4.—REPORT ON THE WORK OF THE U. S. FISH COMMISSION STEAMER ALBATROSS FROM JANUARY 1, 1887, TO JUNE 30, 1888.

By Lieut. Commander Z. L. Tanner, U. S. Navy, Commanding.

AWARDING OF CONTRACT FOR NEW BOILERS.

The *Albatross* was lying at the navy-yard, Washington, D. C., at the close of my report of 1886, awaiting the awarding of the contract for the construction of new boilers, an appropriation for that purpose having been made by act of Congress dated August 4, 1886. The old boilers were not entirely worn out, but the contemplated trip of the steamer to the Pacific coast of the United States made new ones a necessity. The drawings and specifications having been prepared, advertisements were published in the daily press inviting proposals, and on January 10, 1887, the bid of the Columbian Iron Works and Dry Dock Company, of Baltimore, was accepted, the company agreeing to remove the old boilers, construct new ones from designs of Passed Assistant Engineer G. W. Baird, U. S. Navy, alter the deck-house, extend the sky-light, etc., for the sum of $13,439, the work to be completed and the ship ready for sea in one hundred and twenty working days from the delivery of the contract, January 27, 1887.

The expenditure of the appropriation for new boilers was placed under my charge by the following order:

U. S. Commission of Fish and Fisheries,
Washington, D. C., January 5, 1887.

Sir: You are hereby placed in charge of the expenditure of the appropriation for the new boilers and refitting of the *Albatross*, and will see the contractors and arrange with them as to commencing their work. Before anything is done, however, they must execute a contract and designate their bondsmen, and the Attorney-General will be called upon to ascertain the ability of the bondsmen to discharge their obligations.

Respectfully,

Spencer F. Baird,
Commissioner.

Capt. Z. L. Tanner,
Commanding Steamer Albatross.

The contractors were informed of the acceptance of their bid, and of my having been charged with the execution of the contract by the following letter:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., January 7, 1887.

SIRS: I write to inform you that your bid for the construction and putting in place, etc., of the new boilers of the steamer *Albatross* has been accepted, and that Lieut.-Commander Z. L. Tanner, commanding steamer *Albatross*, has been charged with the execution of the contracts. The expenditures under the contract will be made under his direction and payments made on his certification of the accounts as provided for by the contract.

Passed Assistant Engineer G. W. Baird, U. S. Navy, has been requested to act as the superintending engineer representing the U. S. Fish Commission, as referred to in the specifications and contract.

Very truly yours,

SPENCER F. BAIRD,
Commissioner.

COLUMBIAN IRON WORKS AND DRY DOCK COMPANY,
Baltimore, Md.

Passed Assistant Engineer G. W. Baird, U. S. Navy, chief engineer of the *Albatross*, was superintending engineer, and later, when the contractors were ready to commence work, Mr. W. Bennett was appointed assistant inspector, and was in the shop during working hours, having supervision over material and workmanship, with instructions to see that the provisions of the contract were strictly complied with, Mr. Baird visiting the works as often as practicable.

EXPERIMENTS RELATIVE TO THE IGNITION OF GUNPOWDER, COAL GAS, ETC., BY A FRACTURED ELECTRIC LAMP.

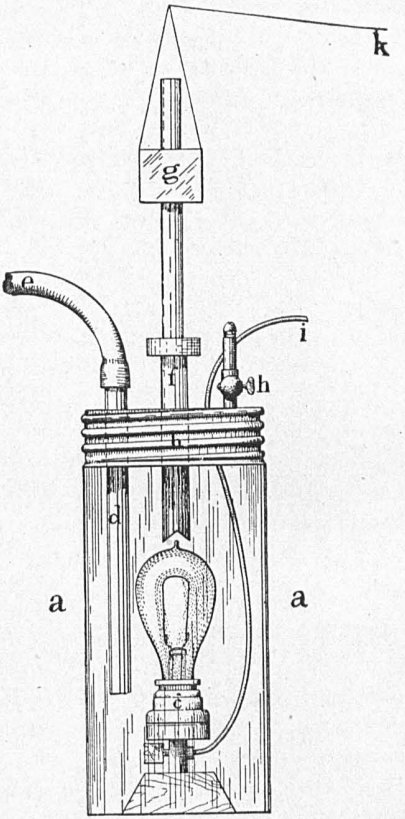
On March 10 experiments were made at the request of the Commissioner of Fish and Fisheries, to determine the results of the fracture of an incandescent electric lamp in contact with gunpowder. The result of these experiments was described in a letter to Professor Baird, of which the following is a copy:

NAVY-YARD, WASHINGTON, D. C., *March* 12, 1887.

DEAR SIR: Your letter of the 7th instant, inclosing a copy of a communication from the Bureau of Navigation, dated March 4, requesting certain experiments to be made with the incandescent electric lamp, etc., was duly received, and, in accordance with your request, I have made the following experiments, viz, to determine the result of the fracture of an incandescent electric lamp in contact with gunpowder:

(1) A 10 candle B lamp was half buried in sand and covered with a mixture of sporting powder and cannon-powder. The lamp was then broken. The powder exploded.

(2) The experiment was repeated, cannon-powder only being used. The powder exploded when the lamp was broken.



APPARATUS FOR DETERMINING THE RESULT OF THE FRACTURE OF AN INCANDESCENT ELECTRIC LAMP IN A COAL-BUNKER CONTAINING COAL-GAS. (See page 3.)

To determine the result of the fracture of an incandescent lamp in a coal bunker where there is coal gas:

(1) A 2-quart butter-jar, *a* (Plate I) was fitted with an air-tight wooden cover, *b*, through which the gas-tube, *d*, electric cable, *i*, and gas-burner, *h*, were passed, all having air-tight joints. The firing bolt, *f*, also passed through the cover, but moved freely, the joint being made air-tight by a ring of putty pressed gently around the rod. A 10-candle B lamp, *c*, was placed in the jar and the cover screwed on. Gas was introduced from a city lamp through the hose, *e*, and tube, *d*, and was lighted at *h*, giving a full flame. The electric lamp was lighted and allowed to burn several minutes, then fractured by releasing the weight, *g*, which, striking the collar on *f*, drove the bolt down and shattered the lamp. The gas did not ignite, but the flame was extinguished.

(2) The experiment was repeated, except that the base of the lamp and bottom of the jar were covered with gunpowder. The lamp was shattered a second time, without igniting gas or gunpowder. The flame was extinguished.

(3) The experiment was repeated, except that immediately preceding the fracture of the lamp the gas was turned off at *h*, leaving the jar air-tight and charged with a full pressure of gas. Neither powder nor gas ignited.

(4) Placed a lighted candle in the jar and turned on the gas, which ignited immediately.

(5) Placed a lighted bunker lamp (lard oil) in an upturned barrel, upper head out, led the hose to bottom of barrel and turned on the gas, which escaped about five minutes, but gas did not ignite.

(6) Placed the barrel on its bilge and introduced the bunker lamp and gas as before. Gas ignited in forty seconds.

There being a vacuum in the incandescent lamp its fracture would cause a strong indraught to fill the void. The burner, *h*, being closed, excluding air, the gas would rush in until the full pressure was attained.

During the first two experiments with gas the burner was left open and lighted:

(1) To show that the jar contained a full supply of gas.

(2) To admit a quantity of air when the fracture of the lamp occurred, in order to increase the inflammability of the gas. The fact of the burner having been extinguished at each trial demonstrates the introduction of air by the indraught before mentioned.

Conclusions:

(1) The fracture of an incandescent electric lamp will explode gunpowder when it is brought in contact with the carbon of the lamp. The latter is consumed so rapidly after its contact with the air that there are no burning fragments scattered about.

(2) The fracture of an incandescent electric lamp will not ignite illuminating gas.

(3) The flame of a candle or bunker lamp (lard oil) will ignite illuminating gas when confined, or partially confined.

Very respectfully,

Z. L. TANNER,
Lieut.-Commander, U. S. Navy, Commanding.

Prof. S. F. BAIRD.

DREDGING OUTFIT SUPPLIED TO THE U. S. S. THETIS.

We remained at the navy-yard until April 5, when we proceeded to Hampton Roads, under the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., April 2, 1887.

SIR: It is proposed to supply the steamer *Thetis*, now under orders for the Pacific Ocean and Bering Sea, with such apparatus as may be most conveniently available for making investigations respecting the fisheries of the northwest coast and the general natural history of the country in accordance with the offer of Lieutenant Emory, commanding that vessel. As her departure is imminent it will be impossible to get up in time a special outfit; and you will, therefore, supply such portions of the fishery equipment of the *Albatross* as can be spared for the purpose, and make, without delay, a requisition to replace them.

You will proceed with the *Albatross* to Chesapeake Bay, or wherever the *Thetis* may happen to be at the time, and make a transfer of the articles in question, together with such additional equipment as may be put on board by Mr. Lee or Mr. Rathbun.

If the necessary arrangements can be made, it is desirable that you give Lieutenant Emory and the officers of the *Thetis* an opportunity of witnessing the methods of making collections and observations on the subject in question. On reaching the *Thetis*, therefore, you will invite them to accompany you on a trip of such length as may be most convenient for all parties.

I learn that the officers of the *Thetis* will not be ready for any trip with you before Thursday next; and you will therefore leave the navy-yard, Washington, in time to meet the *Thetis* in Hampton Roads on that day.

Respectfully,

SPENCER F. BAIRD,
Commissioner.

Lieut.-Commander Z. L. TANNER,
Commanding Steamer Albatross.

We anchored off Fortress Monroe at 1.35 p. m., April 6. The U. S. S. *Thetis* arrived on the morning of the 8th, anchoring near this vessel, and at 9.30 Lieutenant Emory with several of his officers came on board for the purpose of witnessing the practical working of our dredging apparatus, for which purpose we got under way and made several hauls of the trawl, coming to anchor again at 11.30. The following articles were transferred to the *Thetis*:

Three hundred fathoms 3¾-inch Italian hemp dredge rope, two 11-foot beam-trawl frames, one 8-foot beam-trawl frame, two 11-foot trawl nets, two 8-foot trawl nets, twelve trawl weights, three large and two small dredges, one 16-gallon tank, two 8-gallon tanks, twelve 2-quart collecting jars, eighteen 1-quart collecting jars, twenty assorted bottles, seventy-five homeopathic vials, 30 gallons of alcohol, 25 yards of cheese cloth, one tow-net, two pairs forceps, one package of labels, one record book, two dip-nets, two sieves, six sorting dishes, one "Construction and Equipment of *Albatross*," quarto volume.

CONSTRUCTION OF NEW BOILERS AND OTHER REPAIRS TO THE STEAMER.

At 1.50 p. m. we got under way and stood up Chesapeake Bay, en route for Washington. We passed the night in Cornfield Harbor and, getting under way at daylight on the morning of the 9th, arrived at Washington at 3.30 p. m. We remained at the yard until 9.55 a. m., May 2, when we left for Baltimore, arriving and making fast to the dock of the Columbian Iron Works and Dry Dock Company at 1.25 p. m. of the 3d.

We found the contractors much behind in their work, having, in the first place, been delayed in getting material that would stand the test required by the specifications. They also misapprehended the class of work required, and were compelled to do by hand what a first-class establishment would do with machinery. In order to forward the work as much as possible the pipes, etc., were disconnected from the old boilers by the engineer's department on board and other preparations made for removing them. Owing to the failure of an appropriation the Commissioner found himself unable to carry on shad-hatching at Havre de Grace as extensively as he considered desirable, and to assist him in this work we sent, on May 10, a detail of twenty-one men to that place in charge of a commissioned officer. They returned to the ship June 18, after the hatching season was closed, and proper acknowledgment was made for the work done by them during the season. Surgeon J. M. Flint, U. S. Navy, was detached on the same date and ordered for duty under the Commissioner of Fish and Fisheries. The contract time for the completion of the new boilers also expired on that day.

What with labor troubles, and with the difficulty of getting material, the job was but half completed. The new donkey boiler was taken aboard about August 1. One of the new boilers was taken on board August 4 and the other on the 11th. We went into dry-dock August 19, to scrape and paint the ship's bottom. She was docked last in Norfolk July 2, 1886, and although she had been in the water thirteen months the bottom was not badly fouled. There was, however, considerable rust wherever the dredge-rope and sounding wire had come in contact with the bottom. On August 20 we received intelligence of the death of Prof. Spencer F. Baird, U. S. Commissioner of Fish and Fisheries, this sad event having taken place at Wood's Holl, Mass., on

the afternoon of the previous day. We hauled out of dock August 23 and coaled ship during the 26th and 27th, taking on board 165 tons of anthracite coal. Passed Assistant Surgeon James E. Gardner, U. S. Navy, reported for duty on the latter date.

The vessel received a thorough overhauling while at Baltimore, the labor being mostly performed by our own crew. The iron hull was scaled and painted inside and out, rigging overhauled and renewed where necessary. The seine-boat, which was not suitable for use on ship-board, was exchanged for a new ten-oared cutter, and a new suit of sails and poop awning were procured. The cabin and ward-room were partially refitted, and a large supply of trawl and dredge frames, sounding wire, and shot were obtained. We also received 4,000 fathoms of new dredge-rope, and later a number of deep-sea thermometers and a large supply of trawl-nets, webbing, and fishing apparatus, etc., for our contemplated cruise to the Pacific. In the engineer's department may be mentioned the following: New boilers, a donkey boiler, new coal-bunkers, new electric engine and dynamo, new ventilating fan and engine, many new pipe connections, general overhauling of the main engines, relining of the main shafts, etc., all of which will be described in the report of the chief engineer.

The work dragged along slowly, notwithstanding our own efforts and the efforts of the contractors to complete it, and it was not until September 14 that the ship was in condition to go to sea. At 7 the following morning we cast off from the wharf of the Columbian Iron Works and Dry-Dock Company and proceeded down the bay for the purpose of testing the boilers, machinery, and other apparatus.

INVESTIGATIONS BETWEEN CHESAPEAKE BAY AND WOOD'S HOLL.

We passed the capes of the Chesapeake at 5 a. m., September 16, with clear weather and a fresh breeze from ENE., which caused a moderate sea. At 2.40 p. m. we cast the trawl in 958 fathoms, brown ooze (latitude 36° 52′ N., longitude 74° 23′ W.). It was landed on deck at 6.10, having failed to reach the bottom; a number of specimens were, however, obtained from intermediate depths. Four hauls of the trawl were made on the 17th, between latitude 37° 34′ 30″ N. and longitude 73° 58′ W., and latitude 37° 46′ N. and longitude 73° 56′ W. in from 1,011 to 811 fathoms, bottom green mud. Among the specimens obtained were many crustaceans, cup-corals, pennatulas, shrimp, shells, and a variety of deep-sea fish. The large surface-net was used as occasion offered during the day. Four hauls were made on the 18th, between latitude 38° 31′ N., longitude 72° 53′ W., and latitude 38° 46′ N., longitude 73° 05′ 45″ W., in from 102 to 1,155 fathoms, green mud and sand. Among the specimens were twelve pole flounders, large numbers of *Macrurus*, and other deep-sea fish; starfish, sponges, coral, sea anemones, etc. The surface-net was used as on the previous day. Three hauls were made on the 19th, between latitude 39° 27′ N., longi-

NOTE.—All bearings are true unless otherwise stated.

tude 71° 15′ W., and latitude 39° 42′ N., longitude 71° 17′ W., in from 705 to 1,276 fathoms, blue mud. Many specimens were taken, among them a variety of deep-sea fish, squid, cephalopods, brittle stars, holothurians, shells, *Geryon quinquedens*, and large numbers of skates' eggs. The surface-net was towed during each haul. At 6.15 p. m. we started for Wood's Holl, arriving and making fast at the Fish Commission wharf at 9.50 a. m., September 20.

The engineer's department was employed in making such necessary additions and re adjustments of machinery as were found necessary during the progress of our trial trip. The opportunity was taken to break out store-rooms, etc., and make final preparations for the cruise. Lieut. W. S. Hogg, U. S. Navy, was detached October 15 and ordered to the U. S. S. *Marion*.

PREPARATIONS FOR THE VOYAGE TO SAN FRANCISCO.

At 6 a. m., October 19, we left Wood's Holl for Washington, calling at Newport for the purpose of availing ourselves of the compass station, but the weather being unfavorable, and the facilities for swinging ship not particularly good, we proceeded on our course, arriving at the navy-yard, Washington, D. C., at 11.45 a. m., October 22. Passed Assistant Engineer C. R. Roelker, U. S. Navy, reported for duty on the 23d, relieving Passed Assistant Engineer G. W. Baird, who was detached on the 24th of October and ordered to special duty at the Navy Department. Mr. Baird's service with the U. S. Fish Commission extends over a period of five years and seven months, first on special duty connected with the construction of the *Albatross* and subsequently as her chief engineer. I avail myself of this opportunity to express my appreciation of Mr. Baird's untiring zeal in the performance of his duties and his great mechanical ability, which was always at the service of the Commission. He designed many of our most useful implements on board this vessel, and contributed in no small degree to her success. His advice and assistance were always freely given on matters pertaining to other branches of the work of the Commission, and it is indebted to him for much valuable aid.

Lieut. B. O. Scott, U. S. Navy, was detached on the 31st and placed on waiting orders. Assistant Paymaster C. S. Williams, U. S. Navy, reported for duty on November 5.

We left Washington on the morning of November 10 for the navy-yard at Norfolk, Va., where we arrived at 8.30 on the following morning and went into dry-dock on the afternoon of the same day, to clean and paint the ship's bottom. On the 18th we hauled out and moored alongside the coal-wharf.

Ensigns W. B. Fletcher and Marbury Johnston, U. S. Navy, reported for duty on the 16th, and Ensign W. S. Benson and Paymaster C. D. Mansfield were detached on the 18th. Ensigns E. W. Eberle and C. M. McCormick reported for duty on the 19th. Ensign Fletcher was detached on the same day.

We coaled ship during the 18th and 19th, taking 187½ tons of anthracite on board.

The scientific staff reported on the 19th, bringing with them such articles as were not put on board ship before her departure from Washington. Everything was ready for sea on the evening of the 19th except the paymaster's stores, which were taken on board on Monday, the 21st. Ensign H. E. Parmenter reported for duty on the morning of that day, and at 4.20 p. m. we left the navy-yard and proceeded to Hampton Roads, where we anchored at 5.35 p. m. Having dispatched our last mail, including a complete descriptive list and muster-roll, we got under way at 8.45, and proceeded to sea under the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., November 15, 1887.

SIR: For the purpose of carrying out the long-cherished plan of the late Commissioner of Fish and Fisheries, and in accordance also with the provisions of the act of Congress in the sundry civil bill, approved August 4, 1886, providing for the expenses of the voyage of the steamer *Albatross* from New York to San Francisco, you will proceed as soon as the steamer is ready, to San Francisco, conforming as closely as circumstances will permit with the itinerary already agreed upon between you and myself, and reaching San Francisco on or about the 15th of May, 1888. Upon your arrival at San Francisco you will find awaiting you detailed instructions as to the character of the investigations which it is desired to make concerning the fishery resources of the Pacific coast. During the voyage you are authorized to make such stoppages as may in your judgment be necessary, and also, when opportunity offers, to carry on such investigations as, upon consultation with the assistant in charge of the scientific staff, shall seem to be advisable, considering always the limitations of time and of the appropriation.

Instructions for the government of the scientific work to be done during the voyage, so far as it is possible to specify them in advance, have been prepared, and are forwarded herewith, addressed to Prof. Leslie A. Lee, who has been appointed assistant in charge of the scientific staff.

As I have already intimated to you, and in accordance with a letter from him, a copy of which has already been forwarded to you, it is expected that Prof. Alexander Agassiz will join the *Albatross* at Panama, in which case I have to request that all facilities may be offered him for carrying out the scientific inquiry which he has in view, consistently with the purposes and limitations of your voyage.

It is desirable that any hydrographic information which can be obtained without detriment to the Fish Commission shall be forwarded to the Navy Department.

In addition to Prof. Leslie A. Lee, assistant in charge of the scientific staff, the following civilian assistants have been assigned to the vessel: Mr. Thomas Lee, Mr. Charles H. Townsend, and Mr. Dennis M. Cole. * * *

From the time of the vessel leaving the Atlantic coast the regulations in regard to requisitions will be waived and all expenditures will be under your direction. * * *

With my best wishes for a pleasant and prosperous voyage, and for the successful conduct of your investigations, I have the honor to be,

Very sincerely yours,

G. BROWN GOODE,
Commissioner.

Lieut.-Commander Z. L. TANNER, U. S. Navy,
Commanding U. S. Fish Commission Steamer Albatross,
U. S. Navy-Yard, Norfolk, Va.

It is seldom the fortune of men to start on a long voyage under more favorable auspices. The ship was well equipped and thoroughly seaworthy in every respect. She had on board an efficient corps of officers and scientists, and her crew could not be excelled. Many of them were experts in our deep sea-work, having served several years on board. Reference to the foregoing orders shows that we were to proceed to San Francisco, Cal., arriving about May 15, 1888, when we would find awaiting us detailed instructions governing our future action. In the meantime we were to make such scientific investigations en route as might be prosecuted without detriment to the ultimate objects of the voyage.

THE VOYAGE FROM NORFOLK TO SAN FRANCISCO.

The following itinerary, approved by the Commissioner, is inserted here, to show the general distribution of our time, although it was not intended to be followed strictly if it were found advisable to depart from it while on the voyage:

Proposed itinerary.

Port.	Arrive.	Leave.	Days dredging.	Days en route.	Days in port.	Distances.	Average speed per hour.
Norfolk, Va	.....	Nov. 20	.....	.....	.....	.....	.....
Santa Lucia, West Indies	Nov. 29	Dec. 5	1	8	6	1,675	8.7
Bahia, Brazil	Dec. 23	Dec. 26	2	16	3	2,665	6.9
Rio de Janeiro, Brazil	Dec. 30	Jan. 5	0	4	6	795	8.2
Montevideo, Uruguay	Jan. 10	Jan. 14	0	5	4	1,020	8.5
Sandy Point, Straits of Magellan	Jan. 23	Jan. 27	2	7	4	1,330	7.9
Valparaiso, Chili	Feb. 13	Feb. 20	6	11	7	1,500	5.6
Callao, Peru	Feb. 26	Mar. 2	0	6	4	1,270	8.8
Panama, United States of Colombia	Mar. 11	Mar. 17	2	7	6	1,350	8.0
The Galapagos	Mar. 25	Mar. 31	3	5	6	950	7.9
Acapulco, Mexico	Apr. 7	Apr. 13	2	5	6	1,125	9.3
La Paz, Lower California	Apr. 19	Apr. 25	2	4	6	820	8.5
San Francisco, Cal	May 15	.....	10	10	.....	1,330	5.5
			30	88	58	15,830	7.8

The time under "days in port" is intended to include the necessary delays of coaling and taking in stores, as well as those to be occasioned by the investigations of the naturalists as before explained. Our subsequent movements were governed accordingly, and it only remains for me to record the leading events of our progress toward the Pacific, leaving to the naturalists the task of reporting the scientific results of our explorations. In noticing the casts of the trawl, etc., mention is made of various forms taken simply to indicate the character of the haul without reference to scientific results or pretending to strict accuracy.

Chesapeake Bay to Santa Lucia, West Indies.—We passed the capes of the Chesapeake at 10.35 p. m. with calm, clear weather, light moonlight, and a clear sea. Cape Henry Light was dropped at midnight, thus severing our last connection with the Atlantic coast of the United States. Pleasant weather and smooth seas continued until the 23d, when a fresh breeze sprung up from the ENE., finally increasing to a moderate gale; but being fair wind we looked upon it with favor, as it enabled us to carry sail and economize coal. It died away on the evening of the 26th, from which time until we made Sombrero, at 4.15 p. m. the following day, we had light southerly winds and squally weather. It was our custom to slow the engines every evening after dark for fifteen or twenty minutes, whenever the weather was suitable for surface towing. At 6.50 on the evening of the 27th, after passing the island, we made a haul of the dredge in 406 fathoms, fine gray sand (latitude 18° 30′ N., longitude 63° 31′ W.). A great variety of shells were conspicuous among the different forms, and large numbers of cup-corals and sponges were taken. The weather had been threatening all the evening with heavy thunder and lightning, and rain all around us, but we escaped till about the time the dredge reached bottom, when we were struck by a tropical tempest which raged with slight interruption for nearly four hours, thoroughly drenching everybody on deck and seriously complicating our work of dredging. It was doubtful whether we would save our apparatus; but it was finally landed, slightly damaged, and it proved a fruitful haul. The sun came up bright and clear the next morning, and we availed ourselves of the opportunity to swing ship under steam, observing azimuths on alternate points for compass errors. It was a particularly favorable opportunity, for, being under the lee of Guadaloupe, the sea was perfectly smooth, and, what was equally important, we were on the line of no variation. Having completed our observations we steamed ahead until 9 a. m., when the trawl was lowered in 687 fathoms, ooze (latitude 16° 54′ N., longitude 63° 12′ W.), and landed on deck at meridian, heavily loaded with ooze, which was pretty evenly impregnated with the shells of pteropods and globigerina. The net contained the usual variety of brilliantly-colored crustaceans, holothurians, deep-sea fish, cup-corals, crinoids, sponges, etc. The haul completed, we resumed

our course, anchoring in Port Castries, island of Santa Lucia, at 11.08 a. m., November 29.

A boat was sent for the United States consular agent, Mr. William Peter, who visited the ship, and later in the day accompanied Prof. L. A. Lee and myself in an official call on the governor of the island, to whom we paid our respects, and of whom we obtained permission for the naturalists to make collections.

We coaled ship December 3, taking on board 104 tons of excellent Welsh coal, 29 tons being stowed in bags on the deck. As a coaling station Port Castries has many advantages, and when the harbor improvements in progress are completed it will have no superior in the West Indies. The United States consular agent placed us under many obligations by his advice and assistance.

Santa Lucia to Bahia, Brazil.—At 7.50 a. m., December 4, we left the beautiful little harbor of Port Castries for Bahia, Brazil, and at meridian of the same day cast the trawl in 281 fathoms black sand (latitude 13° 34′ N., longitude 61° 04′ W.), midway between the islands of Santa Lucia and St. Vincent. It caught on rough bottom before it had dragged a fathom, but on getting it on board some very fine specimens were found fastened to the net, among them a small stemless sea lily, *Antedon*, corals, etc. It was evidently no ground for a trawl, so we lowered the tangles, and they had a rough time of it, but brought up numerous specimens of pennatulus, antedons, ophiurans, gorgonians, corals, etc. One little spray of vermilion coral attracted attention. Black fish, porpoises, and flying fish were plentiful, and numerous sea birds were observed feeding in the tide rips and eddies between the islands. The weather was warm, but pleasant, with light winds and smooth sea.

We cast the trawl at meridian, December 5, in 880 fathoms, ooze (latitude 11° 40′ N., longitude 58° 33′ W.), landing it on deck at 3.10 p. m., with numerous archasters, holothurians, a variety of crustaceans, mollusks, etc., many of them apparently being similar to those taken by us on the Atlantic coast of the United States. The surface net was used with moderate success, several specimens of young fish, crustaceans, etc., being taken.

December 6 was marked by variable winds and frequent rain squalls. At meridian we sounded in 2,069 fathoms, ooze (latitude 9° 47′ N., longitude 55° 51′ W.), and proceeded on our course after a detention of forty-five minutes.

The trawl was cast at meridian, December 7, in 720 fathoms, blue mud (latitude 8° 04′ N., longitude 52° 47′ W.), and was landed on deck at 2.33—a water haul, notwithstanding more than ordinary precautions had been taken to insure success. The depth increased probably before the trawl was down; at least that is the only way I can account for the failure.

Easterly winds and squally weather continued and everything above

decks was pretty well saturated. The last bag of our deck load of coal was struck below during the day, much to the relief of every one; it was certainly a great nuisance, but it carried us 640 miles on our course, so we took the dirt and inconvenience philosophically.

A sounding was made at meridian, December 8, in 2,406 fathoms, ooze, (latitude 6° 25′ N., longitude 50° 29′ 30″ W.). We did not expect more than 1,000 fathoms, and intended to get a cast of the trawl, but abandoned the idea, not only on account of the great depth, but a heavy easterly swell and strong current combined made a successful haul improbable.

Hydrographic Office Chart No. 41 has on its face a note—"Discolored water;" and between latitude 5° 00′ and 5° 12″ N. and longitude 46° 43′ a line of three soundings extending NE. by N., and SW. by S., 12 miles with 52, 64, and 68 fathoms. As this was a long way from land and in a region of supposed deep water, I considered it advisable to settle the point, and, deviating somewhat from our course, sounded at 9 p. m. in 1,876 fathoms, ooze (latitude 5° 01′ N., longitude 46° 44′ W.), demonstrating beyond question the non-existence of shoal water in the position indicated. Discolored water may have been seen, as the discharge from the Amazon in the season of floods has been traced much farther to the eastward.

At 11.30 a. m., December 11, we sounded in 2,440 fathoms, ooze (latitude 1° 53′ N.; longitude 43° 00′ W.), demonstrating the fact that deep water approaches the coast southward of the mouths of the Amazon.

The next sounding was made at 10 a. m., on the 14th, in 391 fathoms, sand and ooze (latitude 3° 22′ S.; longitude 37° 49′ W.), and the small beam trawl put over, the strong trades, heavy confused sea, and rapid current, making it unsafe to attempt a haul with the large and more effective one. It came up at 11.50, and among the many specimens were a small octopus, several specimens of *Macrurus*, different from any I had seen; hundreds of red shrimp of various species, *Rhizocrinus*, a sea spider new to us, and many other forms. It was a successful haul made under adverse circumstances, when the loss of the apparatus seemed the most likely occurrence.

We sounded again at 10 a. m. the following day in 1,263 fathoms (latitude 4° 38′ S.; longitude 35° 55′ W.), intending to make a haul of the trawl, but the unexpected depth and boisterous weather prevented.

The first indication of our approach to land was the discovery of a couple of fishermen in a "catamaran," reported by the officer of the deck as two men adrift on a raft. He seemed quite surprised that we did not go to their assistance, and would doubtless have felt that the shipwrecked mariners had been left to their fate, had not the subsequent discovery of many more, both under sail and at anchor, enlightened him as to the nature of this peculiar craft, which he now saw for the first time.

At 4.32 p. m., December 16, we made two hauls of the dredge, fol-

lowed by one with the small beam trawl, in 20 fathoms, coralline bottom (latitude 6° 59′ S.; longitude 34° 47′ W.). Several bright-colored fishes were taken besides bryozoans, mollusks, corallines, and other algæ. The coralline bottom referred to is peculiar and deserving of notice. It is composed of coarse sand and broken or disintegrated mollusk shells, corallines, and bryozoans in equal quantities, often consolidated into large nodules, which are covered with living corallines and bryozoans. Occasionally small pebbles are scattered through the deposit, angular in form, composed of quartz and feldspar, and covered with a deposit of lime, the same material which enters so largely into the composition of the nodules before mentioned. Thus it will be seen that the bottom is composed largely of vegetable growth.

We passed the latitude of Cape St. Roque between 12 and 1 a. m. on the 17th, were off Formosa at meridian, and passed Pernambuco later in the day, when we kept off for Bahia, made all sail to a moderate SE. trade and considered ourselves at the top of the hill, which we had been climbing since we left Santa Lucia, having encountered strong trades dead ahead, with heavy seas and adverse currents, aggregating 270 miles on a daily average of 30 miles.

The trawl was cast at 3.30 p. m., December 18, in 1,019 fathoms, brown clay (latitude 12° 07′ S.; longitude 37° 17′ W.). Everything worked smoothly until we began heaving in, when the trawl, buried in the tenacious mud of the bottom, obstinately refused to come out until the bridle stops parted, allowing it to come up tail first after disgorging its load. There were a few specimens in the net, and the mud-bag and ring-nets presented an interesting contrast in the nature of the bottom deposits brought up. They had all been well buried in the mud, presumably passing through the same deposit, yet one contained a quantity of coarse pteropod ooze and the other fine globigerina ooze, with only here and there a pteropod shell. A *Macrurus*, unknown to us, was among the few specimens in the trawl net; there was a small starfish also, and a flat cup-coral, besides shrimps, sponges, etc.

Numerous flocks of birds were observed following schools of surface fish, and flying fish were constantly scurrying away from the ship. A noticeable quantity of conferva was seen in the water during the day, and a sufficient amount secured for examination.

We arrived at Bahia, Brazil, at 8.50 a. m., December 19. The usual visits were made and returned. One hundred and fifty-six tons of coal were taken on board on the 22d, and at 6.50 p. m., December 25, we got under way and proceeded to sea.

Up to this time we had been using both boilers, with a consumption of 10 to 12 tons of coal per day, which necessitated very light fires—so light in fact that we thought it worth while to try the experiment of one boiler burning as much coal as it would consume economically—from 9 to 10 tons per day, and we left port with only one in use.

Bahia, Brazil, to Montevideo.—The trawl was lowered at meridian on the 26th, in 818 fathoms, ooze (latitude 15° 39′ S.; longitude 38° 32′ 54″ W.), and landed on deck at 3.18, bringing up several species of fish, besides starfish, ophiurans, crustaceans, etc. The quantity of material was small and the mud was completely washed out of the net, showing an entirely different bottom from that encountered north of Bahia, where the clayey mass would not wash through the meshes of the trawl.

Soon after daylight, December 27, we swung ship under steam, observing azimuths of the sun for compass errors and at 7.50 a. m. anchored in the harbor of Abrolhos, where we called to give the naturalists an opportunity of examining the flora and fauna of these out-of-the-way islands. The group is composed of masses of rock rising above the sea, with no living water, scant vegetation, and uninhabited except by the light-house keeper and his assistants. A few wild goats find a precarious existence on the largest island. The group is a favorite resort of sea birds, the naturalists taking eight species. Lizards were plentiful, and a couple of rats were found on one of the uninhabited islands. An enormous *Mygale* was among the most interesting specimens, a spider so large and powerful that it was able to capture and kill young sea birds, upon which it subsisted. Our list of fishes was materially increased by the use of several Bahia fish-baskets, which not only provided specimens, but also supplied the officers' mess with many excellent fish.

We left the islands at 3.55 p. m., December 28, still under one boiler, our experimental run from Bahia having proved satisfactory. Cape Frio was sighted at daylight, December 30, and at 6 a. m. the dredge was lowered in 59 fathoms, blue mud and clay bottom (latitude 23° 08′ S.; longitude 41° 34′ W.), and although the prospect was not encouraging, when the uninviting mass was emptied into the table-sieve, we procured specimens of fish, starfish, shells, annelids, sea-urchins, cup-corals, and the dead shell of a rare brachiopod. About 4 p. m., I observed several patches of light green water, and, as we were standing toward reported dangers, it occurred to me that they might exist and that we were approaching them, but a closer scrutiny as the ship passed through one of the discolored spots, showed that the peculiar tint was confined to the surface or within a foot or two of it, and was caused by a mass of conferva.

On Saturday, December 31, we ran a line of soundings over reported dangers marked on the chart as follows:

⊕ ? Edith Rose, 1865; 17 fathoms, sand, in latitude 25° 45′ S.; longitude 44° 44′ W.
⊕ ? Rock just awash; seen February, 1811, by a pilot of Bahia named Medeiros. Position, uncertain; latitude, 25° 41′ S.; longitude, 44° 48′ W.
⊕ Medeiros Rocks, latitude 25° 32′ 30″ S.; longitude 44° 59′ W.

This shoal is plotted in the direct route of commerce and is a standing menace to navigation. It has been searched for by men-of-war of various nations, but, as the negative soundings indicate, they were not supplied

with deep-sea sounding apparatus and had no means of demonstrating the contour of the bottom, which is the only effective means of determining the non-existence of submarine dangers.

Although not on a surveying voyage, I thought it would be unjustifiable to pass over supposed dangers of such serious nature with a ship perfectly appointed for deep-sea investigation without settling beyond question their existence or non-existence. This we have done, and a reference to the table of hydrographic soundings will show a regular and gradual increase in depth from the coast to the position assigned them, where we found between 800 and 900 fathoms, globigerina and pteropod ooze. There was no indication of change in depth or character of bottom. These soundings were made during fine, clear weather, the positions determined by good astronomical observations and the surface indications were observed by a lookout at the mast-head, whose line of vision included 12 or 15 miles in every direction.

The light green conferva, first encountered on the 30th, was seen again while sounding over one of the positions assigned to the Medeiros Rocks, and it occurred to me that these algæ might be peculiar to the locality, and have given rise to the various reports of shoals. Conferva is of common occurrence on the surface of the sea, but its usual color is buff, brown, or even red. I never saw it of this peculiar light green hue before.

The *Albatross* was in latitude 27° 54′ S., longitude 47° 03′ W., at meridian, January 1, 1888. We were just emerging from the heat of the tropics, and the cool southerly winds effected a most grateful change in the temperature. An occasional school of skip-jacks was observed, besides other surface fish. Among the birds were two or three large white-breasted petrels, which the naturalists vainly attempted to capture. We saw our first albatross on the morning of the 2d, in latitude 30° 33′ S., longitude 49° 29′ W. The same afternoon a sounding was made in the position assigned to Ried's Bank, latitude 31° 05′ S., longitude 40° 45′ W., in 78 fathoms, which agrees with depths surrounding it, and indicates the non-existence of a bank in that position.

Land was seen during the afternoon of the 3d, and at daylight the following morning Ponta del Este and the coast to the northward were in sight. The rounded hill-tops and sand downs presented a rather disappointing appearance for a region possessing so many agricultural resources. The character of the country changed after passing Maldonado, an occasional forest or grove improved the landscape, and extensively cultivated estates relieved the impression of sterility acquired from a first view of the coast.

We anchored in the outer roads of Montevideo, near the United States Flag-ship *Lancaster*, at 2.50 p. m., January 4, received pratique at 6 p. m., and at daylight on the 5th moved to the Inner Harbor, where we found the United States steamers *Alliance* and *Tallapoosa*, besides several foreign men-of-war.

The usual official calls were made and received. The weather was boisterous, and a heavy swell made communication by ship's boats exceedingly uncomfortable. A southwest gale (pampero) sprung up about noon on the 8th, and continued through the following day, cutting off communication with the shore. Coal began to come alongside on the morning of the 10th, in canvas bags, containing about 600 pounds each, the lighters having a capacity of 30 tons. It was hoisted aboard rapidly by the steam winch, and at 6 p. m. we had received 115½ tons, for which we paid $8.44 per ton, American gold.

Montevideo to the Straits of Magellan.—We left Montevideo on the evening of the 11th, and the next morning lowered the trawl in 11 fathoms, sand and shells, 25 miles NNE. ½ E. (magnetic) from Medano Point, following it with two more hauls, covering a space of 6 or 8 miles in a southerly direction, finding the same depths and general character of bottom. The hauls were very rich in variety of forms. Several live oysters were also taken, seemingly in good condition, and of fair size.

A successful haul of the trawl was made on the afternoon of the 13th. Porpoises were seen in great numbers, and the engines were slowed for a few minutes while an attempt was made to strike one with a harpoon, but they kept out of reach. Albatrosses, gulls, petrels, and other seabirds hovered over them in large flocks.

The weather was clear and pleasant until 4 p. m., when the sky became overcast, and a light low-lying scud flew rapidly over the masthead, with distant lightning, the whole aspect indicating the near approach of a gale. The officer of the watch seemed quite undisturbed until the wind suddenly shifted from SE. to NW., taking the ship by the lee with all sail set. Luckily the squall was not heavy, and the canvas was taken in without loss. The wind veered around the compass twice within two hours, and the barometer oscillated rapidly between 29.84, and 29.72. The wind finally settled about SE. with clearing weather.

A successful haul of the trawl was made about noon, January 14, in 43 fathoms, dark sand and black specks. Among the most notable specimens were a number of fish resembling sea-bass in size and general form, although the external markings were quite different. We had them fried and boiled, for the table, and found them excellent, the texture and flavor of the meat being not unlike bass. The first floating kelp was seen during the evening.

At 11.30 a. m., January 15, the trawl was lowered in 51 fathoms, green mud, fine sand, and a large number and a great variety of species were taken. Among the fish were whiting, hake, flounders, and some species not recognized. The small whiting were very good pan-fish. The large surface net was towed as usual while the trawl was down, but, with the exception of a few minute crustaceans, very little life was found on the surface.

The sudden changes in surface temperature between 45° and 50° S.

latitude have been commented upon by navigators, it being asserted by some that bad weather follows a fall. It is a region of sudden changes and frequent gales in winter, and it would not be strange if such were the case when this phenomenon is likely to occur any day, or several times a day. We experienced notable variations in surface temperature, yet the weather continued almost perfect, owing probably to its being the summer season. These fluctuations in surface temperature are caused by a cold submarine current from the Antarctic, which occasionally finds its way to the surface.

A successful haul of the trawl was made at 11.30 a. m. on the 16th, and another at the same hour on the following day. High land back of Cape Virgins was made at 1.45 p. m., and at 4 we made another successful haul of the trawl in 31 fathoms. Trial lines were put over on Sarmiento Bank, but no fish were taken, owing probably to the rapid drift of the ship over the bottom. The small beam trawl was allowed to drag a few minutes, and new and interesting specimens were taken, although the net came up a mere wreck.

The wind gradually increased from the northwest, until at 5 p. m. it was blowing a moderate gale, with heavy swell, which continued until we rounded the Cape. We steamed ahead as soon as the trawl was up, and at 7 p. m. anchored for the night off Dungeness. The wind moderated after sunset, and was followed by rainy, misty weather.

Dungeness to Sandy Point, Straits of Magellan.—We were under way at 4 o'clock the following morning, and made a haul of the trawl at 4.30 a. m., in 17 fathoms, entered the first narrows at 8, groping our way through the rain and mist, and at 9.41 cast the trawl again, in mid-channel, in 29 fathoms, sand and stones, and made a successful haul, although the flood-tide was running with great force.

Extensive buildings belonging to Wood's sheep ranch were observed on Delgada Point, excellent guides for vessels making the anchorage as well as for those entering the Narrows, when Direction Hills and other landmarks are shut out by fog. The passage through the Narrows was made without difficulty, the weather clearing as we approached the western entrance. A successful haul of the trawl was made near Triton Bank, in 21 fathoms, sand and pebbles, at 12.10 p. m., and at 1.25 we anchored in Gregory Bay.

Felton's sheep ranch lies north and west of the bay, the buildings being conspicuous when approaching the anchorage. Sheep-grazing is a new and very profitable industry, and most, if not all, of the Patagonian coast from Cape Virgins to Sandy Point is now utilized for that purpose. The wilds of Terra del Fuego have even been invaded by the sheep-graziers, they having located on some of the more accessible islands on the south side of the Straits of Magellan, which are well adapted for their purpose. The Indians seem disposed to contest the invasion, and more or less trouble is anticipated before the graziers are allowed to occupy their newly discovered pastures without molestation.

The naturalists, with a party of volunteers, left for the purpose of shore collecting, as soon as the anchor was down, returning toward sunset, with fair results. A seining party took sufficient mullet to supply the ship, but caught very few of the other species. Frequent showers made this work rather disagreeable, but did not deter the naturalists or volunteers, who, after their long confinement on board ship, were wild for a run on shore.

The collectors left at daylight the following morning, and returned a little before noon, well satisfied with their first exploration on the coast of Patagonia. We got under way at 1 p. m. and lowered the trawl a few minutes later in 20 fathoms, sand and pebbles, making a successful haul; then steamed through the second Narrows, and at 3.40 p. m. anchored in 7 fathoms off the south side of Elizabeth Island. A breeze had sprung up from the southwest as we were getting under way, which increased rapidly to a moderate gale. It continued until we reached our anchorage, and prevented further work with trawl or dredge.

A large party of collectors left as soon as the anchor was down, and on their return reported a rich field for exploration. There was a variety of birds on the island, including ducks and wild geese. *Bernicla Magellanica* was plentiful, and on the southeast extremity was a tern rookery, where millions of the pretty little sea-birds were nesting. It was located on a plateau about 20 feet above the sea, and covered many acres. The nests were on the ground, and exceedingly simple in structure, being composed of a little grass and a few dried twigs, hardly sufficient to keep the eggs from rolling about. They contained from 1 to 3 eggs, and were so close together that it required the greatest care to walk among them without crushing eggs or the young birds that thickly covered the ground. The old birds abandoned their nests as the exploring party approached, literally filling the air, and scolding at the top of their piercing voices, the united protest of these millions of throats being little short of deafening. This, in addition to other disagreeable features, such as their locality directly beneath countless numbers of sea-birds frightened from their nests, was sufficient incentive for the explorers to seek other quarters as quickly as possible.

Elizabeth Island is now occupied as a sheep ranch. It has not been inhabited by Indians for many years, although the early Dutch navigators reported them on the island in considerable numbers, and numerous shell-heaps of great extent covered with soil from 6 inches to 3 feet in depth indicate the existence of a large population at some remote period.

January 20 was a pleasant day, and we made the most of it by sending a strong working party on shore under the direction of Professor Lee, with shovels, to excavate and explore shell-heaps. Messrs. Townsend, Miller, and myself went to Sta. Marta Island in the hope of finding a colony of penguins or a few antarctic sea-lions, but we encountered instead a rookery of cormorants, covering several acres on the central

portion of the island. The elaborate nests were circular in form, 16 to 18 inches in diameter at the base, 6 inches in height, and ten inches in diameter at the top, hollowed out and lined with grass and small twigs. They were so placed as to get the greatest possible number in a given space, the nests of one row alternating with those of the next with great regularity. This applies more particularly to the central portion, as the nests on the outskirts were irregularly placed, having open spaces of several feet in extent at times. There was great commotion among the birds as we approached, the more timid taking to their heels, or wings, according to individual ideas of the necessities of the moment, but the great mass remained until we approached within fifty feet, enabling us to take several photographs.

One nest might contain from one to three eggs, the next a couple of young just hatched, the soft, velvety skin as black as jet, and no sign of feathers, while in a third might be seen two or three half-grown birds covered with a uniform growth of down nearly black. The young birds were unable to fly, and the old ones seemed disinclined to use their wings at close quarters. When a rush was made by the men they simply scurried off en masse, leaving the young, who seemed to have little or no fear of us, several of them taking food from our hands without the least hesitation.

Another species was found nesting on the cliffs, and could be distinguished by their black necks, those of the rookery being white. Specimens of eggs and birds, adults and young, of both species were collected.

There were a few wild geese, an occasional hawk, and many gulls on the remote points. These last were nesting, their eggs lying on the ground without the least attempt at nest-building, the young being left to hide themselves as best they could when we approached. They concealed themselves in the grass, under a bush or stone, or even on the beach, while the older ones took to the water and paddled about under the matronage of an old gull.

We found a shell heap on the island, from which several stone implements and bones were procured. Professor Lee met with deserved success in his exploration of the shell heaps of Elizabeth Island, and the others did very well in general collecting.

January 21 commenced with weather overcast and light westerly winds, which backed to SW. between 5 and 6 a. m., increasing to a moderate gale at 11. This made communication with the shore so difficult that the parties were called on board, and at 2.40 p. m. we steamed to Laredo Bay, anchoring there at 4.20. We expected to find it smooth, as the wind was off shore, but there was sufficient surf on the beach to make landing unpleasant; so the collectors were obliged to remain on board until 4 o'clock the following morning, when they landed and commenced work in various directions.

Cape Negro forms the northeastern boundary of Laredo Bay, and is covered with an irregular forest growth. It may, in fact, be considered the dividing line between the comparatively low treeless coast of eastern Patagonia, and the mountainous, heavily-wooded regions to the westward. A deep valley back of the bay and the surrounding heights were occupied as cattle ranches, large herds being seen a short distance inland. Horses, cattle, and sheep graze the year round, and require little attention, except the protection of the last from wild beasts. The seine was hauled with fair success, as far as procuring specimens was concerned; half a dozen mullet were all the edible fish taken.

The barometer took one of its inexplicable Antarctic flights on the 22d, ranging from 29.58 to 30.32 within twenty-four hours, pleasant weather prevailing meantime.

At 10 a. m., January 23, we got under way, stood out to the middle of the straits, and made two successful hauls of the trawl in 60 and 77 fathoms. Large numbers of specimens were procured, but there was a notable absence of fish. As soon as the last haul was completed we steamed to Sandy Point, anchoring off that place at 1.20 p. m.

We were visited by the health officer and granted pratique without delay. Official calls were exchanged with the governor of the province, Sr. Francisco R. Sampaio, who extended every courtesy, and made our stay at Sandy Point very pleasant. Sr. Ramon Lista, governor of the Argentine Colony of Santa Cruz, arrived soon after the *Albatross*, and calls were exchanged. We also met the governor of the Argentine Colony of Ooshooia, in southeastern Terra del Fuego, who informed us that shipwrecked mariners need not fear the natives east of Cape Horn. On the contrary, they could be depended upon to render all practicable aid.

The naturalists expressed a wish to have some specimens of the Antarctic sea-lions for the National Museum; so, after having made inquiries on the shore, Mr. Townsend and I left the ship in the steam-cutter at 8 a. m., on the 26th, for St. Peter and St. Paul Rocks, latitude 53° 43′ S., longitude 70° 44′ W., about 35 miles from Sandy Point. They are on the south side of the Straits, about 1 mile in length, a quarter of a mile in width, 10 feet above high water, and connected by a narrow neck, which is awash at half tide. They are quite barren, with the exception of a few bushes on the higher part of the largest islet. Nearing the rocks we saw a number of seals, or sea-lions, hauled out on a steep, rocky beach, just above high water, and, landing on the opposite side, we worked our way to a favorable position, about 200 yards from them, fired at the word, killing four at one discharge. One fell into the water and sunk, so we secured but three. They proved to be fur seals on closer inspection, entirely different from the animals we were in search of, but we skinned them, nevertheless, and preserved one skeleton. We shot several birds, and a number of fossil shells were chiselled out of the rocks.

A canoe containing two men, three women and a child came off from Dawson Island, and went first to the cutter begging for tobacco and bread; but the crew distrusted their motives, so, after giving them a little tobacco, made a suggestive display of an ax, hatchet, and a double-barreled shot-gun, which caused the Fuegians to beat a hasty retreat. The two men landed and watched the process of seal-skinning, appropriating the carcasses, which they carried to the canoe for food, while one woman increased the supply of their larder by capturing a dozen or more half-grown cormorants from a rookery near by. Eggs which she took from the nests were eaten raw with evident relish. Another woman was bailing the boat, while the third busily employed herself over a fire, which was built on a bed of sand in the bottom of the canoe. She was cooking young cormorants and seal meat, on which they were regaling themselves when we left the rocks.

We had strong winds and squally weather during the day, and as there was no harbor nearer than Port Famine on the Patagonian side, we steamed across the straits and anchored in a snug little bay for the night, where we were protected from wind and sea. We were fortunate in finding a secure harbor, as it came on to rain and blow heavily, getting up a sea that would have made us exceedingly uncomfortable in an open bay in the straits. As it was, we passed the night under our water-proof canopy without interruption or discomfort, except that incident to the cramped quarters of the boat.

The morning was occupied in shore collecting until 10 a. m., when we started on our return, encountering a fresh breeze and heavy swell after leaving Port Famine. A landing was made at the southern extremity of Fresh-water Bay, where the country was covered with a dense forest and many flowers. The fuchsia was seen growing wild, some of the bushes being 3 inches in diameter, and 15 feet or more in height. Embarking again after an hour's tramp, we reached the ship at 6 p. m. Several large forest fires were seen sweeping over the country, leaving utter desolation behind, houses, barns, fences, and growing crops being destroyed.

The climate and soil are well adapted to the growth of many vegetables, were it not for the heavy winds, which blow the rich black loam away, where the sward is broken for cultivation. Gardens and cultivated fields are surrounded by high fences, to break the winds, except in rare instances, where surrounding forests or the peculiar conformation of the land serve the same purpose.

Sandy Point has a population of about 2,000, and is increasing in size and commercial importance since the occupation of the Patagonian coast for sheep and cattle grazing, and the colonization of southeastern Terra del Fuego by the Argentines. Its central location makes it a convenient stopping place for steamers passing through the straits, and it is the distributing point of all that region. A recent fire had destroyed the public buildings, including the Governor's residence, and we

found him and his family occupying very cramped quarters in a small one-story wooden structure. A large iron hulk was moored off the settlement, on board of which they usually kept a stock of coal. We had depended on it for a supply to carry us to Callao, past the cholera stricken ports of Chili, but for the first time in years they were without a ton, the coal famine on the Pacific coast having caused an unusual demand, while the loss of one vessel, and the non-appearance of another, made it impossible to replenish their stock.

Sandy Point to Port Churruca, Straits of Magellan.—We received a mail on the 31st, and no coal arriving, made preparations to proceed to Lota for our next coaling port. We were under way at 2.40 on the morning of February 1, steaming to the westward through the mist and rain which partially obscured the land; upon entering Famine Reach it cleared somewhat, and though we had occasional showers, the shore was generally visible.

Cape Froward, the southern extremity of the continent, was passed at 9 a. m. with the usual accompaniment of rain and sleet, and furious williwaws, which came tearing down the mountain sides with almost the force of a hurricane.

Passing Fortesque Bay at 11.30 a. m. we entered English Reach, where a strong northwest wind was encountered. Several parties of canoe Indians shoved off from York Point, and waited our approach, clamoring for tobacco and ship's bread. We slowed down and allowed them to come alongside, at the request of the naturalists, who immediately struck up a spirited barter for articles destined for the National Museum. They were ready to exchange everything in their possession, except their canoes; spears, paddles, domestic utensils, clothing, and ornaments belonging to men and women were offered in trade. They even expressed a willingness to sell their children. After a delay of a few minutes the canoes were cast off against the earnest protests of their occupants, and the *Albatross* proceeded on her course. We arrived at Borja Bay at 2.15 p. m., and anchored, to allow the naturalists to examine the shores. It is a time-honored custom for vessels passing through the straits to leave a sign-board in Borja Bay, generally nailed to a tree, giving the ship's name and date of arrival, besides other information of interest to the mariner. Following this example, the *Albatross* left the usual record nailed to a tree, where it could be read with an ordinary marine glass from the deck of a vessel at the anchorage. We were again visited by canoe Indians, who kept up a lively barter with the naturalists and others until near night, when they camped on shore.

We were under way at 4 a. m., February 2, and steaming out of the bay, groped our way through Crooked Reach in a fog and mist so dense that we could not see more than a ship's length. It cleared gradually after passing Field Anchorage, about 7 a. m., revealing several fine glaciers, Mount Wyndham, Mount Wharton, and Mount Hart Dyke, being among the most impressive.

A successful haul of the trawl was made at 11.27, off Chapman Island, Sea Reach, in 369 fathoms, after which we started ahead and arrived at Nassau Anchorage, Port Churruca, at 2.12 p. m., anchoring in 17 fathoms, rocky bottom, near the center of the bay.

The various anchorages in Port Churruca are perfectly land-locked, and surrounded by high and precipitous mountains, down which furious squalls rush whenever it is blowing heavily outside. The interstices of the rocky bottom are filled with tenacious mud, through which the bight of the long scope of chain is dragged before the full strain is taken by the anchor; otherwise it would be unsafe for vessels to attempt to lay out heavy gales in these small rock-bound basins.

It was remarkably quiet on the day of our arrival, and, although rapidly flying clouds could be seen overhead, scarcely a breath of air reached us. Fierce and frequent williwaws came down upon us the following morning, first from one direction then from another, sheering the vessel about in the most alarming manner, yet, being of momentary duration, they usually passed before the cable was straightened. Snow and ice were seen on the mountains, and on the south side of the Cosmo Arm a beautiful glacier extended far down from the summit. Many fresh-water streams poured down from the height and in the old days of sailing ships would have been convenient watering places.

A portage about 300 feet in length was found at the head of Lobo Arm leading to a bay of considerable extent, not shown on our charts. It may cross Desolation Island from the vicinity of Beauclerk Islands, or is possibly an extension of Puchachailgua Inlet. There are evidences of its having been used by others than Indians, large trees having been cut away with axes in the hands of experts, and sufficient logs laid to prevent the boats miring in the marshy soil. The naturalists added materially to their collections from land and water and the photographers obtained some interesting views.

The charts and sailing directions of the Straits of Magellan furnished by the Hydrographic Office were sufficient for the purposes of navigation, and although we had thick rainy weather much of the time, we found no difficulty in locating the ship, except when making the first narrows, and there we could have found anchorage if desired.

Port Churruca to Port Otway, Chili, by the inland passage.—We left Fort Churruca at 1.30 p. m. February 3, and, on reaching the channel, found it blowing a moderate gale from WNW. with a heavy sea. Passing Tamar Island at 3, we kept off for Smyth's Channel, set double reefed fore topsail and fore staysail, and made the passage in good time, considering we were using but one boiler.

We passed Pearse Rock at 6 and Alert Rock a few minutes later, both showing above water, and easily seen in moderately clear weather. Reaching Otter Bay at 7.10, we anchored for the night in 9 fathoms, mud, and veered to 30 fathoms. It is an excellent harbor for small craft, but is rather cramped for vessels over 250 feet in length. An-

chorage on the ridge to the southward of the islands would be preferable for large vessels. The plan and sailing directions for Otter Bay leave little to be desired, but should the weather be thick, making it difficult to distinguish the entrance, it might be mentioned that the crosses and sign-boards on Bedwell Island will settle all doubt.

We were visited by canoe Indians, who camped on Cunningham Island for the night, and next morning entered into a spirited trade with the naturalists, who, for a few trinkets obtained about all the movable property they possessed, except their canoes, which they declined to part with at any price.

Leaving our comfortable harbor at 10 a. m., February 4, we steamed through Gray Channel against a strong northerly wind, the frequent heavy squalls coming down with the force of a gale. Welcome Bay was passed at noon. Bessel Rock and Cloyne Reef showed above water and were seen at a distance of at least 3 miles. Clearing Victory Pass, the Cordilleras of Sarmiento, with their glacial ice caps, burst upon our view as the clouds lifted for a moment. The trawl was cast off Redfern Point, Newton Island, in 348 fathoms, blue mud, and a successful haul made, notwithstanding it having caught on a rough coral patch, which tore the net badly.

The strong winds of the morning moderated towards noon, but, after clearing Farquhar Pass and entering Sarmiento Channel, they came down with renewed force, retarding our speed until it became doubtful whether we would be able to reach our anchorage before dark.

Numerous errors in the charts became noticeable from S. Bartolome Point. The group of islands between Lecky Retreat and Hamilton Point are not shown, and those to the northward of Piazzi Island are not properly located. Prominent points would not cut in, and the topography was entirely omitted on the charts, matters of little importance in that particular locality if it is clear, but it would be rather confusing for a stranger, in thick weather, to find himself near a group of islands when his chart shows a clear, bold coast.

We reached Mayne Harbor at dusk and anchored in the outer bay, which is quite secure, although more exposed than the landlocked inner harbor. We passed the Italian man-of-war *Christofo Columbo* about noon, steaming to the southward, homeward bound.

The wind was from NW., light to moderate on the 5th, with frequent squalls of wind and rain sweeping across the harbor from various directions, causing the ship to swing around her anchor in a most lively manner, but the bottom being a soft mud, no harm resulted.

The collectors were out all day in spite of the rain; in fact, we had become so accustomed to it that we seldom allowed it to interfere with our work. Something of an excitement was caused by the absence of two of the collectors, who failed to return at sunset, it being a general rule that they should all be on board at that time. Darkness came on and still they were absent. The wind increased as the sun sank below

the horizon, and the rain poured down in torrents. A strong search party left the ship and soon found the missing men, who had carelessly strolled so far away that they were unable to return before dark, and were wet to the skin, cold and hungry. The naturalists made valuable additions to their collections, both from land and water.

We left Mayne Harbor at 4 a. m. on the 6th, the weather still squally, with snow and sleet. Two successful hauls of the trawl were made in Sarmiento Channel, and at 10.40 we anchored in Latitude Cove, in 24 fathoms, mud, where we remained until the following morning in order to give the naturalists an opportunity to examine the locality. The plan and sailing directions for Latitude Cove are all that could be desired for making that snug and convenient anchorage.

The morning of the 7th was thick and rainy, with squalls of snow and sleet. We were under way at 4.35, and after leaving the cove, steamed to the position of a kelp-covered rock reported in midchannel between Cape Charles and Europe Point, but saw no indication of shoal water. We did, however, see a patch of kelp extending off Blanca Point, the northern extremity of Latitude Cove, outside of a line drawn from Cape Alexander to El Manchon.

We were obliged to depend mostly on compass courses, until, between 9 and 10, the fog lifted, and although it remained overcast and squally, we had no difficulty in recognizing landmarks. Passing Cape Somerset at noon, we were near Grappler Reach at 5 p. m., when, off Chill Point, in Eyre Sound, a small iceberg was discovered a mile or more from the nearest land. Our ice-house was empty, and with a tropical voyage before us, we looked upon this opportunity of filling it as providential. Steaming alongside, we got a line fast, and a few minutes sufficed to give us about 7 tons, all we could stow, of excellent ice, which lasted until our arrival in Panama.

We anchored in Port Grappler at 7.52 p. m. in 9 fathoms, mud, an excellent harbor, and easy of approach. The chart of Grappler Reach is simply a reconnaissance, but the channel is clear, and one can not go amiss having once entered it. It was still rainy and squally when we anchored, but the wind came out from the southward during the night, bringing clear weather.

We left Port Grappler at 4.30 on the morning of the 8th, and steaming to the northward, passed through Indian Reach and English Narrows without difficulty. The short turn around Mid Channel Island and Caution Shoal is the only really difficult navigation in the western Patagonian channels, and it would be imprudent to attempt this with a heavy vessel, except at slack water or with a head tide. The wreck of a German steamer was seen on a reef off the south end of Newton Island, near Eden Harbor. We saw nothing of the kelp-patch reported by H. B. M. S. *Zealous* off Greville Point, the southern entrance to Eden Harbor, but it might have been towed under by the tide. Quite a large number of fur-seals were hauled out on the small islets of the

Coradonga Group, but they took to the water as soon as the *Albatross* hove in sight, experience having taught them to give passing vessels a wide berth.

A successful haul of the trawl was made in 196 fathoms, blue mud, 1½ miles to the southward of Direction Islands, and another in 449 fathoms, in Messier Channel, 2½ miles N. E. ¼ E., magnetic, from Sidney Point, Black Island.

We swung ship under steam from 3.50 to 4.30 p. m., then ran into Island Harbor, and anchored for the night in 20 fathoms, mud. It is a good harbor for vessels of the size of the *Albatross*, but it can hardly be recommended for heavier vessels, on account of its limited space and the difficulty of turning. Anchorage may be found outside of the harbor in ordinary weather. The naturalists had several hours on shore and made some additions to their collections, but found the fauna and flora closely resembling that which we had seen farther south.

We were under way at 4.20 the following morning, and steaming through Messier Channel crossed Tarn Bay and the Gulf of Peñas to Tres Montes Gulf, made two hauls of the trawl in Holloway Sound in 57 and 61 fathoms, then steamed to Port Otway and anchored in 7 fathoms, sand and mud. The weather was beautifully clear, giving us a magnificent view of the snow-capped Andes during our run across the Gulf of Peñas. We were surrounded by snow-covered heights in the Straits of Magellan and the western Patagonian channels, yet our view was so restricted by thick weather and intervening mountains that we saw comparatively little of them. On this occasion, however, there was spread before us a vast extent of the Andes, whose gigantic peaks were seen towering one above the other far into the region of eternal snow and ice.

Port Otway was found to be an excellent harbor, with particularly good facilities for procuring wood and water, while in the inner basin a vessel would be entirely protected from the ocean swell and find a secure haven in case extensive repairs were required.

The naturalists, with many volunteers, were soon scattered in every direction, and returned at sunset laden with many new and valuable specimens. They were very enthusiastic over the region, declaring it to be rich in life, both animal and vegetable, specimens being found peculiar to the temperate and frigid zones. Familiar forms in the Straits and western Patagonia grow more luxuriantly, and others unknown to that inhospitable region were found in abundance. Forest trees were larger, straighter, and of greater variety, and while the surface was generally covered with mosses, it was not in a state of complete saturation, as we found it farther south. The weather was milder, the sun shining all day without rain or fog; in fact, everything gave evidence of our approach to a temperate climate.

We remained at anchor during the 10th, to enable the naturalists to make further investigations in a region of such unusual interest to them.

The weather continued clear and pleasant in the harbor, although it was foggy outside for several hours. I made the circuit of the bay during the afternoon, and found the shores heavily timbered, beeches predominating and growing to the water's edge, often overhanging. Fresh water streams were frequent and distinguishable by small sand beaches off their mouths. The rock formations differed from those of the Straits and western Patagonia, and in place of the universal granite, conglomerates were conspicuous, and trap was of frequent occurrence, with an occasional thin vein of quartz.

Fur seals, blue heron, humming-birds, wood-peckers, and parrots were seen, and among the specimens brought in by the collectors were wild geese, penguins, cormorants, hawks, etc. Fish were plentiful, several species being taken with the seine and hand-lines. Two large squid were caught, one of them 5 feet 2 inches, and the other 5 feet 7 inches in length, both of the same species, which was new to us.

Port Otway to Lota and Tomé, Chili.—We left Port Otway at 4.20 a. m., February 11, and rounding Cape Tres Montes proceeded on our course to the northward under steam and sail. A successful haul of the trawl was made at 4 p. m. in 1,050 fathoms, and while the ship was under low speed three fine albatrosses were taken with hook and line. They measured from tip to tip of wings, 10 feet 7 inches; 10 feet 3 inches; and the smallest 10 feet.

A haul of the trawl was made between 2.40 and 6. p. m., February 12, in 1,342 fathoms, green mud, and although the net was badly torn, quite a number of valuable specimens were brought up. The substance encountered on the bottom was mud and clay, cemented by carbonate of lime into masses from one-fourth of an inch to 3 inches in thickness, underlying a thin coating of mud. The mass was perforated with holes made by burrowing animals, and could be broken and crumbled in the hand, yet it had a slight ring under the hammer. It closely resembled the formation encountered by us off the capes of the Delaware and seems identical with the "tosca" of the east coast of South America. The trawl was cast at 3 o'clock p. m. on the 13th, in 1,287 fathoms, green mud, but failed to reach the bottom, a few red shrimp only being found in the net.

Land was seen to the southward of Lota Bay at daylight on the 14th, but was soon obscured by a dense fog. At 9.40 a. m. the trawl was cast off the entrance to the bay in 677 fathoms, yellow mud, and landed on deck at 12.47 p. m., after long and tedious efforts to get it off the bottom with its enormous load of mud, then to wash out sufficient to enable us to hoist the remainder on board. It turned out one of the richest hauls of the cruise, which compensated somewhat for the long delay. We steamed into the bay as soon as the trawl was landed, taking the passage south of Sta. Maria Island, and anchored in the harbor of Lota at 4.55 p. m., in 7 fathoms, about one-third of a mile south of the iron pier. The captain of the port visited the ship and granted

us pratique. He informed us that cholera was prevalent in many places in Chili, but Lota was considered healthy. Such precautions were adopted as the surgeon considered necessary, and we had the satisfaction of leaving the country without a case of sickness of any kind.

From a distance the several anchorages in the bay looked much alike, but on nearer approach Lota was recognized by the light-house near the extreme point of the elevated peninsula which forms the northern boundary of the bay. It is a conspicuous object, standing in the Cousiño Park, its white cylindrical tower contrasting strongly with the two huge chimneys of the smelting works and the dark background of hills in rear of the town. The peninsula itself, on which stands the splendid mansion of the Cousiños, surrounded by its beautiful park-like grounds and heavily wooded avenues, is an unmistakable landmark. There are several piers, and it might puzzle a stranger to recognize the one referred to in the sailing directions. It is the first on entering the bay, is of iron, and belongs to the coal mines. Others will be seen near the smelting works, and a little farther on a breakwater is in process of construction, its dark sides contrasting with the white sand beach in front of the town.

I returned the call of the captain of the port on the following day. We coaled ship on the 17th and 18th, taking on board 171 tons. There was a thick fog during the morning of the 19th, but it cleared about 11 a. m., and at meridian we left the harbor and steamed to Tomé, where we anchored at 5.50 p. m. The naturalists made some collections in Lota, and used the seine about the beaches of Tomé; otherwise there was but little communication with the shore.

Tomé, Chili, to Panama.—We were under way at 2 p. m., February 20, and when clear of the land made sail to a fresh southerly breeze, which, with the consumption of 10 tons of Lota coal, gave us a speed of 200 miles or more per day.

We first saw flying-fish in the Pacific in 33° S. latitude. Albatrosses were still following us and an occasional petrel was seen. A sparrow hawk hovered about the ship for several hours, lighting on spars and rigging. A school of sperm whales was seen moving leisurely about, and patches of floating kelp were passed at frequent intervals through the day. We carried southerly winds until February 22, latitude 30° S., when it fell calm and we began to look for the SE. trades. The surface temperature rose from 59° in Lota to 75° at meridian, indicating that we were to the westward of the Humboldt current.

The surface net was put over on the evening of the 24th, in about 23° S., with fair success. Porpoises played about the vessel for a few minutes, but kept out of the reach of harpoons. Albatrosses and gulls had left us, and two or three species of petrels were the only birds seen during the day. Nothing of interest occurred until the following morning, when half a dozen or more fish were discovered following the vessel. They were about 18 inches in length, their bodies round and slim,

their general form being somewhat like that of a gar. Attempts were made to capture one, but they disappeared without noticing the tempting baits thrown to them.

We took the SE. trades on the 26th, in latitude 17° S. Life became more abundant in sea and air as we approached the equator. Flying-fish were swarming about us night and day, followed by porpoises, dolphins, man-of-war hawks, and other enemies. Petrels of three or four species were common, and boobies lit on spars or rigging occasionally for a quiet nap. Huge turtles were frequently seen asleep on the surface or scurrying away from the ship. Our first view of the tropic bird in the Pacific was in 17° S.

We lost the trades March 1, in latitude 4° S. They were light all through, and we were disappointed in not receiving more assistance from them. The surface net was towed for fifteen minutes at daybreak on the morning of the 1st, with satisfactory results, several new forms being taken, besides many with which we were familiar. A successful haul of the trawl was made at 3 p. m., March 2, in 401 fathoms, green mud, off the coast of Ecuador. The haul was completed at 5.02, at which time we started ahead full speed. Three minutes later A. E. Anderson, coxswain, fell overboard from the rail forward of the fore rigging while working about the trawl net. A life-buoy was thrown to him as he passed the stern, the engines were stopped and reversed, the life-boat lowered nearly to the water and manned, but not detached. When the vessel gathered stern board she was steered by helm and engines to the man, who was then taken in the life-boat as she hung from the davits, and hoisted to the rail, the vessel starting on her course again after a delay of five minutes.

After our departure from Lota we traversed upward of 2,000 miles without using trawl or dredge, or even taking a sounding. As this is quite foreign to our usual custom, it may not be out of place here to explain. Cholera raged in Chili and all South American countries quarantined against her ports. There was no coal at Sandy Point, consequently we were obliged to call at Lota for a supply, thereby incurring the penalty of exclusion from all coaling stations thence to Panama, a distance of about 3,000 miles. While we would not hesitate to add even another thousand miles to the steaming capacity of the vessel with a good quality of fuel, we did not feel at all confident of our ability to make the run with Lota coal, of which we knew nothing personally and about which we had seen bad reports. So we made the best of our way toward Panama until March 2, when we found the supply of fuel would permit us to resume our usual explorations en route.

The island of Plata and the highlands of Ecuador were seen shortly after daylight, and on the morning of the 3rd Cape San Francisco was in sight, 15 or 20 miles distant. At 6.08 a. m. a successful haul of the trawl was made in 741 fathoms. Tide rips were frequently encountered

as we approached the land, and birds, both land and sea, increased in numbers. Blackfish and porpoises were seen frequently, besides myriads of flying-fish. Squally weather incident to the region of doldrums was experienced after losing the SE. trades until those from NE. were picked up in 4° N.

Four hauls of the trawl were made on the 5th near the Pearl Islands in 62, 33, 33, and 18 fathoms, besides one with the oyster dredge. The results of the day's operations were very satisfactory to the naturalists, the grounds proving very rich in life, and many of the forms new to science. We anchored for the night at 7.30 p. m. between Galera and St. Elmo Islands, in 21 fathoms. Getting under way at 5.45 on the morning of March 6 we steamed to the eastward of the Pearl Islands, and at 11.15 cast the trawl in 30 fathoms, green mud, landing it on deck at 11.45, with a heavy load of mud, composed largely of decayed organic matter so offensive in odor that it was considered prudent to move on.

We anchored off Perico Island at 3.10 p. m. and received a visit from the commanding officer of the Colombian revenue-cutter *Boyaca*, who informed us that by virtue of a decree of the National Congress dated November 3, 1887, all vessels from Chilian ports were forbidden entrance to the harbors of the United States of Colombia, and that we must go immediately to the anchorage near Taboguillo Island. Having handed him cablegrams, letters, etc., which he promised to forward or deliver, we got under way and proceeded to the island, as directed, anchoring in 10 fathoms, about half a mile from shore.

We were left to ourselves until noon of the 8th, when Dr. Halstead, the quarantine officer, came alongside and made the usual inquiries, taking our bill of health, and a statement from the surgeon that we had been at sea seventeen days, during which time there had been no sickness on board. Our case was not one of quarantine, simply, but of absolute exclusion according to law, the governor being the only officer on the Isthmus with authority to modify it. I had already informed the United States consul-general, Capt. J. M. Dow, and Mr. Henry Schuber, of our arrival, and requested their good offices in procuring us pratique with as little delay as possible. The doctor brought us a large mail which had accumulated at Panama, also such mess stores as were ordered by the caterers. Promising to exert himself in our behalf, he left until the following day, when he informed us that the last official act of the retiring governor-general, Alejandro Posada, was to sign an order admitting the *Albatross* to pratique, on March 13, providing cholera did not break out on board in the mean time, and further, that we would not give the crew liberty to go on shore in Panama.

Nothing of moment occurred until the evening of the 13th, when the health officer visited the ship, and, having satisfied himself that no cases of cholera had occurred, gave us pratique. It was too late to move that evening, but we were under way early the following morning, and steamed to the Pacific Mail station off Naos Island, where Captain

Shackford, the company's superintendent, piloted us to a convenient berth. I went to Panama soon after we anchored, and called on the United States consul-general, Mr. Adamson; Captain Dow, general agent of the Pacific Mail Steam-ship Company; Mr. Henry Schuber, and others, and at 10 a. m. on the 17th, in company with Mr. Adamson, I called on the governor of Panama. The consul visited the ship on the 20th.

We hauled the *Albatross* out on the beach at the Pacific Mail Steam-ship Company's station on the morning of the 21st, and scraped and painted her bottom, returning to our berth the following morning. The U. S. S. *Omaha*, Capt. F. V. McNair, arrived from Yokohama on the 23d, and anchored in the outer roads. I paid my respects to the captain during the evening, the call being returned on the 26th.

We were subjected to vexatious delays in getting coal, owing to a scarcity of lighters; the first one came alongside on the 26th, and we finished on the 28th, having taken on board 205 $\frac{1000}{2240}$ tons, for which we paid the Panama Railroad Company $17 per ton. The weather was dry during our stay in Panama, with the exception of a few light mist squalls. Northerly winds prevailed, although calms and light variable airs were of frequent occurrence. The temperature ranged from 75° to 88° Fahr. It was the last of the dry season, and heavy cumulus clouds could be seen gathering in the mountains daily, but the parched surface of that elevated region robbed them of their moisture before they reached the Pacific.

We were under many obligations to the officers of the Pacific Mail Steam-ship Company, the Panama Railroad Company, and Mr. Henry Schuber for their efforts to forward our work and to make our stay as pleasant as possible.

Panama to the Galapagos Islands.—We got under way at 10 a. m., on March 30, and half an hour later commenced a series of dredgings to seaward, making five hauls in from 7 to 51 fathoms, over an exceedingly rich bottom, from which we obtained great numbers of specimens. An unexpected depth of 1,927 fathoms was found the following morning in 6° 44′ N., 80° 27′ W. Porpoises, turtles, flying fish, and birds were constantly in sight, particularly about the numerous tide-rips through which we passed. For half an hour, between 2.30 and 3 p. m., we steamed through a blood-red sea, the margin of discoloration being well defined and extending in irregular lines as far as the eye could reach. This remarkable phenomenon had its origin in a dense mass of minute forms of algæ, *Trichodesmium*, in a larval state, floating from 1 to 3 feet below the surface. This conferva is usually mistaken for animal life by seamen, and, when seen under a microscope, where the minute particles will be observed darting about with great rapidity, it is a difficult matter for the uninitiated to realize that they are of vegetable origin. The surface-net was towed for fifteen minutes in the evening,

when our efforts were rewarded by a large number of specimens, among which were many rare or unknown forms.

A sounding at 4 a. m., April 1, gave 1,727 fathoms, green ooze, in 5° 16′ N., and 83° 09′ W. Blackfish and porpoises were seen frequently, and one of the latter was taken with a harpoon. While steaming quietly along in a perfectly smooth sea a momentary excitement was caused by the port propeller striking a log about 7 feet in length and 12 inches in diameter, the shock being felt fore and aft, but no harm was done. Another sounding was taken at 11.28 p. m. in 1,882 fathoms, latitude 4° 18′ N., latitude 85° 14′ W. A westerly current of over a knot an hour was felt while making the sounding.

Findlay's North Pacific Directory contains the following, on page 694:

RIVADENEYRA SHOAL.

Being on board the steamer *Peru* abreast of Puña, October 22, 1842, and hearing that there was a terrible yellow fever raging in Guayaquil, the steamer put back, and I (Mr. Rivadeneyra) was placed on board a small schooner going to Realejo. On the 28th, in the middle of the day, the sea calm, we had caught a large turtle, when I observed at a few fathoms off a slight swell on the sea. We took the boat and went to it, when we sounded and, to our astonishment, found only 16½ feet (French) of water. In the center of this spot was only 10 feet depth; we then found 14, 16, 27, 56 feet, and then no bottom.

By our very imperfect instruments we made it to be in latitude 4° 15′ N., longitude 85° 10′ W. of Greenwich, but this we considered very nearly correct as we hastened on to Realejo.

The existence of this bank has been in some degree confirmed by the inquiries of Captain Lapelin, in the French corvette *La Brilliante*, in 1852. He ascertained that several vessels had struck on it, but did not give any information as to the correctness of the position assigned. Captain Harvey, of H. B. M. S. *Havannah*, passed within 4 miles of the place, in July, 1857, without seeing anything of it.

If this shoal exists it is a serious menace to the mariner, particularly as its position is so doubtful. We can hardly ignore the evidence of its discoverer, as he took a series of soundings, yet it has been searched for by men-of-war of most of the great maritime nations, without discovering the slightest indication of shoal water. It must be observed, however, that they were not provided with deep-sea sounding apparatus, and could only note surface indications.

We sounded in 1,657 fathoms, brown ooze, at 1.55 a. m., April 2, latitude 4° 14′ N., longitude 85° 11′ W., near the position assigned to Rivadeneyra Shoal, 10 (10 feet), Hydrographic Office Chart No. 1007; and at 4 a. m., in 1,727 fathoms, gray ooze, latitude 4° 02′ N., longitude 85° 25′ 30″ W. Another cast at 4 p. m., in latitude 2° 53′ N., longitude 86° 24′ W., gave us a depth of 1,616 fathoms, gray ooze, largely globigerina. Turtles and surface fish were seen in diminished numbers, and another drift-log of considerable size was observed floating very low, nearly waterlogged.

The line was extended in the direction of Chatham Island on the 3d by two soundings, the first at 9 a. m., in 1,341 fathoms, globigerina

ooze, latitude 1° 13′ N., longitude 88° 02′ W., followed by a cast at 4.45 p. m., in 1,379 fathoms, ooze, latitude 0° 30′ N., longitude 88° 37′ 30″ W. A cast of the trawl resulted in a water haul, notwithstanding an unusual allowance of rope.

The line of the hydrographic soundings from Cape Mala to the Galapagos via the reported position of Rivadeneyra Shoal ended with the last cast, and demonstrated the non-existence of the danger in the position assigned it, or in the line of our soundings. The matter should not be considered as finally settled, however, for it may lie north or south of our route, and it is only by a line of soundings at right angles to those of the Albatross that it can be satisfactorily determined.

Chatham Island was sighted from the mast-head at daylight on the 4th of April, and at 5.31 a. m. we cast the trawl in 812 fathoms, globigerina ooze, latitude 0° 24′ S., longitude 89° 06′ W., and again at 9.07 in 636 fathoms, gray sand, latitude 0° 36′ 30″ S., longitude 89° 19′ W. A third haul was made at 2.20 p. m., in 45 fathoms, gray sand, latitude 0° 50′ S., longitude 89° 36′ W. They were all successful, although the net was badly torn, the second and third casts having come in contact with rocks or coral heads.

The Galapagos Islands.—Steaming along the west, or lee side of Chatham Island, we passed Kicker Rock, its vertical walls, 100 feet or more in height, giving it the appearance of a sail; in fact it was reported by the lookout as a square-rigged vessel. Dalrymple Rock is smaller, from 50 to 60 feet in height, and at a distance resembles a boat with lug sail. It lies about 2 miles from Lido Point, and is an unmistakable landmark.

At 3.20 p. m. we anchored in Wreck Bay, a safe and convenient harbor, near the southwest end of Chatham Island. This is the sea-port of the Hacienda del Progres, a plantation located on the highlands in the interior of the island, about 5 miles distant, and connected with the coast by a good wagon road. The bay is surrounded by low land covered with bushes and small trees, and a smooth steep sand beach affords convenient landing. The projecting points are composed of lava rock. There is a light-house near the beach, and a short distance south of it a store-house, which is also used as a keeper's dwelling, the landing-place being directly in front of it.

The land begins to rise a few hundred yards from the beach, and the ascent is constant until the hacienda is reached, at an elevation of about 900 feet above the level of the sea. The low lands of Chatham, in common with those of all the islands of the archipelago, is entirely without living water, and in the dry season presents a most barren and desolate appearance. All this is changed, however, during the rainy season, which usually begins about the 1st of April, and continues until the last of June. It began in February this year, and in consequence everything was fresh and green, the general aspect being decidedly tropical.

To enter Wreck Bay stand for Dalrymple Rock, and when up with it steer SSE. ¾ E. for the light-house. This consists of a spar 25 or 30 feet in height surrounded by an iron cage, which contains the lantern. Make due allowance for the current, and anchor in from 5½ to 6 fathoms, when Malamocco Point will bear about SW. ¾ W. and the light-house SE. by S., magnetic.

We were visited about an hour after our arrival by Manuel A. Cobos, the son of Señor Manuel J. Cobos, one of the proprietors of the island. In his father's name, and in very good English, he tendered his services during our stay, and offered to send horses down. to the beach for as many of us as wished to visit the hacienda. Proper acknowledgments were made, and the following morning Professor Lee, Mr. Townsend, Mr. McCormick, and I availed ourselves of his invitation, and went up to the settlement. Señor Cobos met us at the door of his residence, expressed great pleasure at our arrival, and entertained us in a most hospitable manner.

The settlement consisted of the residence of the proprietor, with the necessary store-houses, cane-mills, etc., and numerous simple native houses, sufficient for the accommodation of the inhabitants, who numbered about two hundred.

Fresh horses were brought to the door, and in company with Señor Cobos and son we rode over a portion of the estate, where we saw great fields of sugar-cane, sweet-potatoes, and other tropical and semi-tropical products growing side by side. A young coffee plantation gave promise of future profit, and oranges, lemons, and limes were growing in profusion. Large herds of cattle were seen feeding in excellent pastures, inclosed with iron fences, hedges, or the favorite broad, deep ditch, the proprietor estimating the number of cattle on the island at 20,000. Horses, mules, asses, sheep, and hogs were seen in large numbers, more than sufficient for all purposes of the plantation. Water was procured from a large spring and carried to the settlement by ditches which could be seen winding around the hills.

Guayaquil is their only market, and, as most of the products compete directly with those of Ecuador, it does not always prove a profitable one, only the higher priced articles bearing the cost of transportation. Rum, hides, orchilla, fish, and a little fruit are the principal exports.

Chatham Island, and in fact all the islands of the archipelago are of recent volcanic origin, the only arable land being in the elevated basins of the craters. Here, on the principal cone near the center of the island, we found the Hacienda del Progres.

Before our return to the ship, Señor Cobos proposed to send his son and a couple of his best native guides with us through the islands, as their local knowledge would save us much time and be the means of adding to our collections. His proposition was thankfully accepted, and they made the cruise through the archipelago with us, rendering valuable service both afloat and on shore.

Leaving Wreck Bay on the morning of the 7th, we steamed to Hood Island, anchoring at 10 a. m. in Gardner's Bay. The naturalists, with large parties of volunteers, spent the day on shore, and added many specimens to our collection. Birds, lizards, and hair seals were found on the island, while several species of fish were taken by parties on board. The anchorage was infested with small sharks, which were taken by the dozens until the fishermen tired of the sport.

Hood Island is low compared with others of the group, its surface being covered with masses of broken lava rock. A little soil has formed between the blocks, in which bushes of various kinds find root, and, during the season of rains, lend a rich green hue to the otherwise barren surface. It is wholly devoid of fresh water during the dry season, and has no commercial value. Gardner's Bay is a good anchorage in the fine weather that usually prevails, but is open to northerly and westerly winds.

At 5.08 p. m. we got under way and made two hauls with the dredge over a rough bottom, then one with the tangles, and finally the small beam-trawl was lowered, but came up a wreck. The submarine electric light was used for surface collecting during the evening. A sounding was made in 286 fathoms, fine gray sand, latitude 1° 23′ S., longitude 89° 58′ W.; another in 191 fathoms, latitude 1° 25′ S., longitude 90° 07′ W., and at 7.47 on the morning of the 8th we anchored in Black Beach Road in 11 fathoms, sand.

This anchorage is an open bay, but, being on the west (or lee) side of Charles Island, affords good shelter from the trades, which blow most of the year. It is the sea-port of what was at one time a flourishing settlement, now abandoned, and derives its name from a short stretch of black sand beach lying at the head of the bay, between low cliffs of dark lava rock. To make the anchorage, bring the sand beach to bear east (magnetic), having the highest peak visible on the island a little on the starboard bow, and stand in carefully, anchoring in from 10 to 11 fathoms. The bottom is very rocky outside of that depth, and has the reputation of being foul inside.

The settlement mentioned was a penal colony of Ecuador, established about 1830, and was in a flourishing condition until 1879, or near that time, when the convicts mutinied, murdered those in authority, and seizing the vessels in the harbor put to sea, landing, it is supposed, on the coast of their native country. Buildings, stock, etc., were left unmolested, and at the time of our visit great numbers of cattle, horses, mules, donkeys, sheep, and hogs were running wild. The buildings were falling to ruin, but there was a plentiful supply of fruit on the trees, from which we procured many bushels of oranges and limes, a pleasant addition to our monotonous fare. The distance from the landing to the first improvements was about 3 miles, over what had been a good wagon-road.

The naturalists, with numerous volunteers, were soon on shore, and,

following the native guides, spread over the accessible portions of the island, making collections. One party took the road to the interior, and arriving at the first watering-place, met, much to their astonishment, an almost naked man, a Robinson Crusoe in appearance. He was recognized by the guide as Pedro Guaza, one of a party of orchilla-pickers from Chatham Island that had been there over a year ago, and who, when about to return, could not be found. He claimed that he had lost his way, and had searched in vain for the station until long after the party left, but after questioning him I had no doubt of his intention to remain behind. He was doubtless fascinated by the sight of flocks and herds roaming over the island, waiting only for man to reclaim them, and desired to be the possessor of all this wealth. He had lost the run of time, and one of his first questions was, "What month is it?"

His methods of getting animal food were simple and effective. He constructed a blind near where the animals were obliged to pass to the watering place, and with his large knife lashed to a pole he speared the hogs and sheep; a lasso properly disposed was equally effective for the capture of bullocks. A donkey or two taken in the same manner served for transporting fuel, he having obtained fire by the well-known process of rubbing together two sticks. It was evident that he had enjoyed his solitary honors long enough, and was glad to find himself again among men, even to return to bondage on Chatham Island.

The naturalists made large collections on Charles Island, being able to reach the high lands in the interior by the old wagon-road. Several flamingoes were shot in a lagoon about 2 miles from Post-Office Bay.

Leaving Charles Island on the evening of the 9th, we made three hauls of the dredge and tangles near the anchorage, then steamed for Albemarle Island, anchoring in Iguana Cove at 9.10 the following morning. We intended spending the day in exploring the southern portions of the island, but the surf was rolling in so heavily that landing was impracticable. We were disappointed, for great things had been expected of this locality. Getting under way we steamed to the northward for Tagus Cove, on Albemarle, opposite Narborough Island, where we were more sure of a good harbor and convenient landings.

Albemarle Island is by far the largest of the Archipelago, but is uninhabited, and has no present commercial value except for its orchilla, which grows on bushes and trees and has slight resemblance to Florida moss. It is used for making purple dye, and commands a high price in the European markets. The highest point on the island is within 3 or 4 miles of the southern extremity, and reaches an elevation of 4,700 feet. A rich green foliage covered the rugged surface of huge lava bowlders to the very summit. Further to the northward and all along the west coast as far as Tagus Cove the land was comparatively low and presented a striking resemblance to a burnt district, dotted with numerous small volcanic cones. The general aspect was a reddish brown, but it

was varied by occasional pyramids, symmetrical in form, and of lighter color, resembling artificial mounds of sand and mud which had had barely time to dry. The line of demarkation between the rich carpet of foliage and utter desolation of the barren district was so regular and well-defined that it was difficult to realize that it was nature's handiwork.

Narborough Island presented in the distance an unbroken covering of rich green foliage to the very summit of its central peak, 3,720 feet above the sea, and, on nearer approach, a fringe of luxuriant mangroves bordering the eastern shore, and the margin of a small bay, or lagoon, added fresh charm to the view. As we steamed through the narrows between Narborough and Albemarle Islands the contrast of a rich and abundant vegetation on the one hand, and utter barrenness and desolation on the other, was very striking. We anchored in Tagus Cove at 4.45 p. m. and found it a perfect harbor, with swinging room for the largest vessel, although the high land surrounding the bay dwarfed it at first view.

The naturalists and volunteers scattered over the land and along the shores as soon as the anchor was down, and returned at dark, well satisfied with the results of collecting. The watering place marked on the chart was perfectly dry, and we learned from Mr. Cobos that it was only during the latter part of the rainy season that water could be found. There were patches of green near the northern end of Albemarle Island, but the general aspect was barren and desolate. As the sun went down we were beset by myriads of mosquitoes, bent upon making the most of a rare opportunity. Their attack was so vigorous that at 9.25 p. m. we got under way and steamed out to sea, en route for James Bay.

The weather was partly overcast when we left our anchorage, but we thought little of it, supposing it to be one of the short passing squalls so frequent during the rainy season. When we reached the vicinity of Cape Berkeley, however, the rain poured down in torrents for several hours, and it became so thick that we were obliged to stop the engines until the weight of it passed, when we continued our course, anchoring in James Bay at 1.30 p. m. in 6 fathoms, white sand.

The naturalists with their corps of volunteers were off as usual as soon as the anchor was down, returning at sunset with many additions to their collections. Several flamingoes were shot in a small lagoon back of the beach, and a variety of fish were taken with hand lines from the ship. Among them were many bacallão (cod-fish), so called by the inhabitants of Chatham Island, who take them in large numbers for their own consumption as well as for the Guayaquil market, where they bring a good price. It is a species of grouper from 6 to 30 pounds in weight, and takes the hook readily. We found it an excellent fish when fresh, and it is said to resemble cod-fish in texture and flavor when cured in the same manner.

James Bay is on the west end of James Island, which protects it from

the prevailing winds, the swell being partially broken by projecting points and small islands. It is a good anchorage with easterly winds, and may be recognized by the following landmarks. Albany Island is conspicuous, being lighter in color than its surroundings, and abreast of it are bold lava cliffs which extend to a short stretch of white sand beach at the bottom of the bay. The southern extremity is marked by a point having a double peak from which extends a barren lava-covered belt, resembling that described on Albemarle Island. Small salt lagoons lie just back of the sand beach. To make the anchorage it is only necessary to stand in for the center of the white sand beach, anchoring in any depth desired. The watering place mentioned is on a point nearly abreast of Albany Island, and, during the latter part of the rainy season, furnishes a good supply, but at other times the flow is either very small, or fails altogether. The supply is so limited and uncertain that the orchilla pickers who visit the island periodically do not depend upon it. The general aspect north and east of the bay was fresh and green, and a fringe of mangroves surrounding the lagoons gave that portion of the bay a particularly attractive appearance, while to the southward was a barren waste.

We left James Bay on the morning of the 12th, and, after a run of about six hours, anchored in Conway Bay in 6 fathoms, white sand and stones. Several parties of collectors left the ship, and volunteer fishermen soon had lines over the rail, where several species of fish were taken.

Indefatigable Island is circular in form and about 20 miles in diameter, with a central cone, in the basin of which lies a vast tract of arable, well watered land, capable of growing all the tropical and semi-tropical products in great perfection. Its natural resources are greater than any other island in the group, yet it is uninhabited and wholly undeveloped. The low lands are devoid of water, and, like the other islands, barren and desolate during the dry season, the rain only bringing life to the bushes and stunted trees, which find a precarious existence among the lava bowlders and scoria. To render the fertile lands of the central elevated region available it would be necessary to construct a road 6 or 8 miles in length to connect it with the sea.

Conway Bay lies on the west end of the island and is easily recognized by the Guy Fawkes Islands to the northward and Eden Island to the southward. It is protected from the prevailing winds, and, in that region of almost universally fine weather, it is a good anchorage.

We were under way at 5.30 on the morning of the 13th and at 6.55 anchored in 15 fathoms, sand and stones, in an open bay on the northeast side of Duncan Island. We were off a conspicuous gorge in the mountain side, and about 200 yards to the southward of a small islet which lay directly in front of it, and about 50 yards from the shore. Its surface was covered with bushes and other vegetation, which distinguishes it from rocks further to the southward. There was an excellent landing place for boats inside of the islet.

The general appearance of Duncan Island was green, bushes and

cactus being distributed over its surface. There is no living water on the island, yet it is a favorite resort for the celebrated galapagos, from which the group derives its name. A hunting party, consisting of our guides and several of the crew, were dispatched to the mountains for tortoises, while the naturalists gave their attention to birds, lizards, fishes, etc. Ten galapagos of moderate size were secured, the guides bringing two each down the rugged mountain side.

We left our anchorage at 4.40 p. m., cast the lead in 108 fathoms 4 miles S. ½ W. of Barrington Island, and in 139 and 329 fathoms between the latter and Chatham Island, where we arrived and anchored at 6.55 a. m. April 14. Young Mr. Cobos and the native guides left us during the morning, the latter having been compensated for their services, and acknowledgments made to the former for his advice and assistance. Supplies were received from the plantation during the day, and preparations made to leave the islands. Señor Cobos visited the ship during the afternoon, and in the evening we received from him eight tortoises, one very large one, a quantity of fruit, and a fine bullock. While on board he informed me of the existence of a rock not shown on the chart of Wreck Bay, lying about 3 cables SSE. magnetic from Lido Point, having 15 feet on it at low water. It undoubtedly exists in about that position, but I had no opportunity of verifying it.

At 7.50 a. m. April 15 we left the island, made three successful and very interesting hauls of the trawl during the day, and, at 7.20 the following morning, anchored in 20 fathoms off the south end of Abingdon Island, about midway between Capes Chalmers and Ibbetson. We had just swinging room, and, although entirely exposed, the swell was not heavy, and landing was effected with but little trouble. The collectors went on shore, returning at 10 a. m. thoroughly satisfied with their experience of the island, which they declared was the hottest place they had seen during the voyage. The collection of birds, lizards, etc., was increased by numbers of fine specimens. Among the fishes was a beautiful golden grouper, the only one taken, although they were seen in the water on several occasions.

Galapagos Islands to Acapulco and La Paz, Mexico.—We were under way again at 10.37 a. m., en route for Acapulco. The winds were light and variable with passing rain squalls and frequent lightning, and several water-spouts were seen during the afternoon.

At 5 p. m. we made Wenman Island, about 25 miles distant, and next to Culpepper, the most northern of the archipelago.

The 17th was calm most of the time, hot and sultry, with frequent lightning to the northward. At 8 p. m. we sounded in 1,976 fathoms, brown ooze, latitude 4° 44′ N., longitude 93° 02′ W. The trades were encountered on the 18th, in 6° N., light at first, but gradually increasing to a moderate breeze with clearing weather. The equatorial counter current was felt between latitudes 3° and 6° N., setting 13 miles N. 32° E., in twenty-four hours, it having been 30 miles N. 32° W. the previous day, and 46 miles S. 81° W. the day following. The first indication of

a weather set was a confused swell which could not be accounted for by the prevailing winds.

At 8.05 on the morning of the 19th, a sounding was made in 1,997 fathoms, green mud, latitude 8° 26′ N., longitude 95° 30′ W. We were surprised by the announcement from the laboratory that, after a careful microscopical examination, they failed to find more than a trace of foraminifera in the bottom specimens, and that it was without doubt of continental origin. Another sounding was made in 2,256 fathoms, green mud, at meridian on the 20th, in latitude 11° 45′ N., longitude 97° 03′ W. Tropic birds and boobies were seen every day, also flying fish and turtles, which constituted about all the life seen between the islands and the Mexican coast. The last sounding of the series was made at 1 p. m., on the 21st, in 1,862 fathoms, green mud, latitude 14° 33′ N., longitude 98° 14′ W., and at 11.25 on the morning of the 22d we anchored in the harbor of Acapulco.

The United States consul visited the ship during the afternoon, and on the following day Prof. L. A. Lee and I returned his call. Accompanied by him we paid official visits to the military commandant and captain of the port, and later in the day I called on the commander of the Mexican gun-boat *Democrata*. We commenced coaling on the 23d and finished at 7 p. m. the following day, having taken on board 122 tons. It was a good quality of Cardiff coal, delivered in lighters at the wharf for $14 per ton.

We got under way as soon as the coal was on board, and left the harbor at 7.30 p. m. for La Paz. The weather was clear and warm with light, variable winds and smooth sea. Nothing occurred worthy of mention until on the 26th at 1.40 p. m., we cast the trawl in 294 fathoms, blue mud, latitude 18° 43′ N., longitude 104° 04′ W. A large number of a scaleless *Macrurus*, unknown to us, were found in the net, but, to our surprise, nothing else. Another haul was made at 4 p. m. in 117 fathoms, blue mud, latitude 18° 52′ N., longitude 104° 10′ 30″ W., in which large numbers of small red shrimp were taken, besides five species of fish and an octopus. The bottom was composed largely of decomposed vegetable matter, which emitted an offensive odor.

Resuming our course after the haul was finished, we had a quiet and uneventful run to Pichilinque Harbor, Bay of La Paz, where we anchored at 1.20 p. m., April 29. A boat was sent to town to communicate with the United States consul and to get a mail which we were informed had been sent there. A market boat was sent in at daylight the following morning, and on its return at 9.30 we got under way and made two hauls of the trawl in the bay, two hauls of the tangles and dredge in San Lorenzo Channel, and finally three hauls of the oyster dredge off the west side of Ceralbo Island, abreast of Point Gorda. They were all successful, some of them being particularly rich.

La Paz, Mexico, to San Francisco, California.—We were off San José del Cabo at daylight on the morning of May 1, and half an hour later swung ship under steam for compass errors. At 8.18 the tangles were

lowered in 31 fathoms, rocky bottom, near the Frailes, Cape San Lucas, and a variety of interesting specimens were secured, although it was not so rich as we anticipated. A strong current to the southward and eastward was felt as we rounded the cape, but we lost it later in the day. At 6 p. m., a successful haul of the trawl was made in 66 fathoms, fine sand, latitude 23° 33′ N., longitude 110° 37′ W. We began to feel the coast winds from NW. during the day, light at first, but increasing to a moderate breeze with a decided fall in temperature.

Passing Cape Tosca at daylight on the 2d we entered Magdalena Bay, and at 7.35 anchored in 7 fathoms near the NW. extremity of Sta. Margarita Island, and one-fourth of a mile from shore. The naturalists with parties of volunteers landed as soon as we anchored and returned at meridian, having met with fair success. We got under way immediately after their return and made a haul of the trawl near the anchorage; then steamed out of the bay, passing Entrada Point at 1.18 p. m. A haul of the trawl, and another with the tangles was made between 3 and 4 p. m., and an hour later we passed Cape San Lazero and laid a course for Abreojos Point.

Pleasant weather continued, with increasing winds from the westward. High land was sighted at daylight on the 3d, and at 7.30 a. m. the trawl was cast in 48 fathoms, sand and mud, latitude 26° 14′ N., longitude 113° 13′ W. Large numbers of whales were seen during the forenoon while we were passing Ballenas Bay. Abreojos was made at 11 a. m., and at 12.30 p. m. we anchored in 5 fathoms under the lee of the point.

The surf was quite heavy, but we landed the collectors without much difficulty, and they returned at night fairly well satisfied with the day's collecting. Being anxious to obtain specimens of the coyote for the National Museum, Mr. Townsend placed several pieces of poisoned bait on the beach, and, on visiting the locality the following morning, found three fine specimens lying dead.

Getting under way at 7.30 a. m., we made a haul of the dredge in 5 fathoms, followed by the tangles in 6 fathoms, in the vain endeavor to procure living specimens of mollusca. Great windrows of their dead shells were thrown upon the beach, but were perhaps from deeper water. Standing out clear of the shoals we steamed up the coast, passing Asuncion Island at 4 p. m., San Roque Point at 5.30, and Morro Hermoso at 9.10 p. m. Whales were seen frequently during the day.

May 5 opened with moderate westerly winds and frequent mist squalls, which saturated everything about decks, and was so thick at times that we were unable to see the ship's length, but it cleared at daylight, and at 6.20 we anchored in a small bay to the northward of Morro Redondo, Cerros Island.

The collectors were landed, returning on board at 9 a. m., when we got under way and steamed along the east side of the island, finally anchoring at 10.30 about 9 miles from Morro Redondo, off quite an extensive valley, and in sight of the cedars on the heights, from which the island derives its name. The collectors were again landed, and re-

turned at 4 p. m. with birds, lizards, etc., and two wild goats. Three deer were seen, and the skeleton of a horse which had died, probably from lack of water. The following legend was found on a head-board over a grave near the beach: "To the memory of John Andrews, ship *Latonia*, 1819," with other information that was not deciphered.

Getting under way at 4.15 a haul of the dredge was made in 23 fathoms, mud, and standing off shore about 2 miles, the trawl was lowered in 44 fathoms, a few interesting specimens being taken. Arriving off the north end of the island at 6.30 p. m. the Benitos were in sight on the port hand, and Lagoon Head to starboard, a view possible only in very clear weather.

We passed San Martin Island at 2.25 p. m. on the 6th, Cape Colnett at 6.15, the Coronados on the morning of the 7th, and at 5 p. m. we anchored outside of the kelp in Smuggler's Cove, San Clemente Island. The surf was too heavy to land that night, but at daylight next morning a party got on shore from the boat, landing at the SE. extremity of the island, and returned at 8.30, when we steamed along inside of the island until 11.05, and anchored off a sheep corral near the NW. extremity. The collectors landed as usual and returned at 2.40 p. m., well satisfied with their few hours' work. The island is occupied as a sheep ranch, and although it is entirely without water during the dry season the large flocks seemed to be thriving.

We left the island at 2.40, and at 4 made a successful haul of the trawl in 414 fathoms, gray sand. Passed Santa Barbara Island at 9.50, the Santa Cruz channel between 3 and 4 a. m., on the 9th, and at 8.30 made a successful haul of the trawl in 276 fathoms, green mud.

We passed Point Conception at 12.30, and Point Arguello at 2.30 p. m., and at the close of the day were steaming up the coast against a brisk breeze and moderate head sea. Piedras Blancas was passed at 2.35 a. m. on the 10th, Point Sur at meridian, Point Pinos at 3.50 p. m., and at 10.22 p. m. made Pigeon Point Light. We were steaming against a strong head wind and heavy sea throughout the day.

May 11 commenced with misty weather about the horizon, obscuring the land at times. At 7 a. m. we entered the Golden Gate, and at 8.10 anchored off the foot of Washington street, San Francisco, Cal.

The officers and crew were in good health, and the ship was in fine condition considering the long voyage just completed. Some small repairs were needed on boilers, machinery, and boats, but had it been necessary we could have turned the vessel's head homeward and steamed to the Atlantic without a dollar's expense for repairs.

San Francisco.—We were visited by the quarantine officer and granted pratique without delay. The United States revenue officers visited us also, and were evidently at fault as to our status. They were shown through the laboratory and other parts of the ship, and finally left, still puzzled, but apparently satisfied regarding our honest intentions, as we heard nothing more from them. Mr. Jos. D. Redding, Mr. C. Josselyn, and Mr. J. K. Orr visited the ship soon after our arrival, and Governor

Waterman made a long call the following morning. Much interest was manifested in the vessel and her work, and we were the recipients of much kindly attention during our stay in San Francisco. Necessary repairs were promptly made by the Union Iron Works.

The terms of service of a large portion of the crew having expired they were discharged. A few reshipped, and vacancies were filled by new men. Seamen's wages on the Pacific coast were so much higher than the Navy pay that we found it difficult to get good men.

On the 19th of June we made a series of observations to determine the specific gravity of the water in San Francisco Bay, in order to ascertain whether it would be practicable to plant the lobsters, which were en route for the Pacific, anywhere within its limits.

Specific gravity of the water of San Francisco Bay, reduced to 60° Fahrenheit.

	Surface.	Bottom.
One-quarter of a mile west of Yerba Buena Island	1.019887	1.021487
One-quarter of a mile WSW. of Saucelito Wharf	1.019887	1.021487
One-eighth of a mile off Yellow Bluff	1.018687	1.021687
One-quarter of a mile S. by W. of Alcatraz Island	1.019887	1.021487

The average specific gravity of sea water being 1.0274, it became evident that, all impurities aside, the salinity of the water would not warrant the planting of lobsters in the bay, with any probability of success.

The vessel was docked, her bottom cleaned and painted on the 26th and 27th of June. We coaled ship on the 30th, and, being at a wharf, took advantage of the opportunity to discharge a large number of specimens. We dropped into the stream before dark, practically ready for our Alaskan trip.

An itinerary was prepared before we left Washington, in which an estimate was given of the time required to make the voyage, the distance, average speed, amount of coal consumed, average cost, etc. The following table, showing the estimated and actual distances, etc., will be of interest as an evidence of the accuracy with which such matters can be calculated with a modern steam-vessel over known routes.

	Time actually en route.		Total distance.	Average speed per hour.	Coal.			
					Bought.	In bunker on arrival.	Total cost.	Average cost per ton.
	Days.	*Hours.*	*Miles.*	*Miles.*	*Tons.*	*Tons.*		
Estimated	88	0	15,830	7.8	1,066	30	$10,573.60	$9.92
Actual	85	5	15,956.7	7.793	1,061.75	30	9,710.53	9.022

A list of anchorages and summary of meteorological observations are appended, and will be found of interest. The engineer's report contains an account of operations in his department. The dredging and trawling record, the record of hydrographic soundings, and the record of specific gravities are appended. With reference to the latter,

it is probably the most systematic and accurate series of observations ever taken over the same regions.

The following officers were attached to the ship on the 30th of June, 1888:

Z. L. Tanner, lieutenant-commander, U. S. Navy, commanding.
H. S. Waring, lieutenant, U. S. Navy, executive officer and navigator.
Marbury Johnston, ensign, U. S. Navy.
Henry E. Parmenter, ensign, U. S. Navy.
Edward W. Eberle, ensign, U. S. Navy.
C. M. McCormick, ensign, U. S. Navy.
James E. Gardner, passed assistant surgeon, U. S. Navy.
C. S. Williams, assistant paymaster, U. S. Navy.
C. R. Roelker, passed assistant engineer, U. S. Navy.

Prof. Leslie A. Lee was attached to the vessel as assistant in charge of the scientific staff, with the following-named gentlemen as assistants: Charles H. Townsend, assistant naturalist; A. B. Alexander, fishery expert; Louis de F. Bartlett, captain's clerk.

Petty officers.—W. L. Watson, Walter Blundell, John Davidson, P. J. Owens, machinists; Charles Wright, master-at-arms; Samuel Le R. Pritchard, equipment yeoman; N. B. Miller, apothecary; A. F. Perkins, paymaster's yeoman; F. L. Stailey, engineer's yeoman. The crew numbered fifty-five men.

Number and name of anchorages on the trip from Norfolk to San Francisco.

No.	Place.	No.	Place.
1	Fortress Monroe, Virginia.	25	Black Beach Road, Charles Island, Galapagos Archipelago.
2	Port Castries, Sta. Lucia, West Indies.	26	Iguana Cove, Albemarle Island, Galapagos Archipelago.
3	Bahia, Brazil.	27	Tagus Cove, Albemarle Island, Galapagos Archipelago.
4	Abrolhos Islands.	28	James Bay, James Island, Galapagos Archipelago.
5	Montevideo, Uruguay.	29	Conway Bay, Indefatigable Island, Galapagos Archipelago.
6	Dungeness Point, Straits of Magellan.	30	North side Duncan Island, Galapagos Archipelago.
7	Gregory Bay, Straits of Magellan.	31	Wreck Bay, Chatham Island, Galapagos Archipelago.
8	Elizabeth Island, Straits of Magellan.	32	Southwest side Abingdon Island, Galapagos Archipelago.
9	Laredo Bay, Straits of Magellan.	33	Acapulco, Mexico.
10	Sandy Point, Straits of Magellan.	34	Pichilinque Harbor, La Paz Bay, Lower California.
11	Borja Bay, Straits of Magellan.	35	Magdalena Bay, Lower California.
12	Port Churruca, Straits of Magellan.	36	Abreojos Point, Lower California.
13	Otter Bay, Western Patagonia.	37	Cerros Island, Morro Redondo.
14	Mayne Harbor, Western Patagonia.	38	Cerros Island, northwest side of.
15	Latitude Cove, Western Patagonia.	39	Smuggler's Cove, San Clemente Island.
16	Port Grappler, Western Patagonia.	40	Northeast end San Clemente Island.
17	Island Harbor, Western Patagonia.	41	Northwest end San Clemente Island.
18	Port Otway, Western Patagonia.	42	San Francisco, California.
19	Lota, Chili.		
20	Tomé, Chili.		
21	Taboguilla Island, Bay of Panama.		
22	Panama, United States of Colombia.		
23	Wreck Bay, Chatham Island, Galapagos Archipelago.		
24	Gardner Bay, Hood Island, Galapagos Archipelago.		

Meteorological summary.

Locality and date.	Winds—hours.					Temperature.			Barometer.			Aggregate current.	Rain days.
	Southerly.	Northerly.	Easterly.	Westerly.	Calm.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.		
						°	°	°	°	°	°		
Montevideo to Cape Virgins, Jan. 12–17.*	47	95	....	....	8	65.5	83	48	29.93	30.14	29.72	N. 22° E. 20′	2
Cape Virgins to Sandy Point, Jan. 18–31.*	146	156	....	....	34	53.5	68	39	29.83	30.36	29.30	Magellan Straits	11
Sandy Point to Port Otway, Feb. 1–10.*	74	137	....	....	29	56	68	44	29.88	30.30	29.40	....do	7
Port Otway to Lota, Chili, Feb. 11–18.*	139	12	....	....	41	65	75	55	30.02	30.24	29.80	N. 76° W. 9″	0
Lota, Chili to Panama, United States of Colombia, Feb. 19–Mar. 6.*	241	124	....	....	43	72.5	85	60	29.90	30.08	29.72	S. 81° W. 60″	7
Panama, United States of Colombia, Mar. 7–29.	23	451	13	35	28	81	88	74	29.84	30.00	29.68	None	3
Panama, United States of Colombia, to Wreck Bay, Chatham Island, Galapagos Archipelago, Mar. 30–Apr. 14.	112	97	105	12	57	83	90	76	29.80	29.94	29.66	S. 74° W. 145 m.	8
Wreck Bay, Chatham Island, Galapagos Archipelago, to Acapulco, Mexico, Apr. 15–23.	28	90	15	50	34	83	87	79	29.78	29.88	29.68	N. 61° W. 116 m.	1
Acapulco, Mexico, to La Paz, Lower California, Apr. 24–29.	24	55	0	44	20	79.5	88	71	29.83	29.94	29.72	N. 78° W. 19 m.	0
La Paz, Lower California, to San Francisco, California, Apr. 30–May 11.	23	6	3	240	12	65.6	80	51	30.06	30.22	29.90	N. 75° E. 40 m.	1

*Inclusive.

REPORT OF THE ENGINEER'S DEPARTMENT (ABSTRACT).

[From January 1 to October 24, 1887, by PASSED ASSISTANT ENGINEER G. W. BAIRD, U. S. Navy.]

Up to the 24th of October, the date of my detachment from the *Albatross*, the ship had steamed 1,745.9 knots on her course, in addition to the distance made while dredging and sounding. The vessel has not been detained in port through any fault of the machinery; the casualties have been few; the working of the machinery has been good.

Synopsis of the Steam Log to October 23.

Mean point of cutting off steam in the high pressure cylinders, from commencement of stroke.....inches..	16.1
Mean point of cutting off steam in the low pressure cylinders, from the commencement of stroke.....inches..	17.6
Mean number of holes (one-eighth) of throttle-valve open.....	4.5
Mean vacuum in the condenser.....inches..	23.16
Mean pressure in boilers, per square inch.....pounds..	60.6
Mean pressure in receivers, per square inch above zero.....do....	20.2

Temperature:		
Of the engine-room	deg. Fah..	110.3
Of the external atmosphere on deck	do....	62.5
Of injection (sea) water	do....	66.8
Of discharge water from condenser	do....	93.6
Of feed water	do....	81.8
Total time the fires were lighted	hours..	3,793¾
Total time engines were in operation, ship being on her course	hours..	1861⅛
Revolutions:		
Total number of starboard engine		815,047
Total number of port engine		821,172
Mean number per minute of starboard engine		72.58
Mean number per minute of port engine		73.21
Total nautical miles steamed		1,745.9
Mean nautical miles steamed per hour		9.33
Total tons of coal consumed		333$\frac{147}{2240}$
Total tons of refuse		56$\frac{1236}{2240}$
Total tons of coal consumed while the engines were in operation		112$\frac{1003}{2240}$
Mean number of pounds of coal consumed per hour while the engines were in operation		1,347

With the new boilers the speed of the ship, as well as the economic performance of the machinery, has been greatly improved. Following is a comparison of the best runs of the ship with each.

	With the original boilers.	With the new boilers.
Date	Sept. 23, 1883	Sept. 15, 1887
Hours and minutes	10.48	8.30
Mean speed	10.44	10.03
Steam pressure	56.1	65.33
Receiver pressure	21.1	17.
Revolutions	78.65	79.91
Vacuum	24.04	21.5
Throttle	4.	4.6
Cut-off H. P. inches..	19.	13.1
Cut-off L. P. do....	18.5	17.3
Temperature:		
Engine-room deg. F...	103.7	117.
On deck do....	68.4	72.8
Injection do....	56.7	72.
Discharge do....	97.9	104.8
Feed-water do....	64.3	78.6
Mean draught of water feet and inches..	11.8½	12.7
Displacement in tons at above draught	978.	1142.
Indicated horse-power developed by the engines	442.	472.8
Indicated horse-power developed by circulating-pump	5.	5.
Aggregate indicated horse-power	447.	477.8
Pounds of coal consumed per hour	1406.	1177.
Pounds of coal per indicated horse-power per hour	3.14	2.31

The new boilers have not yet been urged, and the rate of combustion can be increased about 50 per cent. over that recorded above.

The usual periodical inspections have been made of valves, pistons,

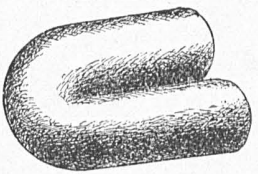


Fig. 1.

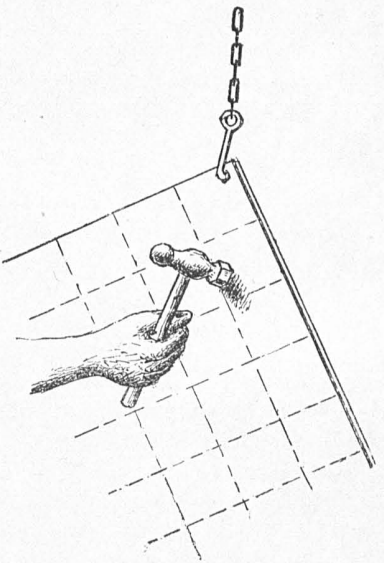


Fig. 2.

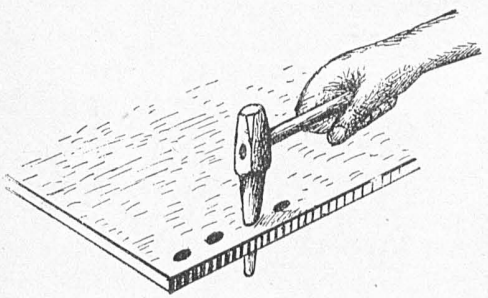


Fig. 3.

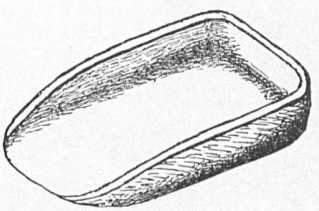


Fig. 4.

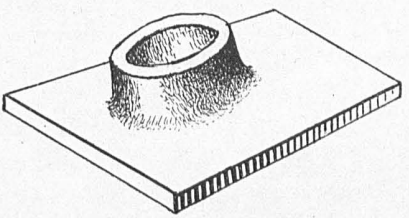


Fig. 5.

FIGURES ILLUSTRATING THE MANNER OF TESTING THE IRON FOR THE NEW BOILERS.

(See page 47.)

journals, etc. Liners were placed under low-pressure eccentric rods to restore lead of valves, which had become slightly worn, and repairs were made to the starboard low-pressure brasses.

The ship was docked at Baltimore August 19, after having been in the water continuously thirteen months and five days. One rivet in the forward end of the starboard bilge-keel was found to be loose. This was the first loose rivet, and the first leak discovered in the hull of the ship. All outboard valves were in good condition. The stern bearings were badly worn, but the shafts were clean and bright under the Edison insulator taps which had been put on to prevent corrosion. The Katzenstein packing placed on the valve stems has been beneficial. An expansion joint has been put in main steam-pipe between the engines. The Svedberg governors have had to be shifted, as by the new arrangement of bunkers they would have been in the coal storage. They are now more convenient for use than before, but they are also more in the way. I have converted the regurgitating valves of the feed-pumps into safety feed-valves, and have so piped the pumps that each will feed either boiler. The pneumatic indicators have answered their purpose well, and the Navy Department has again followed the lead of the Commission (as it did in the case of electric lighting) in placing this instrument in the new cruisers.

The contract for new boilers was signed by the president of the Columbian Iron Works, January 10, 1887, and by the Fish Commissioner, Professor Baird, on the 27th of the same month. The contract time was one hundred and twenty working days, a forfeit of $10 to be paid by the contractors for each day in excess of that limit required for completing the boilers. The writer was designated as superintending engineer of the construction, representing the Fish Commission, and the designs, specifications, and contract were drawn by him.

The iron for the new boilers was ordered by the Columbian Iron Works from the Christiana Rolling Mills, of Wilmington, Delaware. That mill had never made charcoal iron before, but they bought charcoal blooms of the best character, from which to roll the iron for the boilers. To prevent delay, I secured test pieces of the plates at the mill and tested them on a Fairbanks machine in Philadelphia, telegraphing orders to the mill whether the plates were to be accepted or not, thereby saving the expense of shipping condemned plates. For one cause and another it was necessary to condemn a large amount of iron, 26,000 pounds of shell plates being rejected in a single day.

The manner of testing the materials is represented in the accompanying figures: Figure 1 shows the bending test of a brace; figure 2, the hammer test of a plate; figure 3, the punching test; figures 4 and 5, the flanging tests; figure 6, the bending test for plates; figure 7, the bending of a rivet and the flattening of its head. These tests were made in the boiler-shop after the delivery of the iron. In the grooved specimens, some of the shell plates stood 59,000 pounds per square inch with

a reduction of area of 26 per cent. in the grooved specimens, and 56,000 pounds in the long specimens, with 35,000 pounds elastic limit, and 26 per cent. reduction of area. It is rarely that three-fourths-inch iron plates reach such high figures. Some of the flange iron (heads, furnace flues, etc.) failed in the shop; specimens from plates substituted were tested on the machine belonging to the supervising inspector at Baltimore. The contractors having failed to press satisfactory hemispherical braces for the back connections, asked the privilege and were allowed to make them of "low steel" (in reality ingot iron). Specimens from these showed 57,142 pounds per square inch, with 66 per cent. reduction of area. I was careful to see that they were annealed. The formers on which they were made were borrowed from the chief engineer of the Washington navy-yard.

The first main boiler was put on board August 5, and the second the 11th of the same month. As soon as they were closed steam was raised in the donkey-boiler and turned into the main boilers for the purpose of drying the kaolin which they were putting on. Thus the drying was kept up day and night. I utilized our own crew, doing whatever work it could, whether the items were included in the contract or not, in order to complete the arrangements and get the ship ready for sea. As the mechanics in the yard were vigorous patrons of the Knights of Labor, I was in constant fear that they would strike, on account of the amount of their work which our enlisted men were doing. In urging our work in the yard as well as on board ship, my own position became very much like that of a foreman in that ship-yard. The last delay was in getting the iron to lengthen the smoke-pipe. The pipe was erected September 6, the ventilators were put in on the 7th, and we raised steam on the 8th, at the earliest moment. The captain had declared his intention to sail as soon as we could run the engines. The last connection was made on the 14th, and the same day we raised steam and turned the engines over. At 10 o'clock that night the boiler-room gratings and ladders were temporarily in place, and although the boiler-room had not been painted, we went to sea at daylight on the following morning.

Instead of making the customary trial trip, the ship sailed directly to the deep water on the inner edge of the Gulf Stream, and began her regular fishery investigations, including dredging. On arriving at Wood's Holl I reported certain leaks in the boilers to the contractors, and boiler-makers were sent to calk them. The boilers were then accepted, but seventy-five working days over and above the contract limit had been required to complete them.

The total weight, as well as the potential and economic performance of the boilers, came within a small percentage of the results of my original calculations. The new boilers and bunkers are all contained within the bulkheads which inclosed the original ones, but there is now room for four days' additional coal, and 25 per cent. more maximum power.

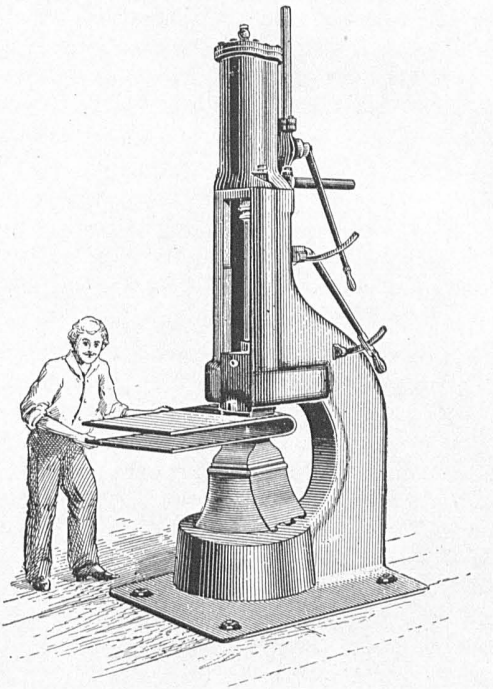


Fig. 6.

Fig. 7.

FIGURES ILLUSTRATING THE MANNER OF TESTING THE IRON FOR THE NEW BOILERS.
(See page 47.)

The dredging and reeling engines have been overhauled. The sounding engine is too small for its work. By being able to run the latter all the time, since the new reel, designed by the writer, has been in use, the nuisance of a cylinder full of water, every time they began to reel in, is now obviated. Although the reel is made of aluminum bronze, specimens of which showed a tensile strength of 93,520 pounds per square inch, it was found to be harder on one side than on the other. From this fact I judge that the copper and aluminum were not well mixed,* although the casting was made by the patentees. The reel is lighter and has a stronger shape than the steel ones, and it will not corrode.

The steering engine continues to work well. I have provided a shunt by which it may be made to exhaust into the air. An attachment by which it may be worked from the top of the pilot house is recommended.

The old exhaust fan and motor were displaced by the new boilers, and in their place have been erected a pair of No. 5 monogram exhausters and an orthodox steam-engine, which deliver more than double the quantity of air the original did. The relative economy of the two fans and motors, calculated in cubic feet of air delivered per pound of feed water used to propel the air, is as follows:

The Wise motor and No. 6 fan	1.00
The present engine and pair of No. 5 fans	21.86

The two steam cutters continue to perform excellent service. They have done more work than any other two Herreshoff boats the Government owns, but they have received unremitting attention. This has resulted from the hearty encouragement given to the engineer's department by the commanding officer; his appreciation of efficiency, and his willingness to sacrifice his own convenience to that end.

On stripping the wooden ceiling from the sides of the ship in the wake of the old bunkers, we found much corrosion of the hull on the inside. This has resulted from putting wet coal into the ship, the cold sides of which condense the moisture on their surface. The warm air, after the coal is removed, absorbs the moisture; the next charge of wet coal again moistens the plates, and this will continue as long as the present custom prevails.

The original Z dynamo and 8½ by 10 engine have been taken from the ship and replaced by a No. 3 dynamo and a 6½ by 8 engine. Much weight and space have been saved by this change. The new outfit gives the ship 120 lights of 10-candle power each, a gain of about 25 per cent. on the old one.

The old wooden boxes which carried the tiller ropes through the coal bunkers were defective and objectionable. Iron tubes and carriers, which are tight and serviceable, have been devised by the writer. They are represented in figures 8, 9, 10, and 11.

* Those two metals are of greatly different densities.

[From October 24, 1887, to July 1, 1888, by PASSED ASSISTANT ENGINEER C. R. ROELKER, U. S. Navy.]

The main engines and boilers have worked generally satisfactorily, and, with the exception of some slight repairs to a leaky bottom blow-pipe at Montevideo, Uruguay, all the incidental repairs and adjustments were made by the engineer force of the vessel and have caused no delay in her movements until her arrival at San Francisco, California. There the machinery, both main and auxiliary, was thoroughly overhauled and placed in an efficient condition, the shops of the Union Iron Works being utilized for such work as could not be done to advantage by the engineers' force of the vessel.

Only one boiler has been in use at a time, and during the greater portion of our steaming the grate surface of the boilers was reduced to 49½ and 45 square feet in order to steam more economically with a limited consumption of fuel. Leaks have continued to develop in the bottom of the boilers, the most active cause for this being undoubtedly the low temperature of the feed-water. The donkey-boiler has been used in port for lighting, heating, and ventilating the vessel and for running the steam-pumps whenever the fires could be hauled in the main boilers with due regard to safety and economy.

With the exception of a small quantity of anthracite coal remaining in the bunkers from the supply received at Norfolk, Virginia, and a few tons of Seattle and Wellington coals received at San Francisco, the fuel used has been Cardiff and Chilian coal. About 170 tons of the latter were obtained from the Alberto mine at Lota, Chili. The bulk of this coal is about 11 per cent. greater than that of Cardiff coal. It ignites easily and burns rapidly with a large flame; it does not cake, but breaks up into small particles, which run through the grate, but should be put back into the furnace. It forms large clinkers, which often cover the entire grate and are the principal part of the refuse. The quantity of refuse produced amounted to 7¼ per cent. of the quantity of coal consumed. Its evaporative power was about 75 per cent. of that of good Welsh coal. For economical reasons the consumption of coal was limited to 10½ tons per day. With this consumption the vessel maintained a speed of 8½ knots per hour in smooth water under steam alone, and attained a speed of 9 knots per hour on several occasions.

At Panama, March 21, the vessel was beached for the purpose of scraping and painting her bottom, which was quite foul, but unfortunately the slight rise and fall of the tide on that day left the greater part of the bottom inaccessible. During the latter part of June, however, she was placed on the hydraulic lifting dock of the Union Iron Works, at San Francisco, where her bottom was thoroughly cleaned and painted.

Temporary repairs were made to the leaky steam-piston of the Sigsbee Sounding Machine at Montevideo, whereby the working of the ma-

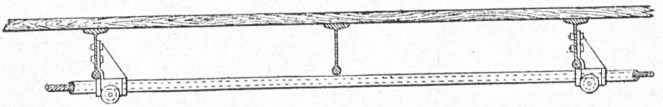


Fig. 8.

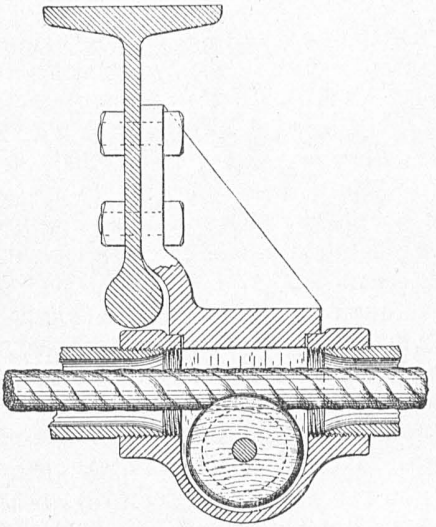


Fig. 9.

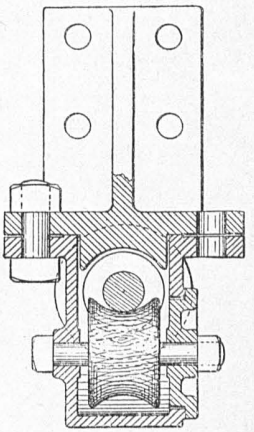


Fig. 10.

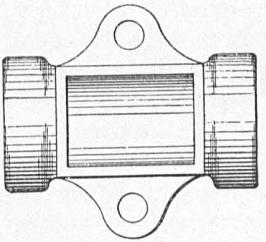


Fig. 11.

IRON TUBES AND CARRIERS FOR THE TILLER ROPES. (See page 49.)

chine was greatly improved. At San Francisco the piston was repaired in the most approved manner, and on a preliminary trial has worked very satisfactorily.

The steam cutter and steam gig have been thoroughly overhauled at San Francisco and placed in good working condition. Both received slight injuries to their machinery at Panama, without, however, causing a serious delay in their use.

The total number of nautical miles steamed since leaving Norfolk, Virginia, has been 16,320.4; the total amount of coal consumed for steaming, $879\frac{700}{2240}$ tons.

Trawling and dredging stations made by the U. S. Fish Commission Steamer Albatross, during the year and a half ending June 30, 1883.

Serial No.	Date.	Time.	Position.		Temperature.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Latitude.	Longitude.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Force.	
	1887.				°	°	°	*Faths.*					*Knots.*	
2736	Apr. 6	11 a.m.	Hampton Roads		48	46	46	11	S	E	4			S.B.T.
2737	Apr. 8	11.17 a.m.	do		48	46	47	12	S	E	4			Do
			° ′ ″	° ′ ″										
2738	Sept. 16	3.14 p.m.	36 52 00 N.	74 23 00 W.	70	70	38	958	gn. m	NNE	6	NW. by W.	1	L.B.T.
2739	Sept. 17	8.03 a.m.	37 34 30	73 38 00	65	69	38.2	811	gy. m	NE	4	NNW	1	Do.
2740	Sept. 17	11.52 a.m.	37 40 00	73 50 00	65	70	38	1,011	br. oz	NE. by N	4	NW. by N.	1½	Do.
2741	Sept. 17	3.49 p.m.	37 44 00	73 57 00	64	70	38	852	gn. m	NNE	4	N	1	Do.
2742	Sept. 17	6.25 p.m.	37 46 30	73 56 30	64	69	38	865	gn. m	NNE	2	NW. by N.	1	Do.
2743	Sept. 18	8.06 a.m.	38 31 00	72 53 00	62	67	37.8	1,155	gn. oz	ESE	2-3	NW	1	Do.
2744	Sept. 18	11.48 a.m.	38 35 00	73 05 15	65	69	39	554	bu. m	E	2	N. by E	½	Do.
2745	Sept. 18	4.20 p.m.	38 42 00	73 05 30	67	68	41.8	224	gn. m	SE	2	NNE	½	Do.
2746	Sept. 18	5.14 p.m.	38 46 00	73 05 45	65	68	51.2	102	gr. s	SE	2	W	½	Do.
2747	Sept. 19	6.05 a.m.	39 27 00	71 15 00	67	67	37.5	1,276	bu. m	NNW	2	S	1	Do.
2748	Sept. 19	10.53 a.m.	39 31 00	71 14 30	72	68	37.8	1,163	gy. m. for	SW	1	W	1	Do.
2749	Sept. 19	3.20 p.m	39 42 00	71 17 00	69	67	38.8	705	gn. oz	S	2-3	NW	½	Do.
2750	Nov. 27	6.52 p.m.	18 30 00	63 31 00	81	80	44.5	496	fne. gy. s	SSW	4	SE	1	2 S.D.
2751	Nov. 28	2.18 a.m.	16 54 00	63 12 00	81	81	40	687	bu. glob. oz	ESE	3	SSE	1½	L.B.T.
2752	Dec. 4	12.13 m.	13 34 00	61 04 00	82	82	48	281	bk. s	SE	2			Do.
2753	Dec. 4	1.31 p.m.	13 34 00	61 03 00	82	83	48	281	bk. s	NE	2			T.
2754	Dec. 5	12.09 m	11 40 00	58 33 00	85	84	38	880	glob. oz	SE. by S	2	S	2½	L.B.T.
2755	Dec. 7	12.03 m.	8 04 00	52 47 00	83	81	40	720	bu. m	SE. by E	3	S	1½	Do.
2756	Dec. 14	10.06 a.m	3 22 00 S.	37 49 00	80	79	40.5	417	gy. sbk. sp	SE. by S	5	S. by E	¾	S.B.T.
2757	Dec. 16	4.32 p.m	6 59 00	34 47 00	81	79	79	20	brk. sh	SE. by S	4			S.D.
2758	Dec. 16	4.50 p.m.	6 59 30	34 47 00	81	79	79	20	brk. sh	SE. by S	4			Do.
2759	Dec. 16	4.59 p.m.	7 00 00	34 47 00	81	79	79	20	brk. sh	SE. by S	4			S.B.T.
2760	Dec. 18	3.32 p.m.	12 07 00	37 17 00	84	80	39.5	1,019	br. co	SE	1	S. ¼ W	1	L.B.T.
2761	Dec. 26	12.06 m.	15 39 00	38 32 54	80	79	39	818	Pter. oz	SE. by S	1	SSE	2	Do.
2762	Dec. 30	6.05 a.m	23 08 00	41 34 00	72	70	57.1	59	bu. m	S	1	SSW	¼	S.D.
2763	Dec. 30	5.31 p.m	24 17 00	42 48 30	73	75	37.9	671	br. glob. oz	ENE	3	SW. ¼ S	1	L.B.T.
	1888.													
2764	Jan. 12	8.46 a.m.	36 42 00	56 23 00	69	68	.....	11½	s. brk. sh	NW	3	S	½	Do.
2765	Jan. 12	9.10 a.m.	36 43 00	56 23 00	69	69	.....	10½	s. brk. sh	NW	3	S	1	Do.
2766	Jan. 12	9.55 a.m	36 47 00	56 23 00	69	68	.....	10½	s. brk. sh	NW	3	S	¾	Do.
2767	Jan. 13	12.42 p.m	40 03 00	58 56 00	66	64	.....	52	fne. dk. s	NW	3	SSW	1	Do.
2768	Jan. 14	11.53 a.m.	42 24 00	61 38 30	62	61	.....	43	dk. s. bk. sp	SSE	2	SW	1	Do.
2769	Jan. 15	11.33 a.m.	45 22 00	64 20 00	60	58	56.6	51½	gn. m. fne. s	N	3	S. ¾ W	¾	Do.
2770	Jan. 16	11.32 a.m.	48 37 00	65 46 00	55	52	.....	58	gy. s. bk. sp	S	1	S	1½	Do.
2771	Jan. 17	11.29 a.m.	51 34 00	68 00 00	49	50	49.4	50½	gy. s. bk. sp	WSW	3	S. by W	1	Do.
2772	Jan. 17	4.02 p.m	52 16 00	68 13 00	50	52	.....	31½	fne. gy. s	N	4	S	¼	Do.
2773	Jan. 17	5.13 p.m.	52 23 00	68 11 00	56	51	.....	10	fne. gy. s	NNW	4	S	¼	S.B.T.

2774	Jan. 18	4.30 a.m.	32 23 00		68 31 30		52	49	.....	17	S.G.	N. by W.	4	SW. by W.	¼		Do.
2775	Jan. 18	9.41 a.m.	32 22 30		69 29 00		54	51	.....	29½	S.St.	NW.	3	None	.....	.....	Do.
2776	Jan. 18	12.10 p.m.	32 41 00		69 55 30		53	51	.....	21	S.G.	W.	1	None	.....	.....	Do.
2777	Jan. 19	1.18 p.m.	32 38 00		70 10 30		57	51	.....	19½	G.	W.	2	None	.....	.....	Do.
2778	Jan. 23	10.15 a.m.	33 01 00		70 42 15		52	49	47.9	61	gy. s. bk. sp.	ENE.	2	E. by S.	1		L. B. T.
2779	Jan. 23	11.39 a.m.	33 06 00		70 40 30		52	49	46.9	77½	gn. oz.	ENE.	2	SSW.	1¼		Do.
2780	Feb. 2	11.40 a.m.	33 01 00		73 42 30		54	51	46.9	369	gn. m.	WNW.	4	SW. by W.	1		Do.
2781	Feb. 4	2.30 p.m.	31 52 00		72 41 00		51	51	48.9	348	bn. m.	NW.	3-5	NW.	½		Do.
2782	Feb. 6	5.34 a.m.	31 12 00		74 13 30		46	49	47.9	258	bn. m.	W.	4-6	NW. by N.	¾		S. B. T.
2783	Feb. 6	7.43 a.m.	31 02 30		74 08 30		46	49	47.9	122	bn. m.	W.	3-4	NW. by N.	1		Do.
2784	Feb. 8	10.01 a.m.	48 41 00		74 34 00		55	55	51.9	194	bn. m.	SE.	3	W. by N.	1		L. B. T.
2785	Feb. 8	2.08 p.m.	48 09 00		74 36 00		58	57	46.9	449	bn. m.	SE.	3	NW. by N.	1½		Do.
2786	Feb. 9	12.46 p.m.	46 46 00		75 16 30		60	57	54.9	57	gn. m.	S.	3	S. E.	¾		Do.
2787	Feb. 9	1.18 p.m.	46 47 30		75 15 00		60	57	53.9	61	gn. m.	S.	3	SE. ¼ E.	¾		Do.
2788	Feb. 11	4.25 p.m.	45 35 00		73 35 00		57	56	36.9	1,050	gn. m.	SW.	4	NW. by N.	1		Do.
2789	Feb. 12	2.40 p.m.	42 26 00		75 25 00		61	60	35.9	1,342	bn. m.	SSW.	3	NNW.	¾		Do.
2790	Feb. 13	3.31 p.m.	39 21 00		74 42 00		62	62	35.9	1,287	gn. m.	SSE.	4	N. by E.	1½		Do.
2791	Feb. 14	9.47 a.m.	38 08 00		75 53 00		61	61	37.9	677	yl. m.	SSE.	4	ENE.	¾		Do.
2792	Mar. 2	3.27 p.m.	00 37 00		81 00 00		80	77	42.9	401	gn. m.	SW.	2	N. by E.	¾		Do.
2793	Mar. 3	6.28 a.m.	01 03 00	N.	80 15 00		78	78	38.4	741	gn. m.	SSE.	2	NNE.	1		Do.
2794	Mar. 5	1.52 p.m.	07 37 00		78 46 30		79	78	59.6	62	gy. s. bk. sp. brk. sh.	NNW.	3	W.	¼		S. B. T.
2795	Mar. 5	4.23 p.m.	07 57 00		78 55 00		79	78	64.1	33	gy. s. bk. sp. brk. sh.	NNW.	2	NE.	¼		L. B. T.
2796	Mar. 5	5.52 p.m.	08 05 00		78 51 00		80	78	.....	33	gy. s. brk. sh.	NW.	2	NNE.	1		Oyster.
2797	Mar. 5	6.10 p.m.	08 06 30		78 51 00		80	78	.....	33	gy. s. brk. sh.	NW.	2	E. ¾ S.	¼		L. B. T.
2798	Mar. 5	7.04 p.m.	08 10 30		78 50 30		80	78	.....	18	gy. s. brk. sh.	NW.	2	E. ¼ S.	¼		Do.
2799	Mar. 6	11.16 a.m.	08 44 00		79 09 00		76	75	.....	29½	gn. m.	WNW.	0-2	WNW.	1		Do.
2800	Mar. 30	10.32 a.m.	08 51 00		79 31 30		82	77	.....	7	gn. m.	E.	2	SW.	¼		Do.
2801	Mar. 30	11.41 a.m.	08 47 00		79 29 30		83	78	.....	14	gn. m.	NE. by E.	2	SSE.	¼		Do.
2802	Mar. 30	1.04 p.m.	08 38 00		79 31 30		84	78	.....	16	gn. m.	NE.	3	S. ¼ W.	1½		Do.
2803	Mar. 30	2.49 p.m.	08 27 00		79 35 00		85	78	.....	26	gn. m.	NNE.	3	S. ¾ W.	1½		Do.
2804	Mar. 30	4.38 p.m.	08 15 30		79 37 45		85	81	.....	47	gn. m.	NNE.	3	S. ¾ W.	1½		Do.
2805	Mar. 30	8.04 p.m.	07 56 00		79 41 30		79	78	.....	51½	gn. m.	N. by W.	3	SE. by E.	1		Do.
2806	Apr. 3	4.05 p.m.	00 30 00		86 57 30		85	80	36.4	1,379	br. glob. oz.	ESE.	3	SW. by S.	1½		Do.
2807	Apr. 4	5.05 a.m.	00 24 00	S.	89 06 00		79	79	38.5	812	glob. oz. co. m.	ESE.	2	S.	¾		Do.
2808	Apr. 4	9.14 a.m.	00 36 30		89 19 00		79	79	39.9	634	co. s.	ENE.	3	SSW.	¾		Do.
2809	Apr. 4	2.23 p.m.	00 50 00		89 36 00		80	79	74.1	45	gy. s.	ENE.	2	SE. by S.	¾		S. B. T.
2810	Apr. 7	5.08 p.m.	01 22 00		89 39 30		85	81	.....	6½	co. s.	calm.	0	N. by W.	¾		Tangles.
2811	Apr. 7	5.20 p.m.	01 21 30		89 39 30		85	81	.....	19	co. s.	calm.	0	W.	¾		S. B. T.
2812	Apr. 7	5.37 p.m.	01 21 30		89 39 45		85	81	.....	20	co. s.	calm.	0	W.	¾		Tangles.
2813	Apr. 7	5.48 p.m.	01 21 00		89 40 15		85	81	.....	40	co. s.	calm.	0	W.	¾		S. Dredge.
2814	Apr. 9	5.17 p.m.	01 17 30		90 30 00		82	79	.....	20	brd.	NE.	3	W. ¾ S.	¾		Do.
2815	Apr. 9	5.27 p.m.	01 17 30		90 30 15		82	79	.....	33½	gy. s. bk. sp.	NE.	3	W. ¾ S.	¼		Tangles.
2816	Apr. 9	5.31 p.m.	01 17 00		90 31 30		81	79	.....	76½	gy. s. fne. g.	NE.	3	NW. by W.	¼		Do.
2817	Apr. 15	9.23 a.m.	00 46 00		89 42 00		83	80	46.9	271	wh. s.	calm.	0	WNW.	1½		S. B. T.
2818	Apr. 15	1.13 p.m.	00 29 00		89 54 30		85	83	43.9	392	wh. and bk. s.	calm.	0	NW. by N.	¾		L. B. T.
2819	Apr. 15	6.02 p.m.	00 06 00		90 06 00		87	83	39.9	671	wh. s.	SE.	2	NW. by N.	¾		Do.
2820	Apr. 26	1.41 p.m.	18 43 00	N.	104 04 00		87	85	45.9	204	br. m.	S.	2	NW.	¼		Do.
2821	Apr. 26	4.04 p.m.	18 52 00		104 10 30		87	86	53.9	117	br. m.	S.	2	NW.	2		Do.
2822	Apr. 30	9.38 a.m.	24 16 00		110 22 00		76	73	.....	21	gy. s. brk. sh.	SSW.	2	NW.	¼		S. B. T.
2823	Apr. 30	11.15 a.m.	24 18 00		110 22 00		76	73	.....	26½	brk. sh.	SSW.	1	NNW.	¼		L. B. T.
2824	Apr. 30	11.23 a.m.	24 22 30		110 19 30		76	73	.....	8	brk. sh.	SSW.	1	E.	¼		Tangles.
2825	Apr. 30	11.35 a.m.	24 22 15		110 19 15		79	73	.....	7	brk. co.	SSW.	1	E.	¼		Ship dredge.

Trawling and dredging stations made by the U. S. Fish Commission Steamer Albatross—Continued.

Serial No.	Date.	Time.	Position.		Temperature.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Latitude.	Longitude.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Force.	
	1888.		° ′ ″	° ′ ″	°	°	°	*Faths.*					*Knots.*	
2826	Apr. 30	3.07 p. m.	24 12 00	109 57 00	78	74	.....	9½	sh	SSE	4	SE. by S.	½	Oyster dredge.
2827	Apr. 30	3.18 p. m.	24 11 45	109 55 00	78	74	.....	10	sh	SSE	4	SE. by S	½	Do.
2828	Apr. 30	3.34 p. m.	24 11 30	109 55 00	78	74	.....	10	sh	SSE	4	SE. by S	½	Do.
2829	May 1	8.18 a. m.	22 52 00	109 55 00	75	75	74.1	31	rky	SW. by W	0-1	SSW	1	Tangles.
2830	May 1	6.01 p. m.	23 33 00	110 37 00	67	67	74.1	66	fne. s	WNW	3	NW	1½	L. B. T.
2831	May 2	12.15 p. m.	24 32 00	111 59 00	65	67	.....	12	fne. gy. s	NW. by W	3	NNW	½	Do.
2832	May 2	3.36 p. m.	24 38 00	112 17 30	63	60	56.4	51	gn. m	WNW	3	None	.....	Do.
2833	May 2	3.54 p. m.	24 38 00	112 17 30	63	60	.....	51	gn. m	WNW	3	NW	½	Tangles.
2834	May 3	7.31 a. m.	26 14 00	113 13 00	62	61	53.9	48	rl. m	NW by W	4	NNW	1½	L. B. T.
2835	May 4	7.24 a. m.	26 42 30	113 34 15	54	56	.....	5½	gn. m	W	2	SE	¾	Ship dredge.
2836	May 4	7.37 a. m.	26 42 30	113 34 15	60	57	.....	6	gn. m	W	2	SE	¾	Oyster dredge.
2837	May 5	4.24 p. m.	28 10 00	115 09 45	64	62	.....	23	fne. s	W	3	NE	½	Ship dredge.
2838	May 5	4.50 p. m.	28 12 00	115 09 00	64	62	.....	44	gn. m	W	3	N	¾	L. B. T.
2839	May 8	4.03 p. m.	33 03 00	118 40 00	58	61	41.4	414	gy. s	W	3	WNW	1¾	Do.
2840	May 9	8.34 a. m.	34 11 00	120 15 00	55	51	43.9	27.6	gn. m	NW	2	NW	1	Do.

Record of hydrographic soundings of the U. S. Fish Commission Steamer Albatross during the year ending June 30, 1888.

Serial No.	Date.	Time.	Position. Latitude.	Position. Longitude.	Depth.	Character of bottom.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Remarks.
	1887.		° ′ ″	° ′ ″	*Faths.*		°	°	°	
1090	Sept. 17	5.25 a.m.	37 37 00 N.	74 11 00 W.	352	hrd	64	70	39.5	C=W¼ kt.
1091	Sept. 18	5.06 a.m.	38 31 00	73 15 00	255	gy. s	62	68	41	
1092	Dec. 6	.....	9 47 00	55 51 00	2,069	br. glob. oz	55	82	36.5	C=E3¼ kt.
1093	Dec. 8	12.03 p.m.	6 25 00	50 29 30	2,406	br. glob. oz	82	80	37.5	
1094	Dec. 9	9.00 p.m.	5 01 00	46 44 00	1,876	No specimen	80	80	.....	Wire parted while heaving in.
1095	Dec. 11	11.32 a.m.	1 53 00	43 00 00	2,449	glob. oz	82	80	.....	Ther. failed to capsize.
1096	Dec. 15	10.01 a.m.	4 38 00 S.	35 55 00	1,263	co	78	79	37.9	
1097	Dec. 17	5.00 p.m.	10 10 00	35 32 00	1,276	br. co	81	79	37.9	
1098	Dec. 31	1.27 a.m.	24 40 00	43 45 00	889	br. glob. oz	75	75	38.9	
1099	Dec. 31	7.10 a.m.	25 24 00	44 14 00	1,061	Pter. oz	75	75	38.9	
1100	Dec. 31	10.42 a.m.	25 45 00	44 38 00	1,099	br. glob. oz	78	75	38.9	
1101	Dec. 31	12.10 p.m.	25 51 00	44 48 00	1,019	br. glob. oz	78	75	38.9	
1102	Dec. 31	1.52 p.m.	25 41 00	44 48 00	945	br. glob. oz	78	76	38.4	
1103	Dec. 31	3.28 p.m.	25 42 00	44 58 30	777	br. glob. oz	78	76	37.9	
1104	Dec. 31	9.32 a.m.	26 23 00	45 31 30	756	br. glob. oz	77	76	37.9	
	1888.									
1105	Jan. 2	3.20 p.m.	31 05 00	49 45 00	78	s. and brk. sh	82	76	.....	
1106	Jan. 3	7.40 a.m.	32 51 00	51 48 00	24	s. and g	71	71	.....	
1107	Jan. 3	12.00 m	33 17 00	52 19 00	11	gy. s	72	71	.....	
1108	Jan. 3	4.00 p.m.	33 46 10	52 45 00	14	gy. s	72	70	.....	
1109	Jan. 3	5.30 p.m.	33 55 00	52 53 00	14	fne. dk. s	70	70	.....	
1110	Jan. 3	6.30 p.m.	34 01 00	53 00 00	114	fne. dk. s	68	70	.....	
1111	Jan. 3	7.40 p.m.	34 09 00	53 08 00	13	fne. dk. s	67	70	.....	
1112	Jan. 12	11.00 a.m.	36 56 00	56 23 00	12	s. brk. sh	69	66	.....	
1113	Mar. 31	5.33 a.m.	6 44 00 N.	80 27 00	1,927	gn. m	77	77	35.9	
1114	Apr. 1	4.50 a.m.	5 16 00	83 09 00	1,729	gn. m	80	79	36.9	
1115	Apr. 1	11.28 p.m.	4 18 00	85 14 00	1,882	dk. br. m. and for	82	82	35.9	
1116	Apr. 2	1.55 a.m.	4 14 00	85 11 00	1,657	dk. br. m. and for	83	83	35.9	
1117	Apr. 2	4.05 a.m.	4 2 00	85 25 30	1,724	gy. glob. oz	81	80	35.9	
1118	Apr. 2	3.57 p.m.	2 53 00	86 24 00	1,616	br. glob. oz	84	83	35.9	
1119	Apr. 3	9.01 a.m.	1 13 00	88 02 00	1,341	br. glob. oz	80	80	35.9	
1120	Apr. 7	7.43 a.m.	1 8 00 S.	89 39 00	287	hrd	80	78	.....	
1121	Apr. 7	11.50 p.m.	1 23 00	89 58 00	286	gy. s. bk. sp	76	80	45.9	
1122	Apr. 8	2.31 a.m.	1 25 00	90 07 00	191	fne. gy. s	80	79	53.9	
1123	Apr. 13	8.55 p.m.	00 33 00	90 15 30	103	wh. s	81	79	58.1	
1124	Apr. 14	12.52 a.m.	00 53 30	90 05 30	139	wh. co. s	80	78	56.2	
1125	Apr. 14	2.28 a.m.	00 51 00	89 43 30	329	fne. gy. s	79	78	45.6	
1126	Apr. 17	8.03 p.m.	4 44 00 N.	93 02 00	1,976	rd. br. oz	83	83	35.9	
1127	Apr. 19	8.07 a.m.	8 26 00	95 30 00	1,997	gn. m	83	81	35.9	
1128	Apr. 20	12.06 p.m.	11 45 00	97 03 00	2,256	gn. m	84	84	35.9	
1129	Apr. 21	1.02 p.m.	14 33 00	98 14 00	1,862	gn. m	87	75	35.9	

Record of temperatures and specific gravities for the year and a half ending June 30, 1888.

Date.	Time of day.	Latitude.	Longitude.	Depth.	Temperature by attached thermometer.	Temperature of air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° Fah.
1887.									
Sept. 5	1.30 p. m	Wharf of Columbia Iron Works, Baltimore, Md.		Low water surface.	75	*76	74	1.0030	1.005086
5	8.30 p. m	do		High water surface.	74	69	72	1.0034	1.005164
15	7.15 a. m	Fort McHenry		Surface	72	70	73	1.0038	1.005724
15	7.45 a. m	Fort Carroll		do	73	70	72	1.0040	1.005764
15	9 a. m	Chesapeake Bay, off mouth of Magothy River.		do	72	71	83	1.0048	1.008526
15	10 a. m	Chesapeake Bay, off Thomas' Point.		do	72	72	83	1.0063	1.010026
15	4 p. m	Chesapeake Bay, off Bloody Point.		do	73	75	80	1.0080	1.011160
15	5 p. m	Chesapeake Bay, off Plum Point.		do	73	74	81	1.0084	1.011739
15	6 p. m	Chesapeake Bay, off Tobois Island.		do	73	74	81	1.0088	1.012139
15	7 p. m	Chesapeake Bay, between Cedar and Point-no-Point.		do	74	73	81	1.0091	1.012739
15	8 p. m	Chesapeake Bay, off St. Jerome's Creek.		do	74	73	81	1.0096	1.012939
15	9 p. m	Chesapeake Bay, off mouth Potomac River.		do	75	72	81	1.0100	1.013339
15	10 p. m	Chesapeake Bay, off Smith's Point.		do	75	72	81	1.0124	1.015739
16	7 a. m	Off Cape Henry, Cape Henry bearing W. by S. (true) distance 20 minutes.		do	73	67	78	1.0214	1.024208
		° ′ ″	° ′ ″						
16	12 m	36 54 00 N.	74 46 30 W.	do	73	71	78	1.0228	1.025608
17	12 m	37 40 00	73 50 30	do	70	65	82	1.0228	1.026326
18	12 m	38 35 00	73 05 00	do	69	64	81	1.0230	1.026339
19	12 m	39 34 00	71 17 00	do	69	71	81	1.0234	1.026739
Nov. 22	12 m	34 57 00 N.	74 37 00	do	72	56	85	1.0230	1.027100
22	6 p. m			do	74	61	85	1.0232	1.027300
22	12 p. m			do	60	61	85	1.0232	1.027300
23	6 a. m			do	70	64	85	1.0234	1.027500
23	12 m	32 00 00 N.	72 20 00 W.	do	70	70	85	1.0235	1.027600
23	6 p. m			do	70	69	85	1.0231	1.027200
23	12 p. m			do	72	69	85	1.0232	1.027300
24	6 a. m			do	72	69	85	1.0235	1.027600
24	12 m	28 53 00 N.	70 27 00 W.	do	74	72	85	1.0235	1.027600
24	6 p. m			do	73	72	85	1.0238	1.027900
24	12 p. m			do	73	72	85	1.0232	1.027300
25	6 a. m			do	74	72	85	1.0233	1.027400
25	12 m	25 29 00 N.	68 13 00 W.	do	75	75	85	1.0234	1.027500
25	6 p. m			do	76	76	85	1.0236	1.027700
25	12 p. m			do	76	75	85	1.0236	1.027700
26	6 a. m			do	78	75	85	1.0232	1.027300
26	12 m	22 09 00 N.	66 20 00 W.	do	79	79	85	1.0232	1.027300
26	6 p. m			do	79	78	85	1.0234	1.027600
26	12 p. m			do	80	79	85	1.0234	1.027500
27	6 a. m			do	79	79	85	1.0232	1.027300
27	12 m	19 29 00 N.	63 41 00 W.	do	80	81	85	1.0230	1.027100
27	6 p. m			do	80	81	85	1.0230	1.027100
27	12 p. m			do	80	78	85	1.0230	1.027100
28	6 a. m			do	81	79	86	1.0235	1.027816
28	12 m	16 48 00 N.	63 12 00 W.	do	82	84	86	1.0233	1.027616
28	6 p. m			do	83	84	86	1.0234	1.027716
28	12 p. m			do	82	81	86	1.0234	1.027716
29	6 a. m			do	81	80	85	1.0235	1.027600
29	12 m	Sta. Lucia, West Indies, Harbor Port Castries.		do	82	81	86	1.0212	1.025516
Dec. 4	12 m	13 16 00 N.	61 04 30 W.	do	82	82	86	1.0234	1.027716
4	6 p. m			do	82	80	86	1.0234	1.027716
4	12 p. m			do	81	80	86	1.0234	1.027716
5	6 a. m			do	81	80	85	1.0236	1.027700
5	12 m	11 40 00 N.	58 35 00 W.	do	83	83	85	1.0236	1.027700
5	6 p. m			do	83	82	85	1.0237	1.027800

* Specimens retained in lower laboratory until they had acquired the temperature of the room.

Record of temperatures and specific gravities, etc.—Continued.

Date.	Time of day.	Latitude.	Longitude.	Depth.	Temperature by attached thermometer.	Temperature of air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° Fah.
1887.									
Dec. 5	12 p. m.			Surface	82	81	85	1.0238	1.027900
6	6 a. m.			do	81	80	85	1.0240	1.028100
6	12 m.	9 47 00 N.	55 51 30 W.	do	82	83	85	1.0240	1.028100
6	6 p. m.			do	81	80	85	1.0234	1.027500
6	12 p. m.			do	81	80	85	1.0234	1.027500
7	6 a. m.			do	80	78	85	1.0240	1.028100
7	12 m.	8 04 00 N.	52 47 00 W.	do	81	83	85	1.0240	1.028100
7	6 p. m.			do	81	81	85	1.0240	1.028100
7	12 p. m.			do	81	78	85	1.0236	1.027700
8	6 a. m.			do	80	79	85	1.0240	1.028100
8	12 m.	6 25 00 N.	50 09 00 W.	do	80	82	85	1.0240	1.028100
8	6 p. m.			do	82	83	85	1.0240	1.028100
8	12 p. m.			do	80	79	84	1.0242	1.028112
9	6 a. m.			do	80	78	84	1.0242	1.028112
9	12 m.	5 29 00 N.	47 42 00 W.	do	80	80	84	1.0242	1.028112
9	6 p. m.			do	80	78	84	1.0242	1.028112
9	12 p. m.			do	80	80	84	1.0242	1.028112
10	6 a. m.			do	80	79	84	1.0243	1.028212
10	12 m.	3 38 00 N.	45 06 30 W.	do	81	83	84	1.0244	1.028312
10	6 p. m.			do	81	81	84	1.0242	1.028112
10	12 p. m.			do	79	80	84	1.0242	1.028112
11	6 a. m.			do	80	79	84	1.0242	1.028112
11	12 m.	1 53 00 N.	43 00 00 W.	do	80	82	84	1.0244	1.028312
11	6 p. m.			do	80	81	83	1.0250	1.028720
11	12 p. m.			do	79	80	82	1.0246	1.028120
12	6 a. m.			do	79	78	85	1.0244	1.028500
12	12 m.	00 01 00 S.	41 01 00 W.	do	79	81	85	1.0244	1.028500
12	6 p. m.			do	80	80	85	1.0246	1.028700
12	12 p. m.			do	79	79	85	1.0246	1.028700
13	6 a. m.			do	79	79	85	1.0246	1.028700
13	12 m.	01 45 00 S.	39 11 00 W.	do	79	81	85	1.0246	1.028700
13	6 p. m.			do	79	81	85	1.0244	1.028500
13	12 p. m.			do	79	79	84	1.0246	1.028512
14	6 a. m.			do	79	78	81	1.0247	1.028312
14	12 m.	3 24 30 S.	37 46 00 W.	do	79	81	84	1.0250	1.028912
14	6 p. m.			do	79	81	84	1.0250	1.028912
14	12 p. m.			do	78	79	84	1.0248	1.028712
15	6 a. m.			do	78	78	84	1.0248	1.028712
15	12 m.	4 45 00 S.	35 47 30 W.	do	79	80	84	1.0246	1.028512
15	6 p. m.			do	79	79	84	1.0250	1.028912
15	12 p. m.			do	79	79	84	1.0250	1.028912
16	6 a. m.			do	78	78	84	1.0248	1.028712
16	12 m.	6 25 00 S.	34 19 00 W.	do	79	80	84	1.0250	1.028912
16	6 p. m.			do	80	82	84	1.0250	1.028912
16	12 p. m.			do	78	78	84	1.0250	1.028912
17	6 a. m.			do	78	77	84	1.0252	1.029112
17	12 m.	9 36 00 S.	35 04 00 W.	do	79	80	84	1.0248	1.028712
17	6 p. m.			do	79	81	84	1.0250	1.028912
17	12 p. m.			do	78	78	84	1.0248	1.028712
18	6 a. m.			do	77	77	84	1.0246	1.028512
18	12 m.	11 52 05 S.	36 57 30 W.	do	78	80	84	1.0250	1.028912
18	6 p. m.			do	80	82	84	1.0250	1.028912
18	12 p. m.			do	78	78	84	1.0250	1.028912
19	6 a. m.			do	78	77	84	1.0250	1.028912
22	12 m.	Bahia, Brazil		do	79	80	81	1.0266	1.028939
25	12 p. m.			do	78	78	81	1.0254	1.028739
26	6 a. m.			do	78	78	80	1.0256	1.028760
26	12 m.	15 39 00 S.	38 32 54 W.	do	79	80	81	1.0254	1.028739
26	6 p. m.			do	81	83	80	1.0256	1.028760
26	12 p. m.			do	78	79	80	1.0254	1.028560
27	6 a. m.	Abrolhos Islands		do	76	78	80	1.0256	1.028760
28	6 p. m.			do	78	82	80	1.0252	1.028360
28	12 p. m.			do	77	78	80	1.0254	1.028560
29	6 a. m.			do	77	75	80	1.0253	1.028460
29	12 m.	21 09 00 S.	39 41 00 W.	do	79	79	80	1.0254	1.028560
29	6 p. m.			do	76	77	79	1.0255	1.028483
29	12 p. m.			do	74	75	75	1.0260	1.028265
30	6 a. m.			do	70	72	75	1.0256	1.027865
30	12 m.	23 43 00 S.	42 10 30 W.	do	75	75	75	1.0258	1.028065
30	6 p. m.			do	75	77	75	1.0258	1.028065

Record of temperatures and specific gravities, etc.—Continued.

Date.	Time of day.	Latitude.	Longitude.	Depth.	Temperature by attached thermometer.	Temperature of air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° Fah.
1887.									
Dec. 30	12 p. m.			Surface	75	75	75	1.0260	1.028265
31	6 a. m.			do	75	75	75	1.0260	1.028265
31	12 m.	25 51 00 S.	44 46 00 W.	do	75	78	75	1.0262	1.028465
31	6 p. m.			do	76	78	75	1.0262	1.028465
31	12 p. m.			do	76	76	75	1.0260	1.028265
1888.									
Jan. 1	6 a. m.	27 23 00 S.	46 36 30 W.	do	75	75	75	1.0262	1.028465
1	12 m.	27 54 00 S.	47 03 00 W.	do	74	75	75	1.0260	1.028265
1	6 p. m.	28 35 00 S.	47 39 00 W.	do	75	76	75	1.0260	1.028265
1	12 p. m.	29 15 00 S.	48 15 00 W.	do	74	73	75	1.0254	1.027665
2	6 a. m.	29 55 00 S.	48 51 00 W.	do	74	72	75	1.0252	1.027465
2	12 m.	30 37 00 S.	49 27 00 W.	do	75	75	75	1.0252	1.027465
2	6 p. m.	31 17 00 S.	50 10 00 W.	do	75	81	75	1.0250	1.027265
2	12 p. m.	31 57 00 S.	50 53 00 W.	do	74	71	75	1.0240	1.026265
3	6 a. m.	32 37 00 S.	51 36 00 W.	do	71	71	75	1.0228	1.025065
3	12 m.	33 17 00 S.	52 19 00 W.	do	71	72	75	1.0226	1.024865
3	6 p. m.	33 43 00 S.	53 01 00 W.	do	70	70	74	1.0226	1.024686
3	12 p. m.	34 09 00 S.	53 43 00 W.	do	68	66	70	1.0230	1.024450
4	6 a. m.	34 35 00 S.	54 25 00 W.	do	68	65	70	1.0212	1.022650
4	12 m.	35 03 00 S.	55 45 00 W.	do	71	71	70	1.0084	1.009850
5	12 m.	Harbor of Montevideo		do	74	78	70	1.0022	1.003650
9	6 p. m.	Harbor of Montevideo. Pampero.		do	69	69	70	1.0016	1.003050
11	12 p. m.	35 39 00 S.	56 20 00 W.	do	71	73	70	1.0116	1.013050
12	6 a. m.	36 28 00 S.	56 25 00 W.	do	68	70	70	1.0170	1.018450
12	12 m.	37 04 00 S.	56 30 00 W.	do	68	70	70	1.0214	1.025850
12	6 p. m.	37 48 00 S.	56 58 00 W.	do	69	83	70	1.0248	1.026250
12	12 p. m.	38 32 00 S.	57 30 00 W.	do	64	68	70	1.0246	1.026050
13	6 a. m.	39 16 00 S.	57 58 00 W.	do	61	64	70	1.0244	1.025850
13	12 m.	39 59 30 S.	58 53 00 W.	do	61	65	70	1.0244	1.025850
13	6 p. m.	40 35 00 S.	59 34 00 W.	do	61	63	70	1.0244	1.025850
13	12 p. m.	41 11 00 S.	60 15 00 W.	do	60	59	70	1.0244	1.025850
14	6 a. m.	41 47 00 S.	60 56 00 W.	do	60	60	69	1.0248	1.026087
14	12 m.	42 24 00 S.	61 38 30 W.	do	61	62	69	1.0248	1.026087
14	6 p. m.	43 08 00 S.	62 21 00 W.	do	61	64	69	1.0248	1.026087
14	12 p. m.	43 52 00 S.	63 04 00 W.	do	58	59	70	1.0244	1.025850
15	6 a. m.	44 36 00 S.	63 40 00 W.	do	58	59	70	1.0244	1.025860
15	12 m.	45 22 00 S.	64 20 00 W.	do	58	60	69	1.0246	1.025887
15	6 p. m.	46 10 00 S.	64 42 00 W.	do	55	63	68	1.0216	1.025736
15	12 p. m.	46 58 00 S.	65 04 00 W.	do	51	56	66	1.0250	1.025840
16	6 a. m.	47 46 00 S.	65 26 00 W.	do	52	54	66	1.0248	1.025640
16	12 m.	48 37 00 S.	65 46 00 W.	do	55	58	66	1.0248	1.025640
16	6 p. m.	49 21 00 S.	66 22 00 W.	do	55	57	65	1.0250	1.025600
16	12 p. m.	50 05 00 S.	67 02 00 W.	do	51	53	65	1.0250	1.025600
17	6 a. m.	51 49 00 S.	67 38 00 W.	do	50	49	65	1.0250	1.025600
17	12 m.	51 34 23 S.	68 01 00 W.	do	50	49	66	1.0242	1.025040
17	6 p. m.	Cape Virgins, Straits Magellan.		do	50	50	66	1.0242	1.025040
18	6 a. m.	Possession Bay, Straits Magellan.		do	49	52	65	1.0244	1.025090
18	1 p. m.	Gregory Bay, Straits Magellan.		do	51	58	65	1.0232	1.023890
19	6 p. m.	Elizabeth Island, Straits Magellan.		do	49	58	65	1.0232	1.023890
24	12 m.	Sandy Point, Straits Magellan.		do	51	55	66	1.0231	1.024240
Feb. 1	12 m.	Borja Bay, Straits Magellan		do	48	59	66	1.0230	1.023840
2	12 m.	Ocean Reach, Straits Magellan.		do	51	55	66	1.0216	1.022440
3	1 p. m.	Port Churruca, Straits Magellan.		do	52	53	66	1.0214	1.013240
4	8 a. m.	Otter Bay, Smyth Channel		do	51	53	66	1.0194	1.020240
4	1 p. m.	Mayne Channel		do	52	52	66	1.0194	1.020240
5	12 m.	Mayne Harbor		do	51	51	66	1.0174	1.018240
6	12 m.	Latitude Cove		do	51	50	66	1.0171	1.017940
7	12 m.	Wide Channel		do	50	49	66	1.0166	1.017440
7	5 p. m.	Eyre Sound		do	50	50	65	1.0080	1.008690
7	8 p. m.	Port Grappler		do	53	52	70	1.0140	1.015450
8	12 m.	Messier Channel		do	56	56	70	1.0130	1.014450
8	8 p. m.	Island Harbor		do	57	57	70	1.0082	1.009650

Record of temperatures and specific gravities, etc.—Continued.

Date.	Time of day.	Latitude.	Longitude.	Depth.	Temperature by attached thermometer.	Temperature of air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° Fah.
1888.									
Feb. 9	8 a. m	Gulf of Penas		Surface	57	64	70	1.0206	1.022050
9	6 p. m	Port Otway		do	58	68	70	1.0226	1.023050
11	12 m	46 14 00 S.	75 46 00 W.	do	58	58	70	1.0232	1.024650
11	6 p. m	45 25 00	75 38 00	do	58	57	70	1.0236	1.025050
11	12 p. m	44 36 00	75 30 00	do	57	55	70	1.0236	1.025050
12	6 a. m	43 45 00	75 21 00	do	58	56	70	1.0240	1.025450
12	12 m	42 56 00	75 16 00	do	60	62	70	1.0242	1.025650
12	6 p. m	42 10 00	75 09 00	do	58	60	70	1.0240	1.025450
12	12 p. m	41 24 00	75 02 00	do	61	58	70	1.0240	1.025450
13	6 a. m	40 39 00	74 55 00	do	62	60	70	1.0242	1.025050
13	12 m	39 50 00	74 47 55	do	62	63	70	1.0242	1.025650
13	6 p. m	39 10 00	74 33 00	do	64	62	70	1.0242	1.025650
13	12 p. m	38 28 00	74 18 00	do	63	63	70	1.0242	1.025650
14	6 a. m	37 49 00	74 02 00	do	65	66	70	1.0244	1.025850
14	12 m	37 08 00	73 49 00	do	60	62	70	1.0246	1.026050
14	6 p. m	Lota, Chili		do	65	68	68	1.0250	1.026136
20	12 m	Tomé, Chili		do	62	70	77	1.0246	1.027218
20	6 p. m	36 01 00 S.	73 13 00 W.	do	59	62	77	1.0242	1.026818
20	12 p. m	35 06 00	73 29 00	do	62	60	76	1.0242	1.026032
21	6 a. m	34 13 00	73 45 00	do	67	64	76	1.0240	1.026432
21	12 m	33 21 00	74 01 30	do	68	69	76	1.0240	1.026432
21	6 p. m	32 33 00	74 16 00	do	68	68	76	1.0240	1.026432
21	12 p. m	31 45 00	74 30 00	do	68	67	76	1.0240	1.026432
22	6 a. m	30 57 00	74 44 00	do	67	67	76	1.0240	1.026432
22	12 m	30 09 00	74 58 00	do	69	70	76	1.0240	1.026432
22	6 p. m	29 21 00	75 12 00	do	70	71	76	1.0242	1.026632
22	12 p. m	28 33 00	75 26 00	do	71	70	76	1.0244	1.026832
23	6 a. m	27 45 00	75 39 00	do	70	70	76	1.0244	1.026832
23	12 m	26 57 00	75 53 00	do	73	73	76	1.0246	1.027032
23	6 p. m	26 11 00	76 08 00	do	72	71	76	1.0246	1.027032
23	12 p. m	25 25 00	76 21 00	do	72	71	76	1.0250	1.027432
24	6 a. m	24 39 00	76 36 00	do	73	73	76	1.0248	1.027232
24	12 m	23 52 00	76 51 00	do	73	75	76	1.0250	1.027432
24	6 p. m	23 05 00	77 08 00	do	76	75	76	1.0250	1.027432
24	12 p. m	22 18 00	77 25 00	do	75	73	77	1.0246	1.027032
25	6 a. m	21 31 00	77 43 00	do	73	73	79	1.0259	1.027983
25	12 m	20 44 00	78 00 00	do	77	76	79	1.0250	1.027983
25	6 p. m	19 56 00	78 14 00	do	76	75	79	1.0246	1.027583
25	12 p. m	19 06 00	78 29 00	do	74	74	79	1.0250	1.027983
26	6 a. m	18 20 00	78 42 00	do	75	74	79	1.0250	1.027983
26	12 m	17 29 00	78 57 00	do	76	76	79	1.0246	1.027583
26	6 p. m	16 38 00	79 10 00	do	75	75	79	1.0246	1.027583
26	12 p. m	15 49 00	79 21 00	do	75	75	79	1.0246	1.027583
27	6 a. m	14 58 00	79 32 00	do	75	75	79	1.0246	1.027583
27	12 m	14 07 00	79 49 00	do	77	77	79	1.0244	1.027383
27	6 p. m	13 16 00	80 02 00	do	77	77	79	1.0246	1.027583
27	12 p. m	12 26 00	80 15 00	do	75	75	79	1.0244	1.027383
28	6 a. m	11 37 00	80 25 00	do	76	75	79	1.0244	1.027383
28	12 m	10 44 00	80 43 00	do	77	77	79	1.0244	1.027383
28	6 p. m	9 54 00	80 57 00	do	77	78	79	1.0246	1.027583
28	12 p. m	9 03 00	81 12 00	do	76	77	79	1.0242	1.027183
29	6 a. m	8 13 00	81 25 00	do	75	75	79	1.0240	1.026983
29	12 m	7 21 00	81 40 00	do	76	78	79	1.0240	1.026983
29	6 p. m	6 36 00	81 46 00	do	76	76	79	1.0240	1.026983
29	12 p. m	5 52 00	81 51 00	do	75	75	80	1.0238	1.026960
Mar. 1	6 a. m	5 06 00	81 58 00	do	74	74	80	1.0240	1.027160
1	12 m	4 22 00	82 03 00	do	75	80	80	1.0242	1.027360
1	6 p. m	3 32 00	81 50 00	do	74	75	80	1.0240	1.027160
1	12 p. m	2 41 00	81 36 00	do	73	74	80	1.0238	1.026960
2	6 a. m	1 53 00	81 23 00	do	73	73	80	1.0238	1.026960
2	12 m	1 01 00	81 09 00	do	76	78	80	1.0236	1.026760
2	6 p. m	0 23 00	80 53 00	do	77	79	80	1.0236	1.026760
2	12 p. m	0 15 00 N.	80 36 00	do	78	77	80	1.0234	1.026560
3	6 a. m	0 53 00	80 21 00	do	78	77	80	1.0230	1.026160
3	12 m	1 30 00	80 04 00	do	80	84	80	1.0228	1.025960
3	6 p. m	2 16 00	79 51 00	do	81	80	80	1.0226	1.025760
3	12 p. m	3 02 00	79 37 00	do	78	78	80	1.0226	1.025760
4	6 a. m	3 49 00	79 25 00	do	76	76	80	1.0230	1.026160
4	12 m	4 35 00	79 11 00	do	77	77	80	1.0226	1.025760

Record of temperatures and specific gravities, etc.—Continued.

Date.	Time of day.	Latitude.	Longitude.	Depth.	Temperature by attached thermometer.	Temperature of air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° Fah.
1888.									
Mar. 4	6 p. m.	5 17 00	78 50 00	Surface	77	77	80	1.0226	1.025760
4	12 p. m.	5 59 00	78 25 00	do	77	78	80	1.0222	1.025360
5	6 a. m.	6 42 00	78 08 00	do	77	76	80	1.0222	1.025360
5	12 m	7 24 00	78 45 00	do	78	80	80	1.0222	1.025360
5	6 p. m.	7 41 00	78 51 00	do	78	79	80	1.0228	1.025960
5	12 p. m.	8 05 00	78 59 00	do	73	76	80	1.0230	1.026160
6	6 a. m.	8 24 00	79 04 00	do	75	75	80	1.0230	1.026160
6	12 m	8 46 00 / Panama Bay	79 10 30	do	76	79	80	1.0230	1.026160
30	6 p. m.	8 11 00 N.	79 38 00 W.	do	77	86	83	1.0230	1.026726
30	12 p. m.	7 33 00	79 45 00	do	75	78	83	1.0230	1.026726
31	6 a. m.	6 44 00	80 27 00	do	77	77	83	1.0230	1.026726
31	12 m	6 15 00	80 59 30	do	80	80	83	1.0230	1.026726
31	6 p. m.	5 57 00	81 44 00	do	81	84	83	1.0228	1.026526
31	12 p. m.	5 39 00	82 29 00	do	80	80	83	1.0226	1.026326
Apr. 1	6 a. m.	5 21 00	83 14 00	do	83	81	83	1.0224	1.026126
1	12 m	5 01 00	84 00 00	do	84	85	83	1.0222	1.025926
1	6 p. m.	4 36 00	84 31 00	do	85	88	83	1.0222	1.025926
1	12 p. m.	4 11 00	85 02 00	do	82	82	83	1.0222	1.025926
2	6 a. m.	3 46 00	85 33 00	do	82	84	83	1.0222	1.025926
2	12 m	3 22 00	86 05 00	do	83	83	83	1.0220	1.025726
2	6 p. m.	2 46 00	86 38 00	do	82	84	83	1.0222	1.025926
2	12 p. m.	2 10 00	87 11 00	do	81	81	83	1.0222	1.025926
3	6 a. m.	1 34 00	87 42 00	do	79	80	83	1.0226	1.026326
3	12 m	00 57 00	88 15 00	do	81	82	83	1.0228	1.026526
3	6 p. m.	00 33 00	88 32 00	do	80	85	83	1.0230	1.026726
3	12 p. m.	00 09 00	88 49 00	do	79	80	83	1.0232	1.026926
4	6 a. m.	00 15 00 S.	89 06 00	do	79	79	83	1.0234	1.027126
4	12 m	00 40 00	89 24 00	do	79	82	83	1.0234	1.027126
5	12 m	Wreck Bay, Chatham Island		do	79	81	86	1.0234	1.027716
7	12 m	Hood Island		do	80	82	86	1.0240	1.028316
8	12 m	Charles Island		do	80	83	86	1.0236	1.027916
10	12 m	Albemarle Island / Elizabeth Bay		do	79	81	86	1.0236	1.027916
11	6 p. m.	James Island		do	79	79	86	1.0234	1.027716
15	12 m	00 36 00 S.	89 50 00 W.	do	83	85	86	1.0236	1.027916
15	6 p. m.	00 17 00	90 06 00	do	83	85	86	1.0234	1.027716
15	12 p. m.	00 02 00 N.	90 20 00	do	81	82	86	1.0230	1.027316
16	6 a. m.	00 21 00	90 36 00	do	81	80	86	1.0230	1.027316
16	12 m	00 42 00	90 51 30	do	83	85	86	1.0232	1.027516
16	6 p. m.	1 26 00	91 16 00	do	82	82	86	1.0230	1.027316
16	12 p. m.	2 10 00	91 41 00	do	79	80	86	1.0230	1.027316
17	6 a. m.	3 07 00	92 06 00	do	81	80	86	1.0228	1.027116
17	12 m	3 45 00	92 32 00	do	85	86	86	1.0230	1.027316
17	6 p. m.	4 21 00	92 46 00	do	84	84	86	1.0224	1.026716
17	12 p. m.	4 57 00	93 02 03	do	82	81	86	1.0220	1.026316
18	6 a. m.	5 33 00	93 16 00	do	81	82	86	1.0216	1.025916
18	12 m	6 19 00	93 30 30	do	82	82	86	1.0216	1.025916
18	6 p. m.	6 56 00	94 03 00	do	82	82	86	1.0220	1.026316
18	12 p. m.	7 33 00	94 36 00	do	81	81	86	1.0220	1.026316
19	6 a. m.	8 10 00	95 09 00	do	81	80	86	1.0220	1.026316
19	12 m	8 47 00	95 42 00	do	82	82	86	1.0224	1.026716
19	6 p. m.	9 32 00	96 02 00	do	82	82	86	1.0220	1.026316
19	12 p. m.	10 17 00	96 23 00	do	81	82	86	1.0220	1.026316
20	6 a. m.	11 02 00	96 42 00	do	82	82	86	1.0222	1.026516
20	12 m	11 45 00	97 03 00	do	84	84	86	1.0222	1.026516
20	6 p. m.	12 25 00	97 19 00	do	84	84	86	1.0224	1.026716
20	12 p. m.	13 07 00	97 35 00	do	83	83	86	1.0224	1.026716
21	6 a. m.	13 45 00	97 53 00	do	83	83	86	1.0224	1.026716
21	12 m	14 28 00	98 09 00	do	85	86	73	1.0250	1.026924
21	6 p. m.	14 57 00	98 35 00	do	85	86	73	1.0252	1.027124
21	12 p. m.	15 32 00	99 02 00	do	84	84	73	1.0252	1.027124
22	6 a. m.	15 53 00	99 21 00	do	83	83	73	1.0250	1.026924
24	12 m	Harbor Acapulco		do	83	85	73	1.0252	1.027124
24	12 p. m.	16 52 00 N.	100 23 00 W.	do	82	81	73	1.0250	1.026924
25	6 a. m.	17 07 00	101 04 00	do	83	81	73	1.0250	1.026924
25	12 m	17 19 00	101 28 00	do	85	86	73	1.0250	1.026924
25	6 p. m.	17 37 00	102 05 00	do	84	84	73	1.0250	1.026924
25	12 p. m.	17 56 00	102 43 00	do	83	82	73	1.0248	1.026724
26	6 a. m.	18 14 00	103 19 00	do	83	80	73	1.0248	1.026724

Record of temperatures and specific gravities, etc.—Continued.

Date.	Time of day.	Latitude.	Longitude.	Depth.	Temperature by attached thermometer.	Temperature of air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° Fah.
1888.									
Apr. 26	12 m.....	18 33 00	103 57 00	Surface ...	85	88	73	1.0248	1.026724
26	6 p. m.....	19 00 00	104 27 00	....do.....	83	84	73	1.0250	1.026924
26	12 p. m.....	19 28 00	104 58 00	....do.....	83	82	73	1.0250	1.026924
27	6 a. m.....	19 54 00	105 28 00	....do.....	80	81	73	1.0250	1.026924
27	12 m.....	20 22 00	105 59 00	....do.....	79	78	73	1.0250	1.026924
27	6 p. m.....	20 48 00	106 28 00	....do.....	78	77	77	1.0244	1.027018
27	12 p. m.....	21 18 00	106 57 00	....do.....	76	75	77	1.0246	1.027218
28	6 a. m.....	21 42 00	107 26 00	....do.....	76	74	77	1.0244	1.027018
28	12 m.....	22 15 00	107 58 30	....do.....	75	75	77	1.0248	1.027418
28	6 p. m.....	22 47 00	108 33 00	....do.....	74	74	77	1.0248	1.027418
28	12 p. m.....	23 19 00	109 10 00	....do.....	73	73	77	1.0246	1.027218
29	6 a. m.....	23 51 00	109 43 00	....do.....	72	76	77	1.0246	1.027218
29	12 m.....	24 22 00	110 20 00	....do.....	75	75	77	1.0248	1.027418
		La Pay Bay							
30	9 a. m.....	Pichilinque Bay		....do.....	72	73	77	1.0250	1.027618
30	12 p. m.....	Entrance Gulf of California		....do.....	75	70	68	1.0264	1.027536
May 1	6 a. m.....	Off Cape San Lucas		....do	74	75	68	1.0261	1.027536
1	12 m.....	23 01 00 N.	110 10 00 W.	....do.....	68	68	67	1.0265	1.027487
1	6 p. m.....	23 24 00	110 37 00	....do.....	67	66	67	1.0262	1.027187
1	12 p. m.....	23 45 00	111 05 00	....do.....	65	64	67	1.0262	1.027187
2	6 a. m.....	24 07 00	111 32 00	....do.....	63	62	68	1.0260	1.027136
2	12 m.....	24 31 00	112 00 00	....do.....	67	65	68	1.0260	1.027136
2	6 p. m.....	25 03 00	112 23 00	....do.....	60	63	68	1.0256	1.026736
2	12 p. m.....	25 35 00	112 45 00	....do.....	62	61	68	1.0254	1.026536
3	6 a. m.....	26 08 06	113 09 00	....do.....	61	59	67	1.0256	1.026587
3	12 m.....	26 40 30	113 31 00	....do.....	59	61	67	1.0260	1.026987
4	12 m.....	26 49 00	113 59 00	....do.....	59	60	68	1.0256	1.026736
4	6 p. m.....	27 09 00	114 17 00	....do.....	58	60	68	1.0256	1.026736
4	12 p. m.....	27 30 00	114 35 00	....do.....	60	59	68	1.0256	1.026736
5	6 a. m.....	27 48 00	114 52 00	....do.....	59	59	68	1.0256	1.026736
5	12 p. m.....	29 08 00	115 44 00	....do.....	60	60	67	1.0252	1.026187
6	6 a. m.....	29 37 00	116 03 00	... do.....	59	59	67	1.0252	1.026187
6	12 m.....	30 08 00	116 20 00	... do.....	60	62	67	1.0254	1.026387
6	6 p. m.....	30 43 00	116 38 00	....do.....	61	60	66	1.0256	1.026440
6	12 p. m.....	31 18 00	116 57 00	....do.....	61	60	66	1.0256	1.026440
7	6 a. m.....	31 54 00	117 14 00	....do.....	60	59	66	1.0254	1.026240
7	12 m.....	32 29 00	117 33 00	....do.....	61	59	66	1.0252	1.026040
7	6 p. m.....	St. Clemente Island		....do.....	60	58	63	1.0260	1.026411
8	12 p. m.....	33 34 00 N.	119 17 00 W.	....do.....	59	56	65	1.0258	1.026490
9	6 a. m	33 59 00	119 56 00	....do	54	54	64	1.0260	1.026548
9	12 m.....	34 24 00	120 26 00	....do.....	55	55	64	1.0260	1.026548
9	6 p. m.....	34 52 00	120 48 00	....do.....	54	54	64	1.0260	1.026548
9	12 p. m.....	35 20 00	121 10 00	....do.....	54	54	64	1.0256	1.026148
10	6 a. m.....	35 49 00	121 33 00	... do.....	52	54	64	1.0256	1.026148
10	12 m.....	36 17 00	121 55 00	....do.....	53	53	64	1.0256	1.026148
10	6 p. m.....	Off Monterey Bay		....do.....	52	53	64	1.0256	1.026148
10	12 p. m.....	Entrance San Francisco Bay, Harbor San Francisco.		... do.....	51	51	64	1.0256	1.026148
June 19	1.01 p. m *...	¼ mile West Yerba Buena...		... do.....	63	65	69	1.0186	1.019887
19	1.01 p. m *...	¼ mile West Yerba Buena...		Bottom....	62	65	69	1.0202	1.021487
19	1.45 p. m †...	¼ mile W. S. W. Saucelito		Surface	63	65	69	1.0186	1.019887
19	1.45 p. m †...	¼ mile W. S. W. Saucelito....		Bottom....	62	65	69	1.0202	1.021487
19	1.57 p. m ‡...	⅛ mile off Yellow Bluff		Surface	63	65	69	1.0174	1.018687
19	1.57 p. m ‡...	⅛ mile off Yellow Bluff		Bottom....	62	65	69	1.0204	1.021687
19	2.20 p. m §...	Alcatraz, N. by E. ½ mile....		Surface	62½	64	69	1.0186	1.019887
19	2.20 p. m §...	Alcatraz, N. by E. ½ mile....		Bottom....	61	64	69	1.0202	1.021487
19	2.49 p. m ‖...	Yerba Buena Light, 1 mile..		Surface	62½	64	69	1.0184	1.019687
19	2.49 p. m ‖...	Yerba Buena Light, 1 mile..		Bottom....	62	64	69	1.0194	1.020687

* 0.16 before low water. † 0.28 after low water. ‡ 0.40 after low water.
§ 1.03 after low water. ‖ 1.32 after low water.

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[NOTE.—The references are to page figures in brackets.]