. by S.	0.3	L. B. T.
2964	Feb. 11	8:47 a.m.	34	22	15	119	40	00	20	S. St.	62	59	48	SW. by S.	0.5	Tangles.
2965	do	9:58 a.m.	34	21	20	119	38	30	27	S. St.	62	59	48	SW. by S.	0.5	Tangles.
2966	do	10:25 a.m.	34	20	40	119	38	50	27	inc. gy. S. R.	60	60	58	SW. by S.	0.3	Tangles.
2967	do	10:58 a.m.	34	21	15	119	39	10	30	crs. M.	62	60	58	SW. by S.	0.7	Tangles.
2968	do	11:25 a.m.	34	21	40	119	38	20	31	crs. M.	66	61	58	N. W. by N.	0.6	Tangles.
2969	do	12:05 p.m.	34	20	40	119	37	45	26	M. P. S.	66	61	58	N. W. by N.	0.7	Tangles.
2970	do	12:32 p.m.	34	20	20	119	37	30	62	gy. S. S. M.	63	60	59.1	SE. by E.	0.5	Tangles.
2971	do	1:17 p.m.	34	20	30	119	37	50	29	inc. gy. S. M.	63	60	58.5	SE. by E.	0.3	L. B. T.
2972	do	2:17 p.m.	34	18	30	119	41	00	61	gn. M.	63	60	58.5	W. by N.	0.7	L. B. T.
2973	do	3:08 p.m.	34	19	30	119	44	15	68	gn. M.	63	60	53.5	WSW	1.0	L. B. T.
2974	do	3:47 p.m.	34	19	30	119	44	45	73	gn. M.	63	60	53.2	WSW	0.7	Tangles.

Record of dredging and trawling stations of the U. S. Fish Commission steamer Albatross, July 1, 1888, to June 30, 1889—Continued.

Serial No.	Date.	Time.	Position.		Depth.	Character of bottom.	Temperature.		Drift.		Instrument used.
			Latitude, N.	Longitude, W.			Air.	Surface.	Bottom.	Direction.		Distance.
2975	1889, Feb. 12	8:34 a.m.	34 01 30	119 29 00	56	G. brk. Sh.	57	57	SE ½ E	1.0	L. B. T.
2976	do	9:23 a.m.	34 00 00	119 26 30	31	crs. G. S. brk. Sh.	65	65	SE by E	0.6	S. E. T.
2977	do	9:55 a.m.	33 59 30	119 25 30	45	fne. gy. S. P.	60	60	SE by E	0.8	S. E. T.
2978	do	10:42 a.m.	33 59 45	119 22 15	46	gy. S.	66	66	NE ½ E	0.3	L. B. T.
2979	do	12:28 p.m.	33 56 30	119 22 30	388	gn. M.	65	60	SW by S	1.5	L. B. T.
2980	do	2:40 p.m.	33 49 45	119 24 00	603	gn. M.	70	62	E	0.5	L. B. T.
2981	Feb. 13	6:10 a.m.	33 18 00	119 24 00	43	crs. gy. S. brk. Sh.	61	58	SE ½ S	0.7	L. B. T.
2982	do	1:49 a.m.	33 24 45	119 07 00	178	S. M. G.	63	58	SE ½ S	0.5	L. B. T.
2983	Feb. 28	1:11 a.m.	28 58 30	118 15 45	58	gy. S. brk. Sh.	71	61	S	0.7	S. B. T.
2984	do	1:48 a.m.	28 57 15	118 15 45	113	brk. Sh. R.	68	63	N by E	0.2	S. B. T.
2985	do	1:00 p.m.	28 57 00	118 16 30	36	brk. Sh. R.	66	65	S	0.7	S. B. T.
2987	do	1:37 p.m.	28 57 00	118 14 30	684	fne. gy. S. brk. Sh.	65	64	S	0.6	L. B. T.
2988	Mar. 2	9:10 a.m.	28 54 15	118 18 00	171	gy. S. brk. Sp. G.	65	63	SW by W	0.3	S. B. T.
2989	Mar. 2	9:51 a.m.	24 58 30	115 52 30	34	Coralline	66	65	SW by W	0.7	S. B. T.
2990	do	11:09 a.m.	24 58 15	115 53 00	46	Coralline	64	64.5	SW by W	0.3	Tangles.
2991	do	11:09 a.m.	24 58 05	115 53 10	341	Coralline	64	65	SW by W	0.5	S. B. T.
2992	do	11:28 a.m.	18 17 30	114 40 00	341	Coralline	64	65	SW by W	1.3	S. B. T.
2993	do	1:24 p.m.	18 17 15	114 43 15	460	bk. S. R.	71	72	W ½ N	0.3	L. B. T.
2994	do	2:58 p.m.	18 18 30	114 44 30	364	gy. S. brk. Sh.	72	72	NE by N	0.4	L. B. T.
2995	do	3:31 p.m.	18 19 00	116 44 15	54	brk. Co.	66.6	66.6	NE by N	0.3	S. D.
2996	Mar. 16	1:05 a.m.	24 30 15	110 29 00	31	gy. S. brk. Co.	72	72	NE by N	0.4	S. D.
2997	do	1:26 p.m.	24 39 30	110 34 00	112	gn. M.	76	72	N by W	0.3	L. B. T.
2998	do	3:37 p.m.	24 51 00	110 34 00	21	gn. M.	75	73	N by E ½ E	0.6	L. B. T.
2999	do	4:30 p.m.	24 54 30	110 39 00	39	crs. S.	75	72	N by E ½ E	1.0	L. B. T.
3000	do	5:10 p.m.	24 55 15	110 39 00	43	crs. S.	74	72	NE by N	0.5	Oyster dredge.
3001	do	5:32 p.m.	25 02 15	110 43 00	33	fne. gy. S. brk. Sh.	76	72	NE by N	0.3	Oyster dredge.
3002	Mar. 17	7:08 a.m.	25 02 25	110 43 30	17	S. Sh.	72	70	N by W	0.2	Oyster dredge.
3003	do	7:45 a.m.	25 02 35	110 43 30	9	S. Sh.	72	70	N by W	0.2	Oyster dredge.
3004	do	8:00 a.m.	25 02 45	110 43 30	21	S. Sh. Coralline	72	71	S by E	0.2	L. B. T.
3005	do	8:23 a.m.	25 02 30	110 43 30	8	Shs	75	75	NNE	1.3	L. B. T.
3007	do	12:33 p.m.	25 27 30	110 50 30	362	gn. M.	69	69	NNE	0.6	L. B. T.
3008	Mar. 18	4:12 p.m.	25 59 45	111 03 30	306	gn. M.	70	67	NE by N	1.5	L. B. T.
3009	Mar. 20	4:51 a.m.	27 09 00	111 42 00	887	gn. M.	67	66	NE by N	1.8	L. B. T.
3010	do	10:45 a.m.	28 23 45	111 39 45	1,005	fne. gy. S. brk. Sh.	74	69	NW by W	1.0	L. B. T.
3011	Mar. 23	4:36 p.m.	28 07 00	111 54 00	22	gy. S. brk. Sh.	67	63	N by W	1.5	L. B. T.
3012	do	6:25 p.m.	28 23 45	111 58 00	14	gy. S. brk. Sh.	68	66	WSW	0.5	L. B. T.
3013	do	6:25 p.m.	28 29 00	112 04 30	29	br. M.	68	66	N by E	0.5	L. B. T.
3014	Mar. 24	5:40 a.m.	28 19 00	112 50 00	145	br. M.	64	63	NNW ½ W	1.0	L. B. T.
3015	do	9:01 a.m.	29 40 00	112 57 00	76	gn. M.	70	65	NNW ½ W	1.3	L. B. T.

Date	Time	Lat	Long	Wind	Sea	Temp	Bar	Hum	Dir	Dist	Spec	Remarks
3017	11:19 a. m.	29 54 30	113 01 00	58	gn. M	72	61.8	66.5	NW, by W	L. B. T.	1.3	
3018	2:21 p. m.	30 16 00	113 05 00	36	ft. S. brk. Sh	72	61.8	66.5	N, by E	L. B. T.	2.0	
3019	4:09 p. m.	30 28 30	113 06 30	14	S. brk. Sh	67	66.3	66	N, by E	L. B. T.	0.5	
3020	5:48 p. m.	30 37 30	113 07 00	17	E. S. brk. Sp	67	66.3	66	NW, by W	L. B. T.	0.4	
3021	7:25 p. m.	30 47 00	113 13 00	14	E. S. brk. Sh	67	66.3	66.1	NW, by W	L. B. T.	1.0	
3022	9:00 p. m.	30 58 30	113 17 15	11	E. S. brk. Sp	69	66.1	66.1	NW, by W	L. B. T.	1.3	
3023	Mar. 25	31 17 30	113 57 15	10	G. Sh	69	66.1	66.1	WSW	L. B. T.	0.7	
3024	5:43 p. m.	31 21 00	113 40 00	11	S. brk. Sh, G	68	66.1	66.1	WSW	L. B. T.	0.8	
3025	7:16 p. m.	31 21 15	113 50 00	9	fine gy S	67	66.1	66.1	NW, by W	L. B. T.	1.3	
3026	8:30 p. m.	31 22 00	114 07 40	17	G. brk. Sh	67	66.2	66.2	W, by N	L. B. T.	0.5	
3027	Mar. 26	31 32 30	114 19 00	10	gy S	68	66.2	66.2	W, by N	L. B. T.	0.1	
3028	3:55 p. m.	31 32 00	114 20 00	10	gy S	68	66.2	66.2	W, by N	L. B. T.	0.8	
3029	4:27 p. m.	31 37 00	114 29 00	20	fine gy S, brk Sh	70	64	64	NW, by W	L. B. T.	0.5	
3030	7:06 a. m.	31 42 00	114 20 30	33	br. M	66	63.8	65	SE	L. B. T.	0.8	
3031	7:40 a. m.	31 06 45	114 28 15	12	gy S	67	63.5	65	SSW	L. B. T.	0.4	
3032	8:12 a. m.	31 05 30	114 29 00	13	gy M	67	63.5	65.7	SE, by E	L. B. T.	1.0	
3033	10:17 a. m.	30 36 30	114 29 45	24	gy M	67	63.5	68.5	SE, by E	L. B. T.	1.5	
3034	12:31 p. m.	30 21 00	114 25 15	30	gy M	70	62	62	SE, by E	L. B. T.	1.0	
3035	2:37 p. m.	29 41 30	114 24 00	5	gn. M	73	65.2	67	SE, by E	L. B. T.	0.8	
3036	5:14 a. m.	29 41 30	110 45 00	20	gn. M	71	65.2	69	NW, by W	L. B. T.	1.0	
3037	Mar. 31	5:40 a. m.	29 41 30	41	fine, y. S	66	65.2	67	NW, by W	L. B. T.	0.2	
3038	Apr. 8	5:11 a. m.	29 47 00	31	gy S, brk Sh	66	65.5	67	NW, by W	L. B. T.	0.8	
3039	Apr. 9	10:31 a. m.	29 54 30	41	fine, y. S	66	65.5	67	NW, by W	L. B. T.	0.8	
3040	Apr. 9	2:17 p. m.	29 54 30	21	S. Sh	68	68.5	68	W, by N	L. B. T.	1.0	
3041	Apr. 9	3:35 p. m.	29 54 30	21	S. Sh	68	68.5	68	W, by N	L. B. T.	1.0	
3042	Apr. 10	11:33 a. m.	29 06 15	11	fine, gy S	69	64.5	64.5	NW, by W	L. B. T.	1.1	
3043	Apr. 10	2:30 p. m.	28 06 15	74	fine, gy S	67	65	65	NNW, by W	L. B. T.	0.8	
3044	Apr. 10	4:03 p. m.	28 28 00	58	gy S, brk Sh	64	64.5	64.5	W, by S	L. B. T.	1.5	
3045	Apr. 10	9:22 a. m.	28 28 00	48	fine, gy S	65	64	64	WSW	L. B. T.	1.0	
3046	Apr. 10	10:11 a. m.	28 47 30	50	fine, gy S	55	55	55	SSW	L. B. T.	1.5	
3047	Apr. 10	10:57 a. m.	28 45 30	52	Rky	56	56	56	W, by S	L. B. T.	1.0	
3048	Apr. 10	3:10 p. m.	28 31 00	44	fine, blk. S	59	46.1	46.1	SSW, by W	L. B. T.	1.5	
3049	Apr. 10	8:46 a. m.	28 01 15	43	fine, blk. S	57	46.7	46.7	SSE	L. B. T.	2.0	
3050	Apr. 10	9:37 a. m.	28 58 30	56	Co. brk. Sh	56	56.1	56.1	N, by W	L. B. T.	1.2	
3051	Apr. 10	10:33 a. m.	28 57 00	59	Co. brk. Sh, Rky	55	55	55	N, by W	L. B. T.	1.2	
3052	Apr. 10	4:47 p. m.	28 57 00	48	Co. brk. Sh, Rky	61	47.3	47.3	NW, by S	Tangles,	0.7	
3053	Apr. 10	7:04 p. m.	28 44 00	44	R.	57	48	48	NW, by S	Tangles,	0.2	
3054	Apr. 10	7:58 a. m.	28 41 30	28	fine, gy S	55	47.4	47.4	NW, by W	L. B. T.	2.0	
3055	Apr. 10	8:12 a. m.	28 41 30	28	fine, gy S	55	45.7	45.7	NW, by W	L. B. T.	1.5	
3056	Apr. 10	8:48 a. m.	28 45 00	38	fine, gy S	55	45.8	45.8	N, by W	L. B. T.	1.0	
3057	Apr. 10	9:12 a. m.	28 49 15	45	fine, gy S	55	45.8	45.8	N, by W	L. B. T.	0.7	
3058	Apr. 10	5:09 p. m.	28 12 30	77	fine, gy S, Sh	53	45.1	45.1	ESE	L. B. T.	0.5	
3059	Apr. 10	7:18 p. m.	28 12 30	28	br. m	54	48.4	48.4	NNW	L. B. T.	1.0	
3060	Apr. 10	7:20 a. m.	28 12 30	23	fine, blk. S	54	48.4	48.4	NNW	L. B. T.	0.8	
3061	Apr. 10	8:32 a. m.	28 05 00	44	fine, blk. S	54	45.2	45.2	E, by N	L. B. T.	1.1	
3062	Apr. 10	8:55 a. m.	28 05 15	42	fine, gy S	56	45.8	45.8	NW, by N	L. B. T.	1.0	
3063	Apr. 10	12:33 p. m.	28 04 30	46	fine, gy S, G	57	45.6	45.6	NW, by N	L. B. T.	1.0	
3064	Apr. 10	1:03 p. m.	28 13 00	27	fine, blk. S	58	45.6	45.6	NW, by N	L. B. T.	1.0	
3065	Apr. 10	2:36 p. m.	28 26 30	55	S. M	58	45.6	45.6	NNW, by W	L. B. T.	1.5	
3066	Apr. 10	5:25 p. m.	28 26 30	82	gn. M	58	45.6	45.6	NNW, by W	L. B. T.	1.5	
3067	Apr. 10	1:38 p. m.	28 23 15	47	gn. M	58	45.6	45.6	N, by E	L. B. T.	1.5	
3068	Apr. 10	2:43 p. m.	28 27 00	135	gn. M	60	45.6	45.6	N, by E	L. B. T.	1.5	

Oyster dredge.

Record of dredging and trawling stations of the U. S. Fish Commission steamer Albatross, July 1, 1888, to June 30, 1889—Continued.

Serial No.	Date.	Time.	Position.		Depth.	Character of bottom.	Temperature.		Drift.		Instrument used.	
			Latitude, N.	Longitude, W.			Air.	Surface.	Bottom.	Direction.		Distance.
3069	1889, June 28	7:41 a. m.	47 25 30	125 42 00	Fms. 760	gn. M.	56	56	37.6	WNW	Mites. 2.0	L. B. T.
3070	do	10:56 a. m.	47 29 30	125 43 00	636	gn. M.	57	57	37.9	E	2.0	L. B. T.
3072	do	1:33 p. m.	47 29 00	125 33 30	685	gn. M.	56	55	38	E. by N.	1.5	L. B. T.
3073	do	4:29 p. m.	47 28 30	125 24 00	584	gn. M.	56	55	38.2	E. N. E.	2.0	S. B. T.
3074	June 29	6:48 p. m.	47 28 00	125 15 00	477	gn. M.	56	55	49.2	E	2.0	S. B. T.
3075	do	6:35 a. m.	47 22 00	125 48 30	877	gn. M.	57	54	36.6	E	1.5	L. B. T.
3076	do	10:02 a. m.	47 22 00	125 41 00	859	gn. M.	57	57	36.6	ESE	2.0	L. B. T.
3078	do	4:35 p. m.	47 46 00	125 10 00	178	gn. M.	57	59	43.4	ESE	2.5	L. B. T.

Record of ocean temperatures and specific gravities by the U. S. Fish Commission steamer Albatross, from July 1, 1888, to June 30, 1889—Continued.

Table with columns: Date, Time of day, Station, Lat. N., Long. W., Depth, Temperature by air-bath thermometer, Temperature of air, Temp. of specimen when specific gravity was taken, Observed specific gravity, Specific gravity reduced to 60° F. with pure water at 60° F. as standard, Specific gravity reduced to 32° C. with pure water at 4° C. as standard.

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Record of ocean temperatures and specific gravities by the U. S. Fish Commission steamer Albatross, from July 1, 1888, to June 30, 1889—Continued.

Date.	Time of day.	Station.	Lat. N.	Long. W.	Depth.	Temperature by attached thermometer.		Temp. of specimen at time specific gravity was taken.	Observed specific gravity.	Specific gravity reduced to 60° F. with pure water at 60° as standard.	Specific gravity reduced to 15° C. with pure water at 4° C. as standard.
						Fms.	F.				
1889.											
Mar. 27	7:10 a. m.	3030	31 07 00	114 29 00	Surface	65	66	76	1.0252	1.027612	1.026822
27	7:10 a. m.	3030	31 07 00	114 29 00	20	64	66	74	1.0254	1.027486	1.026660
27	10:17 a. m.	3033	30 50 45	114 29 40	Surface	65	67	74	1.0254	1.027286	1.026460
27	10:17 a. m.	3033	30 50 45	114 29 40	18	63.5	67	74	1.0252	1.027480	1.026660
27	12:30 p. m.	3034	30 36 30	114 27 45	Surface	69	67	74	1.0254	1.027480	1.026660
27	12:30 p. m.	3034	30 36 30	114 27 45	24	63.5	67	74	1.0252	1.027386	1.026660
27	2:30 p. m.	3035	30 21 00	114 25 15	Surface	70	70	74	1.0254	1.027480	1.026660
27	2:30 p. m.	3035	30 21 00	114 25 15	30	62	70	74	1.0252	1.027286	1.026460
28	12 m.	Gonzales Bay, Gulf of California			Surface	68	68	78	1.0244	1.027208	1.026388
29	4 p. m.	Refuge Harbor, Angel I., Cal.			do	69	77	78	1.0241	1.027208	1.026388
31	9:40 a. m.	3037	27 45 00	110 45 00	do	69	72	78	1.0242	1.027208	1.026388
31	9:40 a. m.	3037	27 45 00	110 45 00	20	65.2	77	78	1.0242	1.027208	1.026388
31	10 a. m.	Upper Algodones Lagoon, Mex.			Surface	69	72	78	1.0237	1.026508	1.025688
31	6 p. m.	Lower Algodones Lagoon, Mex.			do	72	72	78	1.0200	1.023808	1.021988
Apr. 1	2 p. m.	Mouth Yaqui River, Mex.			do	74	72	60	1.0000	1.000000	.999180
1	3 p. m.	4 miles up the river, Mex.			do	74	73	60	1.0000	1.000000	.999180
1	5 p. m.	Ship's anchorage 3 miles from shore.			do	73	71	78	1.0040	1.006808	1.005888
1	6 p. m.	Off Yaqui River, Mex.			do	71	73	78	1.0242	1.027008	1.026188
2	12 m.	Off San Juan Lagoon, Mex.			do	70	73	78	1.0240	1.026808	1.025988
2	6 p. m.	Off Puerte River, Mex.			do	70	82	78	1.0240	1.026808	1.025988
2	12 p. m.	25 05 00	109 57 00		do	71	72	78	1.0244	1.027208	1.026388
7	12 m.	San Juan Harbor, Lower Cal.			do	75	75	67	1.0260	1.026987	1.026167
9	12 m.	Magdalena Bay, Lower Cal.			do	67	68	67	1.0260	1.026987	1.026167
9	2:17 p. m.	30 40	24 35 00	112 04 30	do	69	68	67	1.0260	1.026987	1.026167
9	2:17 p. m.	30 40	24 35 00	112 04 30	21	60	68	67	1.0251	1.026387	1.025567
9	2:38 p. m.	30 41	24 35 30	112 05 00	Surface	69	68	67	1.0260	1.026987	1.026167
9	2:38 p. m.	30 41	24 35 30	112 05 00	27	69	68	67	1.0254	1.026387	1.025567
9	2 p. m.	24 57 00	112 33 00		Surface	65	64	67	1.0260	1.026987	1.026167
10	12 m.	26 07 00	113 33 30		do	65	65	67	1.0254	1.026387	1.025567
11	12 m.	San Bartolme Bay, Lower Cal.			do	63	63	67	1.0254	1.026387	1.025567
12	2 p. m.	Cerros Island, Lower Cal.			do	65	65	67	1.0254	1.026387	1.025567
13	12 m.	San Quentin Bay, Lower Cal.			do	50	61	67	1.0250	1.023387	1.025167
May 21	2 p. m.	Golden Gate, Cal.			do	56	57	66	1.0244	1.025240	1.024420
22	10 p. m.	Cape Mendocino, Cal.			do	51	53	66	1.0250	1.025840	1.025020
23	2 p. m.	Cape Blanco, Oregon.			do	55	55	66	1.0250	1.025840	1.025020
24	12 m.	Mouth Columbia River, Oregon			do	60	67	66	1.0114	1.012240	1.011420
25	1 a. m.	Cape Flattery, Wash.			do	55	57	46	1.0234	1.024240	1.023420
25	1 p. m.	Mouth Frazier River, B. C.			do	62	60	66	1.0020	1.002840	1.002020
26	10 p. m.	Active Pass, B. C.			do	60	62	66	1.0100	1.010840	1.010020
June 7	12 m.	46 45 00	124 36 00		do	57	56	66	1.0236	1.024440	1.023620
8	12 m.	44 00 00	124 57 00		do	53	57	66	1.0238	1.024640	1.023820
9	12 m.	Yakima Light-house, Oregon.			do	53	56	66	1.0230	1.025840	1.025020
18	8 p. m.	Port Orchard, Wash.			do	56	66	66	1.0220	1.022840	1.022020
28	12 m.	47 30 00	125 40 00		do	56	56	66	1.0236	1.024440	1.023620
29	12 m.	47 22 00	125 35 00		do	57	57	66	1.0236	1.024440	1.023620

Record of meteorological observations by the U. S. Fish Commission steamer Albatross, July 1 to December 31, 1888.

Date.	Position at meridian.			Temperatures—Fahrenheit.				Barometer.			Weather.	Clear sky in tenths.	Wind Direction.	Force.	Rain.					
	Lat. N.	Long. W.	H.	Air, dry bulb.		Air, wet bulb.		Water at surface.		Mean.						Maximum.	Minimum.			
				Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.											
1888.																				
July 2	do	do	do	71	54	62.5	63	59	62	63	58	60.5	30.14	29.98	30.06	Clear	6-9	SW	0-35	0
3	do	do	do	70	57	65	63	57	61	66	59	62.5	30.08	29.91	29.91	do	8-9	SW, and WSW	1-2	0
4	do	do	do	71	57	63.5	63	57	61	66	59	62.5	30.02	29.90	29.96	do	8-9	SW	0-4	0
5	do	do	do	71	52	61.5	63	52	58.5	63	49	56	30.04	29.88	30.02	Fair.	2-9	SW, NNW, WNW	1-4	0
6	do	do	do	70	54	61	63	53	53	62	48	50.5	30.04	29.88	30.02	do	7-9	WNW, NW, NW, by N	2-7	0
7	do	do	do	70	55	55	63	50	51.5	62	48	50	30.19	29.90	30.05	do	8-9	NW, NW, N	4-7	0
8	do	do	do	63	53	57.5	60	57	58.5	60	52	56.5	30.08	29.92	30.05	do	8-9	N, NW, W	1-6	0
9	do	do	do	63	58	60.5	60	57	58.5	60	52	56.5	30.16	29.98	30.07	Overcast to fair.	0-9	NW, NW, NNW, SW	1-4	0
10	do	do	do	61	54	57.5	60	54	57	65	51	56.5	30.16	29.98	30.12	Fair	0-8	SW, SE, SSE	0-5	Light.
11	do	do	do	69	50	59.5	68	50	59	66	53	58.5	30.16	29.93	30.12	do	8-9	ESE, E	0-5	0
12	do	do	do	69	52	60.5	67	50	58.5	66	58	62	30.16	29.94	30.06	Clear	0-9	E, N, E	0-2	0
13	do	do	do	58	56	57	57	55	56	60	50	55	30.16	29.94	30.05	Overcast to fair	0-8	SW, to NW	1-2	Light.
14	do	do	do	56	53	54.5	55	53	54	56	52	54	30.30	29.94	30.22	Overcast to cloudy	0-4	SW, to E, E	1-2	Light.
15	do	do	do	55	54	54.5	55	53	54	56	54	56	30.34	29.96	30.30	Overcast, fog	0-3	SW, to SE, by S	Mod.	0
16	do	do	do	54	53	53.5	51	53	53.5	54	52	53	30.40	29.98	30.34	Overcast.	0-3	SW, to SE	Light.	0
17	do	do	do	53	49	51	53	50	51.5	52	51	51.5	30.30	30.20	30.25	Fog to fair	0-3	SW, to SE	Light.	0
18	do	do	do	51	48	49.5	50	49	49.5	51	50	50.5	30.40	30.20	30.35	Overcast.	0-7	SW	Light.	0
19	do	do	do	52	49	49.5	52	48	50	51	50	50.5	30.24	30.16	30.29	Overcast to fair.	0-5	S, by W, to ESE	Light.	0
20	do	do	do	51	50	50.5	51	49	50	51	48	49.5	30.24	30.14	30.18	Fog.	0-2	SE, to NW	Light.	0
21	do	do	do	52	52	55	50	52.5	51	49	49	49.5	30.26	30.22	30.24	Fog to cloudy	0-2	NW, to ESE	Light.	0
22	do	do	do	54	51	51.5	53	51	52.5	51	48	49	30.26	30.20	30.25	Fog	0-4	E, to SW	Light.	0
23	do	do	do	52	50	51	52	50	51	50	48	49	30.30	29.90	30.05	do	0-4	SSE, SE, ESE, E	Light.	0
24	do	do	do	58	48	53	57	48	52.5	52	45	48.5	30.20	29.90	30.05	Foggy to fair	0-4	ESE, ENE, SE	Light.	0
25	do	do	do	54	50	56	53	54.5	53	52	52	52.5	29.90	29.80	29.85	Fog, cloudy, and misty.	0-1	SE, ENE, ESE	Light.	0
26	do	do	do	50	50	54.5	56	49	52.5	56	51	53.5	30.00	29.86	29.93	Foggy.	0-3	SE	1-5	Light.
27	do	do	do	57	50	53.5	55	49	53	51	49	50	30.00	29.84	29.94	Overcast, fair	0-7	SE, NNW	0-2	0
28	do	do	do	57	50	52.5	54	50	53	51	49	50	30.00	29.84	29.90	Fog	0	NE	0-3	Light.
29	do	do	do	57	50	52.5	54	50	53	51	49	50	30.00	29.84	29.90	do	0	NE	0-2	Light.
30	do	do	do	52	48	50	52	47	49.5	52	47	49.5	29.80	29.72	29.70	do	0	NE, to SW	1-4	Mod.
31	do	do	do	53	50	51.5	52	50	51.5	52	49	50.5	29.80	29.66	29.83	do	0	SE	3-4	Light.
Aug. 1	do	do	do	51	50	50.5	50	49	49.5	50	49	49.5	29.80	29.72	29.79	do	0	SE, to SE	2-4	Mod.
2	do	do	do	53	52	53	51	51	51	50	49	50	29.86	29.72	29.84	do	0	SE, to SE	2	Light.
3	do	do	do	55	52	53.5	56	52	54.5	55	52	53.5	29.90	29.78	29.84	do	0-4	SE, and SSE	0-4	Light.
4	do	do	do	55	50	51	55	52	54.5	55	52	53.5	30.18	29.70	29.92	Fog, fair.	0-7	SE, to NW	0-4	Light.
5	do	do	do	51	49	50	51	49	50	51	49	50	30.18	29.76	30.17	Fair; foggy	7-0	SE, ESE	0-3	Light.

Record of meteorological observations by the U. S. Fish Commission steamer Albatross, July 1 to December 31, 1885—Continued.

Date.	Position at meridian.		Temperatures—Fahrenheit.				Water at surface.				Barometer.		Wind.		Rain.	
	Lat. N.	Long. W.	Air, dry bulb.		Air, wet bulb.		Maximum.		Minimum.		Mean.	Weather.	Clear sky in tenths.	Direction.		Force.
			Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Mean.							
1885.																
Aug.																
4	54 56.00	159 54.00	53	51	62	53	49	61	47	49	30.30	30.10	30.20	SW		3-5
5	54 50.00	159 08.00	54	50	52	53	49	51	48	50	30.30	30.30	30.40	SE, to SW		1-4
6	54 34.00	158 43.00	58	50	51	56	50	53	50	51.5	30.54	30.50	30.52	SSW		2-3
7	55 43.00	158 25.00	55	50	52.5	54	49	51.5	52	50	30.50	30.38	30.44	SSW		1-3
8	55 43.00	157 24.00	57	53	55.5	56	52	54	53	50	30.38	30.30	30.34	SSW		0-3
9	56 07.00	154 39.00	58	50	54	57	50	53.5	54	48	30.30	30.26	30.28	WSW		1-3
10	57 01.00	153 20.00	73	52	61.5	73	51	61	58	51	30.32	30.32	30.28	SW, WSW		1-3
11	57 01.00	155 12.00	67	51	59	66	51	68	50	51	30.42	30.32	30.37	SW, WSW		0-2
12	Old Harbor, Kodiak.		60	52	56	59	52	58.5	56	53	30.58	30.44	30.51	SW		0-4
13	57 29.00	152 13.00	57	51	51	56	50	53	51	49	30.56	30.48	30.53	SW		Light.
14	St. Paul, Kodiak.		63	51	57	60	53	56.5	55	49	30.42	30.32	30.40	SW		Light.
15	do		69	51	60	66	51	68.5	55	49	30.56	30.48	30.53	SW		Light.
16	do		67	53	55	57	52	54.5	53	51	30.32	30.10	30.21	SW		Light.
17	do		63	52	57.5	59	50	54.5	51	50	30.10	29.84	29.97	NE, to SE		Light.
18	do		57	54	55.5	56	54	55	52	51	24.80	29.58	29.69	ESE, to ENE		Light.
19	do		60	53	56.5	57	52	54.5	54	51	29.64	29.58	29.71	SW		Light.
20	do		61	53	57	60	52	56	51	51	29.90	29.64	29.77	N		Light.
21	do		61	51	56	60	51	56.5	54	50	30.06	30.00	29.95	N, to NE		Light.
22	58 07.00	151 33.00	68	54	61	63	53	68	57	52	30.14	30.04	30.03	N, to NE by E		Light.
23	58 31.00	150 56.00	64	56	59.5	61	57	56	53	54.5	30.12	30.13	30.15	N, to WSW		Light.
24	58 17.00	148 36.00	62	56	59	59	56	57.5	59	56	30.16	30.16	30.18	Variable		Light.
25	59 06.00	147 30.00	64	54	59	61	54	57.5	58	52	30.70	29.94	29.94	Variable		Light.
26	Middletown Island.		61	54	57.5	62	55	58	52	55	30.72	29.50	29.64	ENE, N, to WNW		Light.
27	59 09.00	142 51.00	66	50	62.5	66	58	62	60	58	30.16	30.16	30.18	Variable		Light.
28	57 44.00	139 30.00	60	56	58	66	58	62	60	58	30.16	30.16	30.18	Variable		Light.
29	55 28.00	136 25.00	65	57	61	65	56	64	60	56	30.16	30.16	30.18	Variable		Light.
30	55 18.00	133 55.00	79	56	67.5	71	61	65	56	64	30.22	30.16	30.24	N, to WSW		Light.
31	51 24.00	130 23.00	79	59	63	74	60	65	63	57	30.16	30.16	30.18	Variable		Light.
Sept.	50 15.00	127 43.00	64	60	55	63	57	60	55	57.5	30.12	30.19	30.19	N, to E		Light.
1	50 15.00	125 45.00	70	52	66	66	61	64.5	67	60	30.30	30.03	30.03	Variable		Light.
2	Departure Bay.		64	59	61.5	63	59	61	59	57.5	28.80	29.33	29.33	N, to ESE		Light.
3	do		67	56	57.5	63	53	59	61	54	30.08	29.38	29.63	Variable		Light.
4	43 57.00	120 00.00	70	58	61	68	57	62.5	64	52	30.24	30.08	30.16	N, to WSW		Light.
5	do		70	58	61	68	57	62.5	64	52	30.24	30.24	30.29	N, to WSW		Light.
6	do		68	57	62.5	64	52	66	54	57.5	30.34	30.24	30.29	Variable		Light.
7	do		68	56	63	65	57	61	54	57.5	30.32	30.12	30.22	N, W		Light.

Record of meteorological observations by the U. S. Fish Commission steamer *Albatross*, from January 1 to June 30, 1889.

Date.	Position at meridian.		Temperatures.						Barometer.			Clouds.	Weather.	Wind.		Rain.	
	Lat. N.	Long. W.	Air, dry bulb.		Air, wet bulb.		Water at surface.		Maximum.	Minimum.	Mean.			Direction.	Force.		
			Maximum.	Minimum.	Maximum.	Minimum.	Mean.										
1889.	° ' "	° ' "	°	°	°	°	°	°	°	°	°						
Jan. 1	San Francisco, Cal.	64 51	57.5	57	48	52.5	55	51	53	30.40	30.32	30.36	Cir., cum., nimb., cum.-str.	Fair to clear	N.E., ESE, ENE	0-3	0
2	do	56 48	52	55	47	51	55	51	53	30.30	30.22	30.26	Cir., cum., nimb.	do	E. by N., NE, WNW, E, NE, SE.	1-2	0
3	do	57 47	52	56	47	51.5	57	51	54	30.24	29.98	30.11	Cum.-str., cum., nimb., nimb.	Overcast, and rain to fair.	NNE, NW, NE, SE.	1-7	Mod.
4	34 14 00	122 01 30	56	54	56	53	54.5	58	57	30.00	29.90	29.95	Nimb., cum., nimb.	Squally and rainy to fair.	Variable	8-4	Mod.
5	34 12 00	120 32 00	64	56	60	61	54	57.5	60	57	58.5	30.04	Cum., nimb., cir.	Fair to clear	N.E., NNW, NW	4-1	0
6	34 00 00	120 29 30	66	57	61.5	63	59	61	58	59.5	30.10	29.88	Str.	Clear	NW, NW by N, SW	4-2	0
7	34 01 30	120 01 00	61	57	59	60	55	57.5	60	56	58	30.00	None.	do	Variable	1-4	0
8	34 23 00	120 11 00	70	57	63.5	69	56	62.5	61	58	59.5	30.10	Nimb., cum., str., cir.-cum.	Foggy to clear	NE, E, ESE, W.	0-3	0
9	Santa Barbara, Cal.	61 56	58.5	59	54	56.5	61	58	59.5	30.10	30.00	30.05	Cum., nimb., cir., nimb.	Overcast to fair	Variable	0-2	0
10	San Diego, Cal.	64 53	58.5	60	52	56	61	56	58.5	30.12	30.02	30.07	Nimb., cir.-cum., cum.-str., cum., nimb.	Overcast to clear	do	0-2	0
11	do	60 51	55.5	58	50	54	58	56	57	30.12	30.00	30.06	Cum., cum., nimb., cir.-cum.	Clear to overcast	do	0-2	0
12	do	63 55	59	62	54	58	59	56	57.5	30.04	29.92	29.98	Nimb., cum., cir., cum.	Overcast to fair	do	0-2	Light.
13	do	59 54	56.5	57	51	54	59	56	57.5	29.92	29.64	29.78	Nimb., cir.-cum., cum.	Overcast	do	1-4	Mod.
14	do	55 47	51	53	47	50	57	54	55.5	29.70	29.60	29.65	Cum., nimb., cum., cum., nimb.	Overcast to fair	do	1-6	Mod.
15	do	60 46	53	56	45	50.5	59	54	56.5	29.96	29.72	29.84	Cum., cum., nimb., cir.-cum.	Fair to clear	do	0-3	0
16	32 25 00	119 03 30	60	55	57.5	57	55	60	58	59	30.10	29.94	Nimb., cum., cum., nimb., cir.-cum.	Fair	do	2-3	0
17	32 28 45	119 13 00	65	56	60.5	60	53	56.5	60	57	58.5	30.28	Cum., cir.-cum., cum., nimb., cum.	do	WNW, W	2-3	0
18	San Nicholas Island	67 55	61	64	53	58.5	61	56	58.5	30.28	30.20	30.24	Cir.-cum., cum., nimb.	Fair to clear	Variable	1-5	Light.

19	San Diego, Cal.....	65	46	55.5	60	45	52.5	62	55	58.5	30.40	30.22	30.31	Cir.....	Clear.....	do	1-3
20	do.....	81	42	61.5	74	40	57	58	55	56.5	30.40	30.22	30.31	Cir-cum.....	do	0-3	
21	do.....	70	43	56.5	65	41	53	58	52	57	30.16	30.10	30.16	Cum.....	do	0-3	
22	do.....	65	46	55.5	61	45	51.5	56	54	57	30.36	30.10	30.18	Cum, cir.....	do	0-2	
23	32 43 30 | 117 52 00	61	46	53.5	58	45	51.5	56	54	56.5	30.30	30.24	30.27	Str.....	do	0-2	
24	32 43 43 | 119 16 00	71	57	57	59	55	60.5	62	58	60	30.30	30.14	30.22	Cir-cum, str.....	do	0-3	
25	San Clemente Island	59	55	57	59	53	57	59	55	57.5	30.19	30.04	30.10	Cir-str., cir-cum.....	do	1-2	
26	32 28 30 | 117 16 30	60	56	56	60	51	55.5	60	55	57.5	30.24	30.10	30.17	Cum-str.....	do	0-2	
27	San Diego, Cal.....	60	40	53.5	58	43	51.5	56	54	56	30.32	30.18	30.25	do	do	0-2	
28	do.....	65	46	55.5	63	44	53.5	57	54	55.5	30.28	30.10	30.16	None	NE, WNW, W	0-3	
29	do.....	61	46	53.5	62	44	52	58	55	56.5	30.22	30.10	30.19	do	Variable	0-1	
30	National City, Cal.....	63	44	53.5	62	44	53	58	53	55.5	30.28	30.18	30.23	Cir-cum, cum.....	do	0-2	
31	do.....	71	48	59.5	66	47	56.5	59	49	54	30.30	30.20	30.25	Cum.....	do	0-2	
1	San Diego, Cal.....	72	48	60	71	46	58.5	61	56	58.5	30.31	30.22	30.28	None	SE, E, ESE, NW	0-2	
2	do.....	81	49	65	74	47	60.5	59	54	56.5	30.30	30.12	30.21	do	E, ENE	0-6	
3	do.....	67	49	58	66	47	54.5	64	56	58	30.22	30.10	30.16	do	S, N, W, ENE	0-2	
4	32 48 00 | 117 26 00	65	50	57.5	63	48	53.5	62	56	59	30.20	30.10	30.15	Cum.....	do	0-2	
5	33 36 00 | 118 13 00	61	51	56	59	51	55	60	56	58	30.24	30.12	30.18	Cum, nimb, cir.....	Foggy to fair.....	0-2	
6	34 03 30 | 119 29 00	60	54	57	57	53	53	55	60	57	38.5	30.20	30.10	Cum, cir, cum-str.....	Fair to clear.....	0-2	
7	Santa Cruz Island.....	62	55	58.5	60	54	57	60	57	58.5	30.18	30.06	30.12	Cir, cum, nimb.....	Overcast to clear.....	0-4	
8	33 48 00 | 120 03 00	60	55	57.5	57	54	55.5	59	56	57.5	30.20	30.10	30.15	Niub, cum, cum-str.....	do	0-3	
9	34 06 00 | 120 22 30	68	52	59	64	50	57	59	56	57.5	30.28	30.18	30.23	Cir-cum, cir, cum.....	Clear.....	0-2	
10	Santa Barbara, Cal.....	65	50	57.5	62	49	55.5	61	57	59	30.30	30.16	30.23	Cir-cum.....	do	0-2	
11	31 20 30 | 119 38 00	65	53	59	60	55	61	57	59	57	30.20	30.10	30.15	None	Variable	0-1	
12	33 58 00 | 119 21 30	84	55	69.5	75	53	64	62	57	59.5	30.20	30.10	30.15	Str, cir-str, cir.....	do	0-6	
13	33 25 00 | 119 07 00	63	55	59	62	51	56.5	59	57	58	30.10	28.80	29.95	Cum, cum, nimb, cir.....	Clear to overcast.....	0-7	
14	33 09 00 | 118 11 00	62	54	58	60	50	55	60	56	58	29.62	29.74	29.78	Cum, nimb, cir, cum-str.....	Overcast to fair.....	3-7	
15	San Diego, Cal.....	54	50	52	53	48	50.5	56	57	57.5	29.98	29.82	29.90	Cum, nimb, nimb.....	Fair to overcast.....	1-6	
16	do.....	56	50	53	51	48	49.5	56	57	57.5	30.20	29.98	30.09	Cum, nimb.....	Fair.....	2-7	
17	San Diego, Cal.....	57	48	52.5	52	42	47	57	54	55.5	30.38	30.22	30.30	Cum, cir, cir-cum, str.....	Fair to clear.....	0-2	
18	do.....	65	42	53.5	58	40	49	58	54	56	30.34	30.20	30.27	Cir-str, cum-str, cir.....	Clear.....	0-2	
19	do.....	73	45	59	67	42	54.5	60	54	57	30.34	30.24	30.29	None	do	0-3	
20	do.....	81	46	53.5	68	45	56.5	62	54	58	30.34	30.26	30.30	Cum-str.....	do	0-2	
21	do.....	73	48	60.5	70	45	57.5	60	55	57.5	30.34	30.20	30.27	Cir-str, cum.....	do	0-2	
22	do.....	70	53	61.5	65	52	58.5	60	57	57	30.24	30.12	30.18	Cum, nimb, str.....	Fair to clear.....	0-1	
23	National City, Cal.....	74	50	62	67	49	58	64	55	59.5	30.14	29.98	30.06	Cum-str, cir, cir-cum, cum.....	do	0-1	
24	do.....	58	51	54.5	56	51	53.5	58	54	56	30.06	30.00	30.03	Cum, nimb, nimb.....	Overcast to fair.....	0-5	
25	do.....	63	55	59	59	54	56.5	58	54	56.5	30.22	30.02	30.12	Cum, cum-str, nimb, cum, nimb.....	Overcast to clear.....	0-2	
26	San Diego, Cal.....	68	51	59.5	67	50	58.5	61	57	59	30.30	30.21	30.26	Cir, cum-str.....	Clear.....	0-3	

Feb.

Record of meteorological observations by the U. S. Fish Commission steamer Albatross, from January 1 to June 30, 1889—Continued.

Date.	Position at meridian.		Temperatures.						Barometer.			Weather.	Wind.		Rain.				
	Lat. N.	Long. W.	Air, dry bulb.		Air, wet bulb.		Water at surface.		Maximum.	Minimum.	Mean.		Direction.	Force.					
			Maximum.	Minimum.	Maximum.	Minimum.	Mean.												
1889.																			
Feb. 27	29 54 30	117 58 30	64	60	62	63	58	60.5	62	60	60	30.22	30.10	30.16	None	do	NNW, NW	3-4	0
Feb. 28	28 52 00	118 16 30	71	61	66	65	58	61.5	64	60	62	30.10	29.98	30.04	do	do	Variable	0-4	0
Mar. 1	26 58 00	117 02 00	80	60	70	69	59	64	70	63	66.5	30.14	30.06	30.10	Cir-cum, str., cum-nimb.	Fair to clear	N. to W. by N	1-2	0
2	24 51 00	115 43 00	68	64	66	66	62	64	68	64	66	30.14	30.04	30.09	Cir-cum, cir-str., cum-nimb, cum.	Clear	NE. to W	1-3	0
3	21 52 00	115 11 00	73	65	69	68	63	65.5	71	66	68.5	30.10	30.00	30.05	Cum-str., cir-cum, cir.	Clear to fair	N, NW	0-2	0
4	18 42 00	114 45 00	72	67	69.5	68	64	66	71	69	70	30.02	29.93	30.00	Cir-cum, cum-nimb.	Overcast to fair	NW, NNW, E	0-2	Light.
5	Clarion Island		74	69	71.5	71	68	69.5	72	69	70.5	30.02	29.92	29.97	Cir-cum, cum-nimb.	do	E.ENE, NNE	1-4	Light.
6	do		76	70	73	73	65	69	74	69	71.5	30.02	29.94	29.98	Cum, cir-cum, cum-nimb.	Fair to clear	N. to ENE	0-4	0
7	18 27 00	112 24 00	75	69	72	68	64	66	74	70	72	30.00	29.88	29.94	Cum, cir-cum, cum-str.	Clear	N. to NE	2-3	0
8	Socorro Island		73	68	70.5	68	64	66	73	70	71.5	29.98	29.88	29.93	Cir-cum, cum-nimb.	Clear to fair	NW. to E	0-2	0
9	do		84	65	74.5	74	62	68	73	70	71.5	30.00	29.94	29.97	Cum-nimb, cir.	Fair to overcast	Variable	0-6	Light.
10	San Benedicto Isl-land.		75	70	72.5	69	65	67	73	70	71.5	30.02	29.92	29.97	Nimb, cum, cir-cum, cum-nimb.	Overcast to fair	NNE. to NW	0-3	0
1	21 44 18	110 03 30	73	69	71.0	68	64	66	74	69	71.5	30.00	29.88	29.94	Cir-cum, cum, cir-str.	Clear	NW. to NNE	2-4	0
12	Pichilique B a y Lower California		73	66	69.5	71	64	67.5	72	66	69	29.98	29.86	29.92	Str., cir., cum-str.	do	W. to NNE	0-3	0
13	do		79	64	71.5	71	61	66	74	69	71.5	29.96	29.78	29.87	Cir	do	Variable	0-3	0
14	do		74	62	68	68	59	63.5	73	65	69	29.96	29.83	29.89	None	do	do	1-4	0
15	do		73	63	69	70	62	66	73	67	70	29.98	29.84	29.91	Cir-cum	do	do	1-4	0
16	24 31 00	110 29 15	76	65	70.5	71	60	65.5	73	66	69.5	30.02	29.90	29.96	do	do	S. to WNW	0-3	0
17	25 23 48	110 50 00	72	64	68	65	58	61.5	71	64	66.5	30.12	30.02	30.07	Cir-cum, cir	do	N. to WNW	1-4	0
18	25 59 00	111 07 15	73	65	69	64	60	62	70	66	68	30.12	29.96	30.04	None	do	NNW, NW	3-5	0

19	26 45 30	111 53 00	70	66	68	60	63	67.5	70	66	68	30.04	29.91	29.99	do	NW. by W., to NNE.	1-5
20	27 23 30	111 25 00	75	65	69	63	62	65.5	70	66	68	30.04	29.94	29.99	do	Variable	2-3
21	Guaymas, Mexico		73	66	69.5	64	62	61.5	68	65	66.5	30.06	29.94	29.97	do	WSW to NW	0-5
22	do		77	67	72	66	63	62	69	74	65	30.00	29.97	29.97	do	Variable	0-5
23	28 01 00	111 24 30	71	68	69.5	65	60	62.5	60	61	63	30.10	29.90	30.05	do	W to NNW	1-4
24	29 56 30	113 01 15	73	64	68.5	69	63	63.5	60	61	63.5	30.10	29.90	30.00	do	Variable	1-3
25	31 16 00	113 29 00	70	61	65.5	67	59	63.5	67	63	64	30.60	29.82	29.96	do	E, SE, SSW	0-2
26	31 31 30	114 17 30	70	59	54.5	69	58	63.5	68	64	66	30.08	30.00	30.04	do	Variable	0-2
27	30 40 30	114 28 30	82	62	72	60	66	66	72	65	68.5	30.10	30.04	30.07	do	NE to S	0-1
28	29 48 00	114 23 00	77	66	71	72	61	68	74	64	69	30.10	30.00	30.05	do	NNE to SE	0-1
29	29 40 00	114 02 00	70	66	71.5	71	61	66	72	65	68.5	30.04	29.90	29.97	do	E, W, N, NW, by N.	0-1
30	28 02 00	111 19 00	80	64	72	61	65.5	75	63	69	69	29.94	29.84	29.89	Fair	SE to SSW	0-2
31	27 44 00	110 40 30	73	67	70	71	64	67.5	73	68	70.5	29.86	29.90	29.94	Clear	Variable	0-2
Apr. 1	27 39 00	110 41 30	74	64	69	72	64	68	74	67	70.5	30.00	29.88	29.94	Clear to fair	do	0-2
2	26 01 00	109 28 00	82	70	76	74	68	71	76	69	72.5	29.98	29.88	29.93	do	do	0-2
3	La Paz, Lower California		79	68	73.5	76	66	71	75	70	72.5	30.04	29.90	29.97	Clear	do	0-2
4	Pichilingue Bay, Lower California		80	66	73	73	62	67.5	75	69	72	30.02	29.88	29.95	do	do	0-2
5	do		83	69	76	74	63	68.5	75	68	71.5	29.94	29.76	29.85	do	do	0-4
6	La Paz, Lower California		79	68	73.5	74	65	69.5	78	70	74	29.92	29.80	29.88	do	do	0-3
7	San Lucas Bay, Lower California		80	70	75	74	67	70.5	75	71	73	29.94	29.84	29.89	do	do	0-3
8	24 33 30	112 03 00	69	64	66.5	66	61	63.5	70	66	68	30.00	29.90	29.93	Clear	W to NW by W.	1-3
9	Masdalena Bay, Lower California		68	63	65.5	65	60	62.5	68	64	66	30.00	29.92	29.96	Fair to clear	W to NW	1-4
10	26 07 00	113 33 30	65	62	63.5	63	59	61	65	62	63.5	30.04	29.96	30.00	do	do	3-4
11	San Bartolome Bay, Lower California		64	60	62	61	58	59.5	63	59	61	30.06	30.00	30.03	Fair to overcast	WSW to NW	2-4
12	27 52 00	115 07 00	66	61	63.5	63	59	61	65	59	62	30.10	30.00	30.05	Fair to clear	W to ENE	1-6
13	San Quentin Bay, Lower California		61	59	60	60	57	58.5	60	57	58.5	30.14	30.02	30.08	Cloudy to clear	W to NNW	2-4
14	32 20 00	117 06 30	62	57	59.5	59	55	57	61	59	60	30.12	30.00	30.06	do	Variable	1-3
15	San Diego, Cal.		63	54	58.5	60	56	66	58	62.5	60	30.20	30.12	30.16	Clear	WNW, NW by W	0-4
16	do		70	54	62	67	52	58.5	66	60	63	30.10	30.16	30.16	do	W, WNW	0-2
17	do		72	53	62.5	67	63	60	67	59	63	30.08	29.84	29.96	do	E, NW, WNW	0-2
18	do		71	59	63	67	61	60	61	63.5	29.90	29.82	29.86	Clear to fair	Variable	0-2	
19	do		68	56	63	65	57	61	67	59	63.5	30.08	29.90	29.99	Fair to clear	SE to SW	0-2

Record of meteorological observations by the U. S. Fish Commission steamer Albatross, from January 1 to June 30, 1889—Continued.

Date.	Position at meridian.		Temperatures.				Barometer.			Clouds.	Weather.	Wind.							
	Lat. N.	Long. W.	Air, dry bulb.		Air, wet bulb.		Water at surface		Maximum.			Minimum.	Mean.	Direction.	Force.	Rain.			
			Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.									Mean.		
1889.	° ' "	° ' "	°	°	°	°	°	°											
Apr. 20	San Diego, Cal.		68	60	64	63	58	60.5	66	61	63.5	30.24	30.06	30.15	Cum. nimb. cum.	Fair to clear	N. to W.	0-2	0
21	do		66	59	62.5	63	58	60.5	68	60	64	30.24	30.14	30.19	Cum. cir. cum. cir.	Overcast to clear.	NE. to W.	0-3	0
22	do		70	59	64.5	67	57	62	69	63	66	30.16	29.92	30.04	Nimb. cir. cir.-str.	Clear	SE. W. WSW	0-3	0
23	34 14 00	119 41 00	67	57	62	64	56	60	64	55	59.5	30.04	29.92	29.98	Cir. str. cir.-str. cum. nimb.	Clear to overcast.	Variable	0-1	0
24	36 20 00	121 57 00	58	55	56.5	56	54	55	57	54	54	30.22	30.02	30.12	Cum. nimb. cir. str. cir. cum.	Overcast to fair	WNW. to NW by N.	3-5	0
25	San Francisco, Cal.		63	52	57.5	60	52	56	61	55	58	30.28	30.14	30.21	Nimb. cum. nimb. cir. cum.	Overcast and foggy to fair.	Variable	0-5	0
26	do		58	53	55	56	52	54	60	55	57	30.22	30.08	30.15	Cum. nimb. cir.	Cloudy and misty to clear and pleasant.	SW. veering to WSW.	1-5	Light.
27	do		60	53	56	58	52	55	61	57	59	30.20	30.14	30.17	Nimb. cum. cir.	Cloudy and misty. passing showers. Clear and pleasant.	SW. by W. veering to WSW.	2-7	Light.
28	do		62	54	58	59	52	55	63	57	60	30.18	30.01	30.11	Cum. cir.	Clear to fair.	Variable	0-4	0
29	do		59	53	56	56	52	54	61	56	58	30.14	30.06	30.10	Cum. cir. cir.-cum	Overcast and misty to fair.	S. to WSW.	1-5	0
30	do		57	52	54	55	51	53	60	56	58	30.18	30.08	30.13	Nimb. cum. cir.	Overcast and misty to fair.	WSW. S.W. SSW.	1-5	0
May 1	do		56	51	53	55	50	52	59	54	56	30.10	30.02	30.06	Cum. nimb.	Overcast and drizzly to fair.	SE. to W. by N.	0-5	Light.
2	do		60	54	57	56	53	54	60	57	58	30.10	30.00	30.05	Cum. nimb. cir.	Overcast to clear and pleasant.	S. to WSW	1-4	0
3	San Francisco, Cal.		58	53	55	55	51	53	60	57	58	30.14	30.08	30.11	Cir. cum. nimb.	Clear and pleasant to cloudy.	WNW. to SSW	0-4	0
4	do		59	55	57	59	52	55	60	56	58	30.10	29.86	29.98	Cum. nimb.	Fair to overcast. with rain.	W. veering to SSE.	1-4	Light.
5	do		57	54	55	56	53	54	59	55	57	30.04	29.74	29.89	do	Overcast and rainy to fair.	SSE. veering to WSW.	2-7	Light.
6	do		57	53	55	56	51	53	58	56	57	30.04	29.94	29.99	Nimb. cum.	Cloudy to fair.	SW. S. SSE.	1-5	0
7	do		49	52	55	56	50	53	59	56	57	30.04	30.00	30.02	Cum. cir. nimb.	Clear and pleasant to cloudy.	Veering from SSE. to W.	1-4	0

Record of meteorological observations by the U. S. Fish Commission steamer Albatross, from January 1 to June 30, 1889—Continued.

Date.	Position at meridian.		Temperatures.						Barometer.			Clouds.	Weather.	Wind.					
	Lat. N.	Long. W.	Air, dry bulb.		Air, wet bulb.		Water at surface.		Maximum.	Minimum.	Mean.			Direction.	Force.	Rain.			
			Maximum.	Minimum.	Maximum.	Minimum.	Mean.												
1889 June 19	47 34 00	122 31 00	70	54	62	66	52	50	0	0	0	30.24	30.14	30.19	Fair	ESF., veering to WNW.	0-1	0	
20	Seattle, Wash		74	56	65	67	54	60	70	55	62	30.24	29.94	30.09	do	SW. W. WSW.	0-3	0	
21	do		71	56	63	65	54	59	65	56	60	30.12	29.80	30.01	do	W. WSW. N.	0-2	0	
22	Seattle, Wash		63	54	58	60	52	56	62	55	58	30.34	30.00	30.17	Cum., nimb	Overcast and cloudy.	ESF. to WNW. to ESE.	0-2	0
23	do		63	53	58	57	50	53	60	52	56	30.46	30.22	30.34	Cir. cum., nimb	Misty to fair.	SE. to WNW.	0-3	Light.
24	47 59 00	122 39 00	71	54	62	63	52	57	60	55	57	30.26	30.10	30.18	Cir. cum., str.	Fair.	W. NW. to SW.	0-2	0
25	Port Townsend, Wash.		64	57	60	60	54	57	59	53	56	30.16	30.02	30.09	Cir. cum., nimb	Overcast and misty.	Variable.	0-1	Light.
26	do		62	57	59	58	56	57	56	53	54	30.02	29.80	29.91	Nimb., cum	Overcast and driz- zly.	Variable.	0-1	Light.
27	48 12 00	122 30 00	60	55	57	57	53	55	55	53	54	29.82	29.76	29.79	Nimb	Overcast, rain y, and squally.	SF., S. SSW.	0-5	Light.
28	47 30 00	125 40 00	56	54	55	56	53	54	57	53	55	29.92	29.80	29.86	Cum., nimb	Overcast and rainy.	SF. to SSW.	1-6	Light.
29	47 22 00	125 35 00	60	54	57	56	53	55	58	52	55	30.16	29.92	30.01	Cum., nimb	do	S. by E. to WSW.	2-4	Light.
30	48 38 00	125 00 00	63	55	58	58	51	54	59	51	53	30.24	30.10	30.17	Nim., cum., cir	Overcast to fair	Variable	0-2	0

RECO:
CORTEZ AN
US FISH C

22'
20'

32'
20'

*Soundings will
taken from US*

ABBREVIATIONS OF BOTTOMS

.. Muds	<i>gy</i> for grey	<i>me</i> for fine
.. Sand	<i>dk</i> .. dark	<i>crs</i> .. coarse
.. Shells	<i>gr</i> .. green	<i>hvd</i> .. hard
.. Specks	<i>yl</i> .. yellow	<i>brk</i> .. broken
.. Ooze	<i>bk</i> .. black	
.. Coral	<i>bn</i> .. brown	
.. Gravel		
.. Rocky		



15

15

25

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