SOUNDINGS AND CURRENTS IN THE NORTH PACIFIC OCEAN

PREVIOUS accounts of the soundings of the U.S. steamer *Tuscarora* in the North Pacific Ocean, with reference to laying a cable between America and Japan, have described the work accomplished sailing from the Asiatic coast up to lat. 41° 09′ N., long. 144° 01′ E., after two projected routes had been tried and abandoned. From that point the *Tuscarora* went to Hakodadi to obtain a supply of coal, and thence sailed to lat. 46° 38′ N., long. 151° 47′ E., from which point soundings were taken on a backward line to the position which was left to go to Hakodadi; the backward line skirting the shores of the Kurile Islands. All the soundings are taken at intervals of 29 or 30 miles. Upon the new route thus surveyed from Yokohama, for a distance of 1,000 miles, the depths range from 300 to 2,270 fathoms, the greatest declivity being 161 ft. to the mile, between lat. 40° 10′ N., long. 142° 57′ E., and lat. 41° 09′ N., long. 144° 01′ E. The depth gradually increased between lat. 47° 44′ N., long. 154° 15′ E. and lat. 50° 19′ N., long. 159° 39′ E. (a distance of 260 miles), at the rate of about 60 ft. to the mile; the depth at the point last named being 3,754 fathoms. The course thence was through open water between the Kamschatkan coast and the Aleutian Islands; but just before entering the latter group the steepest declivity was found that has been met with during this survey. The preceding and succeeding coasts, each at a distance of 29 miles, gave depths of 2,460 fathoms, while this one, in lat. 52° 06′ N., long. 171° 15′ E., gave 4,037 fathoms, a slope of at least 326 ft. to the mile. Thence to lat. 51° 58′ N., long. 174° 31′ E. (about three miles from Atchka Island), the water shoaled to 332 fathoms, rising at the rate of 187 ft. to a mile. From the last-named position to Tanaga Island the depths ranged from 200 to 1,800 fathoms, including only one remarkable declivity, which was between lat. 51° 08′ N., long. 178° 35′ W., and lat. 51° 28′ N., long. 177° 57′ W., where the slope was 250 ft. to the mile.

Between Tanaga Island and Illiouk, a distance of about 500 miles, the depths nowhere exceeded 1,500 fathoms. The latter place will afford facilities as an intermediate station for the projected cable. Thence the course surveyed was to the north-east, afterward veering to the eastward through Ounimak Pass, toward the locality at which the survey proceeding from Cape Flattery westward left off last autumn, lat. 53° 58′ N., long. 153° W. From Illiouk to lat. 54° 10′ N., long. 162° 39′ W., the depths were small, being at the latter point 44 fathoms. Thence to lat. 54° N., long. 158° 22′ W., a distance of 151 miles, there was a descent of 130 ft. to the mile, the depth at the last-named being 3,359 fathoms. From this point the bed rises, reaching about the same level as that of last autumn's stopping-place—2,520 to 2,530 fathoms—when within 30 miles of that location. The great depth of 3,359 fathoms can be avoided by selecting a line some 30 miles to the northward, where only 2,900 fathoms' depth is found. A series of observations south of the line already surveyed gave greater depths.

Numerous observations were made on currents and temperatures. Along the shores of Kamschatka and the Kurile Islands, in lat. 51° 39′ N., there is a counter-current setting to the south-west, extending to long. 164° E., with a surface temperature of 42° F. Thence to long. 174° E. in the same latitude, with a surface temperature of 46° to 47° F., is the Kamschatka current (a branch of the Japan stream, setting through Behring Straits), which is here about 350 miles in width. It lost 22° F. between the Japan coast and lat. 51° 39′ N. The counter-current within the same limits gained 6° F. The atmosphere lost 18° F. From long. 174° E., proceeding eastward, the cold Behring Straits current with about 42° surface temperature was found, having for its western limits St. Lawrence and St. Matthew Islands. It is inferred that the counter-current of long. 164° is part of the Behring Strait current, having the same temperature, and that it flows

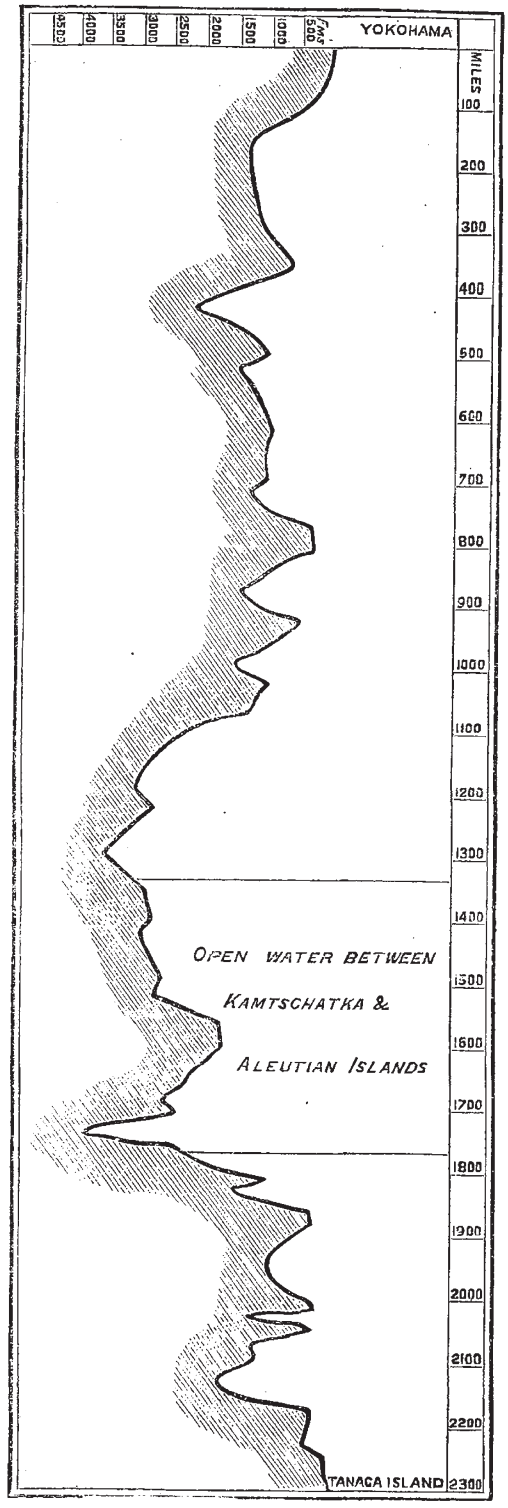

FIG. 1.—Bed of the Pacific from Yokohama to Tanaga Island.

beneath the Kamschatka current; and this belief was confirmed by finding at 30 fathoms' depth and below the latter current one setting to the south-west. On this

theory the excess of loss of heat on the part of the Kamschatka current over that of the atmosphere, as stated above, may be explained by attributing it to the cooling

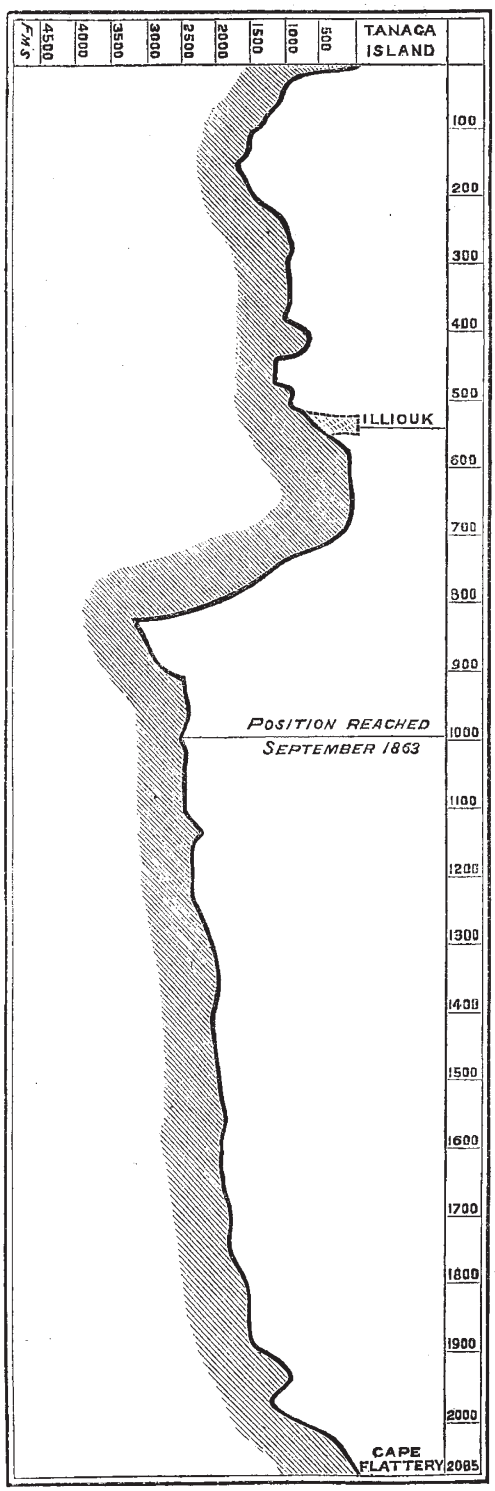

FIG. 2.—Bed of the Pacific, Tanaga Island to Cape Flattery.

effect of the counter-current beneath. It may here be mentioned that the northernmost limit of the Japan stream was 51° 12′ N., long. 178° 20′ E.

The coincidence of observations on temperatures and currents was very noteworthy. There was found, for instance, at lat. 42° 51′ N., long. 148° 14′ E., a north-east surface current of a half-knot per hour; at 5 to 15 fathoms' depth the temperature was 40·3° F., and in this space the current was marked. In the next 5 fathoms the thermometer fell 6°, and correspondingly the current ceased to be observable at this 20 fathoms' depth. At 200 fathoms a steadily increasing current to the south-west was observed; while from 20 fathoms' depth all the way to the bottom—upward of 4,000 fathoms—the fall of temperature was only 1°. A cold stratum of water was discovered, coming down from Behring Straits as an under-current. Between lats. 51° and 52° and longs. 159° and 169°, this current is at 150 ft. below the surface, and itself of 400 ft. depth. It was perceptible at lat. 42° 47′ N., long. 148° 23 E., but south of that it disappears: lat. 51° 22′ N., long. 162° 20′ E. is believed to be nearly its centre. Now, at the last-named location, at 22 fathoms, the thermometer marked 35·7°; at 75 fathoms, 32°; at 100 fathoms, 35·5°. This current was again satisfactorily defined at lat. 51° 43′ N., long. 165° 25′ E., and there the temperatures were, at 25 fathoms, 37·7°; at 60 fathoms, 34·7°; at 100 fathoms, 37·7°. The bottom temperatures vary from 32° to 33·9°.

Reviewing the results of the entire investigation in respect to currents, the following deductions may be summarised:—The Kuro Siwa or Japan current extends on an easterly course toward the American coast, its northern limit nearly reaching the southern shores of Vancouver Island; and it passes down to the southward in what has been incorrectly denominated the "California cold current." Beneath this an under-current sets to the north-west, and in lat. 50° reaches the surface, after which it sets northward along the shores of British America and the outstanding islands, thence gradually turns to the westward, its direction being affected by the outline of the coast, and exhibits at Sitka a strength of one knot per hour and a northward flow. In lat. 53° 30′ N., long. 157° W., the current, to a depth of 5 fathoms, set to the south-east, and this continued while observations were made during sailing to the south-east; but between that position and the line of the islands the current was to the south-west, and close to the islands to the westward. It is believed that a part of the water carried to the north-west by the under-current, returns in long. 157° to the northern portion of the Japan stream, and mingles with it, returning to the southward along the western shores of America, as part of the surface current; and that the part to the westward of long. 157° which sets toward the south-west, passes as an under-current beneath the Japan stream. A rapid fall in temperature—from 57° to 47° in a few miles—in the Ounimak Pass, shows that the north-west shores of the Aleutian Islands are washed by the cold Behring Straits current, which is somewhat modified in temperature by the inflow of part of the westerly current from the eastward of the islands.

Many observations were made which indicated the relation of prevailing winds to surface currents. The material obtained from the sea bottom off the Kurile Islands had, in addition to the usual ooze, greyish-black sand, gravel, and lumps of lava. Similar sand and gravel were found, and also sponge, in the neighbourhood of the Aleutian Islands. The northern route for a telegraph cable, as finally indicated by this survey, is 4,200 miles in length; the southern, about 6,000 miles. The former route will present great though probably not insuperable difficulties, such as that of the sudden declivity off the Aleutian Islands, the frequent fogs which made even the survey tedious, the embarrassments incident to a northern region, where there are few of the means provided on more civilised shores to meet the requirements of working parties and occasional repairs. The chief merits of the northern route are its comparative shortness and its propinquity to United States territory.