SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 60, NUMBER 13

A STUDY OF THE SALINITY OF THE SURFACE WATER IN THE NORTH PACIFIC OCEAN AND IN THE ADJACENT ENCLOSED SEAS

BY
AUSTIN HOBART CLARK

(PUBLICATION 2153)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
DECEMBER 4, 1912

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

A STUDY OF THE SALINITY OF THE SURFACE WATER IN THE NORTH PACIFIC OCEAN AND IN THE ADJACENT ENCLOSED SEAS

By AUSTIN HOBART CLARK

CONTENTS

PREFACE

During the 1906 cruise of the United States Fisheries steamer "Albatross" in the North Pacific Ocean and in the Bering, Okhotsk, Japan, and Eastern Seas, I devoted considerable attention to the question of the salinity of the water through which the ship passed. Though much has been accomplished, thanks chiefly to the activity of the Russian Admiralty, in the working out of the conditions along the Asiatic shores and, thanks to the ships of the German merchant marine, both steam and sail, in the elucidation of the conditions from Seattle southward, very little has been done on the American side north of Puget Sound and in the Bering Sea; therefore particular pains were taken to make the records for this area especially complete.

Water specimens were taken by the quartermaster at 8 a. m. and at 8 p. m., and at once put into 18 oz. crown glass bottles which were tightly corked. As a rule samples of the surface water were also taken whenever the ship was stopped for dredging.

On account of the motion of the ship and because of the great amount of other more pressing work to be done it was not possible to work out the density of the water specimens at sea. They were therefore allowed to accumulate in the laboratory until a harbor or quiet anchorage was reached when the accumulation was disposed of.

The variation in the reading of my salinometers resulting from changes in temperature was not known. But any error arising from such variation was eliminated so far as possible by taking the readings always in approximately the same temperature, the water samples being stored in a room in which the temperature was at all times fairly constant.

There are three important sources of error involved in the method of storing water samples in cork stoppered soft glass bottles until such time as determination is possible. The water will dissolve a certain amount of the glass, thus increasing the density; irregularities from this source, however, are probably negligible so far as my results are concerned, because of the large probable error involved in the method used. Again the date and time of day, or the station number, were written on paper labels and placed in the water; of course the sizing and certain other of the constituents of the paper and of the pencil lead dissolved out, increasing the salt content of the water; but the labels used were of uniform size and composition, and the amount of writing was always the same so that approximately the same error is involved in each reading and may be considered as compensated in the general correction applied. The third source of error lies in the evaporation through and around the corks; occasionally there is an evident discrepancy due to this cause (as for instance in Nos. 9 and 12), but ordinarily the error was probably so small as to be, in view of the probable error as calculated, negligible. In the rough northern waters it was often necessary to retain water samples for several days; but here it was cold and damp and evaporation was reduced to a minimum; in the south determinations could be made much more frequently, and this source of error was largely eliminated.

The apparatus used in determining the specific gravity of the water was Hilgard's ocean salinometer, and the specific gravities were all reduced to the standard temperature of 60° Fahr. (15°.56 C.). The tables employed in this reduction are given in the Report of the Commissioner of Fish and Fisheries for 1883 (1885), p. 78.

The standard used by Makaroff in his work was $S\frac{17.5^\circ}{17.5^\circ}$, he having been induced to recalculate his observations to this standard because of its very general use among oceanographers of other nations, especially by the Germans. In his monograph he includes the salinity records for the Pacific determined by the "Challenger" and other ships recalculated to $S\frac{17.5^\circ}{17.5^\circ}$ from the original figures.

The standard used by the Bureau of Fisheries has generally been $S\frac{15.56^\circ}{15.56^\circ}$, though on one or two of the earlier cruises it appears to have been $S\frac{15.56^\circ}{4^\circ}$, corresponding to that of the "Challenger."

In the following calculation of an empirical correction for my figures no account is taken of the difference between $S\frac{15.56^\circ}{15.56^\circ}$ and $S\frac{17.5^\circ}{17.5^\circ}$ for the reason that such slight differences as exist (Professor Krümmel gives an average of -0.00013 for the difference between $S\frac{15.56^\circ}{15.56^\circ}$ and $S\frac{17.5^\circ}{17.5^\circ}$) are pracitically constant between the extremes recorded on this cruise.

In this paper I have employed figures representing the specific gravity of the water rather than the amount of dissolved salts expressed in grammes per liter for the reason that almost all of the previous records for the area under consideration are so given, and therefore the use of the older method renders my figures more readily comparable with those of previous observers.

Absolute accuracy is not claimed for the figures representing the specific gravities herein recorded; indeed the author is well aware that absolute accuracy cannot possibly be secured by the method used under the limitations imposed by a voyage of this character. Nansen has shown the difficulties in the way of salinity determination by salinometer, even with the precautions taken by him, and in the case of my determinations and subsequent calculations the taking of any but the most obvious precautions meant the expenditure of a considerable amount of time and thus became impossible. But the figures have a distinct comparative value and, in the absence of other data for much of the region covered, may be taken as affording an approximate index of the conditions in the seas traversed by the ship.

As my time was too fully occupied in other work to permit of my devoting my personal attention to it, the greater part of the actual determination of the densities was done by Mr. Leonard M. Tongue, the clerk of the ship, under my supervision. Mr. Tongue's familiarity with the instruments and his conscientious devotion to the scientific work of the ship combined to make his calculations reliable within a comparatively small limit of personal error.

In addition to surface specimens, samples of water were, so far as possible, taken at the same time from the circulating pump the intake of which is about four feet below the surface. This water was drawn from the tap in the laboratory, enough water being first allowed to run off entirely to clear the pipe from the laboratory to the sea. It was not believed that the modification of the water on its passage through this pipe, which was constantly in use, could be sufficient to be detected by the method used in the determination of the specific gravities.

Many of the salinity determinations taken at the surface during this cruise are included, without correction or comment, in the dredging and hydrographic records of the cruise (Bureau of Fisheries Document No. 621, 1907, pp. 1-50). It was necessary in distributing our zoölogical material for study to provide each of our collaborators at the same time with the data of each dredge haul. Immediately upon our return to San Francisco, therefore, Mr. Tongue compiled these records from our undigested notes taken at sea.

THE LIMITS OF ERROR IN THE OBSERVATIONS

There were fifty observations taken on the water from the circulating pump; in three instances these readings were identical with those taken from water dipped from the surface (Nos. 24, 64 and 73); in twenty-four instances they were greater, as follows:

No. 1:	0.00044	No. 57:	0.00005
(No. 9:	0.00286)	No. 60:	0.00030
No. 18:	0.00020	No. 62:	0.00010
No. 19:	0.00003	No. 66:	0.00016
No. 25:	0.00006	No. 81:	0.00003
No. 27:	0.00018	No. 91:	0.00004
No. 28:	0.00023	No. 93:	0.00008
No. 29:	0.00003	No. 94:	0.00056
No. 32:	0.00014	No. 97:	0.00092
No. 40:	0.00009	(No. 99:	0.00207)
No. 46:	0.00005	No. 124:	0.00008
No. 51:	0.00003	No. 129:	0.00021

and in twenty-three instances less, as follows:

No. 2:	0.00042	No. 42:	0.00011
No. 4:	0.00030	No. 43:	0.00015
(No. 5:	0.00119)	No. 50:	0.00003
No. 7:	0.00035	No. 61:	0.00005
No. 10:	0.00041	No. 72:	0.00016
No. 11:	0.00065	No. 83:	0.00010
(No. 12:	0.00385)	No. 84:	0.00006
No. 13:	0.00023	No. 86:	0.00006
No. 22:	0.00019	No. 92:	0.00019
No. 30:	0.00009	No. 110:	0.00023
No. 41:	0.00041	No. 115:	0.00038
	No. 120:	0.00018	

In the cases in which the reading from the circulating pump was greater than that from the surface water (excluding No. 9 in which the surface reading, from rain or some other cause, is obviously abnormally low; and No. 99 in which the reading from the circulating pump, probably because of evaporation, is obviously too high) we find a variation between 0.00092 (No. 97) and 0.00003 (Nos. 19, 29, 51 and 81), with a mean of 0.00018.

In the cases in which the reading from the circulating pump was less than that from the surface water (excluding Nos. 5 and 12 in which the surface reading is obviously too high) we find a variation between 0.00065 (No. 11) and 0.00003 (No. 50), with a mean of 0.00022.

The fact that the variation was plus in twenty-four instances and minus in twenty-three with no variation in three, that there is no correlation between the variation and the latitude, and that the average of all the variation (+0.00018−0.00022) is −0.00004, a quantity altogether too small to be detected by the instruments used, shows that in reality the difference in the water at the surface and a few feet below it is entirely negligible, not falling within the scope of possible detection by the instruments used.

This being so we have a personal and fortuitous error of 0.00018+0.00022=0.00040 to take into consideration so that, under the best of conditions we must admit of a possible variation of ±0.00020 from the truth. This shows graphically the absolute insignificance of the figures in the fifth decimal place and their entire dependence upon chance.

THE REJECTION OF INACCURATE READINGS.

Assuming that the readings from the surface and from the circulating pump are, so far as lies within the power of our instruments to detect, the same, we are able to compare the two readings and in many cases to reject one of them as probably less accurate than the other. Where two readings were taken those which are probably the most nearly correct are (discarding the insignificant fifth decimal) as follows:

No. 1:	1.0212	No. 50:	1.0253
No. 2:	1.0257	No. 51:	1.0253
No. 4:	1.0259	No. 57:	1.0253
No. 5:	1.0256	No. 60:	1.0254
No. 7:	1.0257	No. 61:	1.0253
No. 9:	1.0251	No. 62:	1.0253
No. 10:	1.0252	No. 64:	1.0253
No. 11:	1.0218	No. 66:	1.0253
No. 12:	1.0252	No. 72:	1.0252
No. 13:	1.0243	No. 73:	1.0252
No. 18:	1.0244	No. 81:	1.0248
No. 19:	1.0250	No. 83:	1.0251
No. 22:	1.0250	No. 84:	1.0252
No. 24:	1.0250	No. 86:	1.0253
No. 25:	1.0250	No. 91:	1.0253
No. 27:	1.0254	No. 92:	1.0253
No. 28:	1.0253	No. 93:	1.0253
No. 29:	1.0252	No. 94:	1.0254
No. 30:	1.0252	No. 97:	1.0260
No. 32:	1.0247	No. 99:	1.0263
No. 40:	1.0253	No. 110:	1.0261
No. 41:	1.0254	No. 115:	1.0261
No. 42:	1.0254	No. 120:	1.0257
No. 43:	1.0253	No. 124:	1.0258
No. 46:	1.0253	No. 129:	1.0260

CALCULATION OF THE CONSTANT REPRESENTING THE INSTRUMENTAL ERROR

During the cruise of the "Albatross" among the Philippine Islands two hundred and twenty-one observations of the surface density were taken, with the instruments which I myself had used in 1906; these observations show considerable variation, but the average is 1.024533.

There were also taken on the same cruise eighty observations of the salinity below 100 fathoms; these likewise exhibit a considerable amount of variation, and give an average of 1.025048.

The records for the eighty-four observations taken among the Philippine Islands below the surface are in detail as follows:

34	fms.	1.02386
50	"	1.02523
78	"	1.02516
96	"	1.02551
102	"	1.02451
105	"	1.02496
108	"	1.02476
118	"	1.02496
122	"	1.02526
140	"	1.02482
148	"	1.02597
148	"	1.02506
150	"	1.02513
150	"	1.02513
155	"	1.02509
159	"	1.02517
162	"	1.02421
170	"	1.02489
172	"	1.02359
173	"	1.02468
174	"	1.02513
177	"	1.02496
178	"	1.02523
178	"	1.02496
180	"	1.02510
186	"	1.02510
191	"	1.02489
193	"	1.02517
193	"	1.02467
195	"	1.02447
198	"	1.02468
201	"	1.02538
208	"	1.02456
212	"	1.02593
214	"	1.02354
215	"	1.02465
218	"	1.02485
218	"	1.02468
220	"	1.02509
220	"	1.02500
224	"	1.02525
225	"	1.02492
230	fms.	1.02496
231	"	1.02513
234	"	1.02484
244	"	1.02482
248	"	1.02517
249	"	1.02482
258	"	1.02516
265	"	1.02430
272	"	1.02421
280	"	1.02517
295	"	1.02482
299	"	1.02502
300	"	1.02495
310	"	1.02543
312	"	1.02484
340	"	1.02454
375	"	1.02576
379	"	1.02521
380	"	1.02459
393	"	1.02480
394	"	1.02468
411	"	1.02475
422	"	1.02566
450	"	1.02556
494	"	1.02522
502	"	1.02457
515	"	1.02523
524	"	1.02538
525	"	1.02577
530	"	1.02467
554	"	1.02497
564	"	1.02533
565	"	1.02505
584	"	1.02535
604	"	1.02441
612	"	1.02516
638	"	1.02492
730	"	1.02564
745	"	1.02548
775	"	1.02606
958	"	1.02516
1804	"	1.02574

The averages are:

0-100	fms.	1.02494
100-150	"	1.02505
150-200	"	1.02482
200-250	"	1.02487
250-300	"	1.02480
300-350	"	1.02494
350- 400	fms.	1.02501
400- 450	"	1.02532
450- 500	"	1.02522
500- 600	"	1.02514
600- 700	"	1.02483
700-1804	"	1.02561

Comparing the known average density of the surface water of the Philippine archipelago, about 1.02675, with the average of the observations taken by the "Albatross," 1.02453, we find the latter to be 0.00222 too low. Possibly part of the difference is due to the excess of salinities taken near the shore in the "Albatross" records.

Comparing the known average density of the deep water of the Pacific, 1.02650, with the average of the eighty observations taken by the "Albatross" below 100 fathoms, 1.025048, we find the latter to be 0.00145 too low. A glance at the records suggests that the difference really is somewhat greater, for the water bottles evidently did not always contain water from the depth to which they were submerged.

A similar comparison of the densities as given by Makaroff, and as determined by myself in the same localities at six well separated places show my observations as calculated to be too low by 0.00136, 0.00184, 0.00215, 0.00210, 0.00115 and 0.00175.

If we average these differences between the observations taken on the "Albatross" and those taken by the British, German, Swedish and Russian ships we will get a correction which, when applied to the former, will make them comparable to the latter, or at any rate nearly enough so for the purposes of the present study. The average of these eight differences is 0.00175, which is the correction which will be used throughout this paper. The average of my six observations which are comparable to those of Makaroff, all of which were calculated by the same observer, is 0.00173.

On plotting my observations, corrected by comparison with the determinations of Makaroff on the western side of the Pacific upon a chart, I found that one of my stations was almost on the exact spot occupied by a station recorded by Lenz, in the Gulf of Alaska, and I was gratified to find that the salinity given by Lenz, and my own determination of the salinity with the empirical correction added, were identical.

It will be noticed that all of the salinity records published by Mr. Alexander Agassiz for the mid-Pacific region which were taken on board the "Albatross" are in need of about the same correction to make them comparable with those of the ships of other nations.

The necessity for this correction arises from the fact that the instruments were not standardized before being used.

BRIEF RESUMÉ OF THE CONDITIONS FOUND IN THE NORTH PACIFIC

For our knowledge of the water densities and of the temperatures of the North Pacific we are chiefly indebted to the late Vice-Admiral S. O. Makaroff of the Russian Navy. Not only did he take an enormous number of observations of his own, beginning in 1866 as a naval cadet and from that time almost constantly until his death on the "Variag," but in an exhaustive monograph published in 1894,[1] he summarized and digested all the work of the others who had taken observations in that area, republishing, often with certain corrections calculated by himself, all their data.

The following account of the conditions in the Pacific is chiefly a summary of that given by Makaroff.

Speaking broadly, there is found in the trade wind belt of the western part of the Pacific, a zone of warm water with a high salinity; water with a density of more than 1.0270 is only found in this zone and along the equator; beyond this area as far as the Philippines and Japan, and approaching the equator in a broad curve around it to the eastward, we find water having a density of from 1.0265 to 1.0270. Corresponding to latitude 42° to 46° N. we find water with a density of from 1.0255 to 1.0260; this approaches the coast of California where it mingles with the coast water and, taking a direction toward the southsouthwest, forms a cuneiform area within the area of water of higher salinity. It is probable that this area of low salinity (which lies to the southward of the Hawaiian Islands) is narrower in August than in March, and also that it is then situated more to the southward. This zone corresponds to the so-called California current.

The surface water to the northward of the zone with density ranging from 1.0255 to 1.0260 has a density of from 1.0250 to 1.0255, and Makaroff believed it probable that the larger part of the surface water of the Bering Sea lies within these extremes (see beyond, p. 17).

The mean specific gravity of the surface water of the Pacific (excluding the enclosed seas) is 1.0264.

The specific gravity of the lower levels over the entire Pacific is everywhere the same; the average is 1.0265.

The "Challenger" found near the antarctic ice at 50 fathoms a specific gravity of 1.0265, or the same as the mean for the deep water

[1] "Vitiaz" i Tikhii Okean; Le "Vitiaz" et l'Océan Pacifique. St. Pétersbourg, 1894.

of the Pacific; Makaroff believes that the water of the deeper layers in the Pacific comes originally from the Antarctic Ocean, an hypothesis which finds much support in the zoögeography of the Pacific region.

The specific gravity of the water of the Philippines and of the Sulu and Celebes Seas is much less than that of the adjacent parts of the Pacific.

In order to appreciate the significance of the varying salinities in the North Pacific and in the enclosed seas bordering upon it some attention must be given to the circulation of the water in the region and to the course and interrelationships of the various currents found there.

The largest of these currents, and by far the most important, is the warm current from the south carrying water of high salinity, known as the Kuro-Siwo or Japanese current, and corresponding in a general way to the so-called Gulf Stream of the western Atlantic. On reaching the coasts of Japan and the peninsula of Korea the Kuro-Siwo divides into three parts; the principal part advances along the southern coast of Japan; the second enters the Sea of Japan through the straits of Korea and forms the so-called Tsu-Shima current; the third turns to the westward and resembles in its general characteristics a similar branch which is given off from the Kuro-Siwo south of Formosa. It is not yet definitely known just what direction this branch takes; but as Makaroff found in running from the Chu-San archipelago to Nagasaki a water with a very high specific gravity it seems probable that this branch, after describing a broad curve, turns toward the south in the same manner as does the branch given off south of Formosa.

The Tsu-Shima current does not occupy the entire width of the Korean Straits, for there is a zone of cold water with a low specific gravity along the Korean Coast which is part of a similar zone occupying the entire western part of the sea of Japan. On entering the Sea of Japan through the Korean Straits the Tsu-Shima current turns to the right and runs northeastward along the Japanese coast. It is probable that this current influences the salinity of the entire southeastern part of the Sea of Japan.

Observations have shown that near Dajelet Island at a depth of 100 meters the cold water is sharply separated from the warm water which here is shoved downward, forming a deep current beneath the superficial water of low salinity flowing southward from the north.

The Tsu-Shima current, advancing toward the northeast, reaches the Strait of Tsugaru, through which a large amount of water flows to the eastward from the Sea of Japan to the Pacific. Continuing further toward the northeast the greater part of what remains of the Tsu-Shima current flows through the Strait of La Pérouse into the Sea of Okhotsk, and a comparatively small portion continues northward along the west coast of Sakhalin.

The salinity of the surface water in the Strait of La Pérouse is greatly diminished by an admixture of fresh water from rain and snow, but at depths greater than 25 meters it is found to be the same as that of the water passing through the Korean Strait.

The principal branch of the Kuro-Siwo which follows the southern coast of Japan passes with great swiftness through van Dieman Strait, and thence runs parallel to the coast only touching the extremities of the capes which extend furthest outward from the southern shore, Siwo-Misaki, Kawatsu, etc. It does not enter any of the gulfs or bays. In winter its limits are readily recognized by the high temperature and the high specific gravity, but in summer they can be determined only by the latter.

The salinity of the water of the Inland Sea is much less than that of the neighboring parts of the Pacific or of the Sea of Japan; Makaroff found it to be in January 1.02527, in May 1.02544 and in June 1.02632, the average being 1.0252; the "Challenger" found the average salinity of the eastern part in May to be 1.02375.

The Kuro-Siwo only follows the coast of Japan as far as Cape Inaboïe Saki, at that point turning to the east. Many observations made on vessels running between Kamchatka and Japan have proved that in the later summer months the warm water extends much further to the northward than the parallel of Cape Inaboïe Saki though, judging from the specific gravities, the northern limit of the Kuro-Siwo scarcely passes 40° N. At that latitude the surface water of the Kuro-Siwo turns to the eastward, and has a specific gravity of less than 1.0260. However, water with a specific gravity of 1.0260 is found in the deeps of the Bering Sea and reaches to within 200 meters of the surface. It is to be noticed that in the Bering Sea the isotherms rise toward the east, so that we are justified in believing that the warm water approaches nearer the surface in the eastern than in the western part.

In the Sea of Japan the heavy water, which is borne by the Tsu-Shima current, turns to the eastward; but it does not at all points touch the island of Nipon as it is deflected by a moderately strong current of small salinity which comes from the Inland Sea, entering the Sea of Japan by the Straits of Shimonoseki. This heavy water in flowing northward along the coasts of Nipon, Yezo and Sakhalin very gradually becomes less and less saline.

Near the Siberian coast, water with a specific gravity of from 1.0250 to 1.0255 descends from north to south, washing the whole coast of the western part of the Sea of Japan and making itself felt even in the Korean Strait.

The specific gravity of the water in the Sea of Japan is higher than that in corresponding latitudes in the Pacific; in going from Hakodate to Vladivostok the specific gravity diminishes rapidly west of 134° and near Vladivostok is about 0.0011 less than in the Strait of Tsugaru.

The mean specific gravity of the water of the Sea of Japan, both at the surface and in the deeper portions, is 1.0260.

Tracing a line from the Bay of St. Olga to the middle of the Korean Strait we find that in the western part the specific gravity, both at the surface and below, does not pass 1.0260. The heavy water which enters the Strait of Korea occupies in width more than half the strait, and its entire depth; further northward, however, the thickness of the heavy layer does not exceed 100 meters. Water with a specific gravity of more than 1.0262 is only found in the eastern part of the sea.

The Strait of La Pérouse includes two zones of water of different salinities and temperatures. In the southern part there is a warm current which descends toward the east near the coast of Yezo, and in the northern part, near the coast of Sakhalin, there is a cold current running toward the westward out of the Sea of Okhotsk. The line of separation between these two currents is not vertical but strongly inclined; the water from the Sea of Okhotsk, lighter and colder, advances in a mass having a cuneiform section over the warmer, but also heavier, water of the eastern part of the Sea of Japan which passes downward and, turning to the right on account of the rotation of the earth, extends far toward the northeast under the cold water. This water from the Sea of Japan has a specific gravity of 1.0260, and a temperature of 19°C. in August; it is probable that in winter the temperature does not fall below 3° C.

The surface water of Aniva Bay, in southern Sakhalin, has a specific gravity of 1.0245; for a while in August its temperature may be as much as 17° C., but the rest of the year it is much lower.

Under the upper layer of comparatively warm water is a cold layer with a specific gravity of 1.0254.

On account of the quantity of water which flows through the Korean Strait and raises the surface of the Sea of Japan and that of the Gulf of Tartary above that of the surrounding seas the bulk of the water from the Amur River, instead of turning to the right and flowing to the southward as would naturally be expected, turns to the north, though part of it comes southward along the western shore of the Gulf of Tartary where it causes a considerable diminution of the salinity. In this gulf the water of the lower layers near Sakhalin, below 40 meters, has a higher specific gravity than that near the continent. In the upper layers there is no regularity in the variations so that they are probably the result of the action of winds, local currents, tides, etc.

Almost the entire central portion of the Sea of Okhotsk has a specific gravity between 1.0245 and 1.0250; near the coasts the water is in general less saline. In the Bay of Oudsk and near Sakhalin the specific gravity is less than 1.0230, showing the influence of small rivers which empty into the southwestern part of the Sea of Okhotsk, and especially of the Amur. Krusenshtern found near the northern end of Sakhalin water with a specific gravity of 1.0130.

The deeper water of the Sea of Okhotsk is more dense than that nearer the surface; at a depth of 800 meters it has a specific gravity of 1.0261, or the same as that of the water which enters through the Strait of La Pérouse. As in the Bering Sea this lower stratum of warm water with high salinity is found at a greater depth in the west than in the east, for in both seas there is, along the western coast, a cold current of low salinity which submerges to a great depth the warm water with high salinity. Makaroff believed that the water of the Sea of Okhotsk enters that sea by way of the Strait of La Pérouse and not from the Pacific.

The mean density of the water of the Sea of Okhotsk and of all its bays is 1.0242.

Among the Kuril Islands the surface water is mixed with heavier and much colder water than that occurring on the coast of Kamchatka, the greatest degrees of salinity and cold being midway between Kamchatka and Japan and not at the northern end of the chain; this heavy and cold water forms a broader belt on the Pacific than on the Okhotsk Sea side of the islands; it was supposed by Makaroff to be in reality water from the great depths of the Okhotsk

Sea which is here forced to the surface through the pressure of the deep current of warm heavy water which enters the Okhotsk Sea through the Strait of La Pérouse. It may be, however, that this explanation is not quite correct, and that the presence of this abyssal water among the Kuril Islands is to be accounted for rather by the application of Ekmann's hypothesis.

Relatively warm water with a specific gravity of 1.0260 is found in the depths of the Bering Sea, reaching to within 200 meters of the surface; it is found much nearer the surface at the Commander Islands than along the coast of Kamchatka, a phenomenon similar to that observed in the Sea of Okhotsk. It is to be remarked that in the Bering Sea the isotherms rise toward the eastward as one leaves the Kamchatkan coast so that we are justified in believing that the warm water approaches nearer the surface in the eastern part than in the western, though there is no evidence that the specific gravity is higher in the former.

The layer of warm surface water along the coast of Kamchatka is very shallow, and observations on this coast prove the existence of an intermediate zone of cold water, just as in the western part of the Sea of Okhotsk; determinations made in latitude 60°-62° N. show that the specific gravity is still low at a depth of 150 meters which induces us to suppose that here the water is influenced by the water of the Arctic Ocean and is not directly connected with the warm water of the more southern latitudes.

At Port Clarence, Alaska, the specific gravity of the deeper water is from 1.0136 to 1.0216, much less than in the middle of the Bering Strait or in the Arctic Ocean. The "Vega," on her course across the Bering Strait from Port Clarence to Simavine, found that the specific gravity rose a little, the value being the same from the surface to the bottom; beyond longitude 171° W. the specific gravity of the surface water became much less than that of the deeper layers, while the temperature was also lower at all depths.

In the Bering Strait the more saline water occurs on the western side; the comparatively warm water which enters the Arctic Ocean on the eastern side is strongly mixed with the water from the Alaskan rivers and shows no trace at any depth of the water of the Kuro-Siwo which apparently does not reach this point.

Observations made near the coast of Asia in latitude 63° 16′ N. showed the presence of an intermediate layer of cold water similar to that observed near the coast of Kamchatka.

A water of low salinity descends to the southward near the coast of Kamchatka, and apparently continues down the Kuril chain; further from the coast the water of the Bering Sea has a salinity of about 1.0250, corresponding to the latitude.

METEOROLOGICAL CONDITIONS TENDING TO LOWER THE COMPARATIVE SALINITY OF THE PACIFIC

Professor Krümmel has shown that the Pacific is less saline than the Atlantic, the difference between them being comparatively slight in the southern hemisphere, but very considerable in the northern. A preliminary examination of the data available for the portion of the north Pacific north of Puget Sound shows that the low salinity of this area is much more marked on the eastern than on the western side. Professor Woekoff has explained the increased salinity of the Atlantic by the constant loss of water from the Atlantic and from the Atlantic water sheds through the operation of constant westerly winds which, passing across Europe, Asia and Africa, charged with Atlantic water, deposit it in the interior basins of those continents which have no connection with the oceans, and even in the Asiatic water shed of the Pacific itself. The Pacific loses no water in this way on account of the high mountains which form an almost unbroken barrier along its eastern shores.

THE SEASONAL VARIATION IN THE SALINITY OF THE WATER OFF THE CALIFORNIAN COAST

A preliminary examination of the salinity records obtained by the "Albatross" off the Californian coast, with the necessary corrections applied, shows a most interesting condition. In the summer the isohalines, upon reaching the vicinity of the Californian coast, bend abruptly to the northward and run more or less parallel with the shore, this effect being noticeable nearly to Puget Sound. In the winter this distortion of the isohalines disappears, and they then run to the coast almost exactly along the parallels of latitude.

Dr. Thorade has worked out in great detail the seasonal variation in temperature for the Californian coast, and he finds that the isotherms near the coast bend downward and run far to the southward in summer, but become more or less coincident with the parallels of latitude in winter. He has explained the phenomenon as resulting from the upwelling of abyssal water along the Californian coast in summer, this upwelling decreasing and practically disappearing in winter. His explanation of the coldness of the coast strip as a result of the upwelling of abyssal water presumes that this cold water should also be exceptionally saline, and therefore that the isohalines should bend abruptly to the northward just as the isotherms bend abruptly to the southward, while in the winter both isotherms and isohalines should follow courses more nearly agreeing with the parallels of the latitude. My observations on the seasonal variations in the salinity of this coast agree absolutely with his on the temperature.

The charts published by Makaroff show that in the mid-Pacific, between 170° and 180° W. long. the mean isohaline of 1.0255 runs approximately along the 46th parallel, and the isohaline of 1.0260 is approximately in 42° 50′ N.; the 1.0250 isohaline is far up in the Gulf of Alaska where it runs parallel to the coast, crossing the meridian of 140° W. in about 56° N. From these positions there is a slight southerly movement in winter, and in a corresponding northerly movement in summer.

In the summer the isohaline of 1.0250, running in a generally southerly direction, turns northward at about 42° 15′ N. lat., 127° W. long., joining the coast of Cape Moares, in 45° 30′ N. lat. The isohaline of 1.0255 turns northward at 37° N. lat., 127° W. long., and runs thence almost directly north between the meridians of 125° 30′ W. and 125° 00′ W. (practically coinciding with the latter north of 41° N. lat.) for a considerable distance, eventually turning eastward and reaching the coast at Cape Blanco. The isohaline of 1.0257 rises in a broad curve from 34° 40′ N. lat., 133° W. long. to 36° 30′ N. lat., 123° 30′ W. long., and then turns rather abruptly northward and northwestward, running parallel to the coast to 39° N., when it gradually turns northward again, reaching the coast at Cape Mendocino. The noticeable feature of this isohaline is the broad seaward bend which, considered in its relation to the coast line, reaches its maximum in the latitude of San Francisco, and its actual maximum westerly extension in 39° N. lat. In the San Francisco region there is a small area with a salinity of less than 1.0255 bounded by a curve of large radius extending from Point Arena (just south of 39° N. lat.) on the north to Pescadero Point (about 37° 15′ N. lat.) on the south. This curve crosses 38° N. in 123° 30′ W., and 123° W. in 37° 30′ N., its course being almost parallel to that of the 1.0257 line further off shore. The isohaline of 1.0260 turns northward at 33° N., 125° W., and runs in a broad curve northnortheast to Monterey Bay.

In the winter the isohalines east of 133° W. run approximately along the parallels of latitude, rising only slightly near the coast; the isohaline of 1.0255 rises from 33° 50′ N. lat., 124° W. long to Point Sal, north of Point Conception; the isohaline of 1.0257 runs from 33° N. 123° W. to Santa Barbara; and the isohaline of 1.0260 run from 32° 20′ N. 121° W. to Encinitas, just north of San Diego.

THE BERING SEA

A preliminary examination of the American records available for the Bering Sea shows a rather interesting condition, though one which is essentially what would be predicated from a survey of the land and submarine contours and of the drainage systems.

Makaroff showed the isohaline of 1.0250 running from 45° N. lat. 150° E. long. nearly in a straight line (with a slight regular convexity toward the east) to Bering Island, then turning more to the eastward and running (again with a slight convexity toward the southeast) to about lat. 61° N., long. 180° WE.; from this point he was unable to trace it further owing to an absence of data. It appears from the records at hand that here it turns abruptly to the southward running as far as lat. 55° N. which it crosses in long. 179° 20′ W., then making a broad sweep toward the east, crossing lat. 54° N. at long. 177° 30′ W., reaching lat. 53° 35′ N. in long. 174° 30′ W., and, continuing the same curve, crossing lat. 55° N. again in long. 171° 25′ W.; here it turns abruptly toward the NNW., crossing lat. 55° N. in long. 171° 55′ W., and reaching lat. 55° 50′ in long. 171° 55′ W., curving sharply about and coming southward again in a course parallel to that taken going north and about thirty miles to the eastward (forming a long narrow finger toward the NNW., lying chiefly between long. 171° W. and long. 172° W.) as far as lat. 54° 25′ N. long. 170° 30′ W. where it gradually turns eastward, after long. 169° W. running between lat. 54° 05′ N, and lat. 54° 10′ N. to long. 167° 05′ W. where it turns abruptly south and then west, running WSW. nearly in a straight line to Uliaga in the Islands of Four Mountains.

We thus see that the water with a specific gravity of 1.0250 or more is entirely confined to that part of the Bering Sea west of long. 167° W., while except for a narrow strip just north of the Andreanof Islands, the Islands of Four Mountains, Unmak and western Unalaska, it lies to the west of long. 179°. It therefore lies entirely in the deep western part of the sea, its southeastern extremity showing a curious approximate coincidence with the 1000 fathom line.

The westerly position of this water of comparatively high salinity which enters the Bering Sea from the southward is evidently governed by the breadth and depth of the channels. Between Kamchatka and the Commander Islands it lies beneath the colder and less saline water flowing southward along the Kamchatkan coast, this superficial layer progressively decreasing in thickness toward the east and allowing the heavier and warmer water to reach the surface at Bering Island. The broad deep channel between the Commander and western Aleutian Islands allows of the passage of great quantities of Pacific water, but the large Andreanof Islands with the narrow channels between them form a barrier so that little is able to flow by them. Between the Andreanof Islands and Unmak, however, there are again broad open channels, inluding the Amukta Pass, and these allow of the passage of enough water to form to the northward the long finger above described, and the somewhat similar finger stretching toward the east nearly to long. 167° W.

The general configuration of the area of high salinity in the western part of the Bering Sea suggests that it is not a constant, but rather an intermittent flow, for were it constant, one would scarcely expect to find it extending itself by such long and narrow processes as occur north, and again east, of the Amukta Pass, or failing to reach the shores of islands upon which the precipitation is not by any means sufficient to keep it away.

It is quite possible that we have in the Bering Sea a condition comparable to that shown by Cleve, Ekmann and Pettersson to exist in the Norwegian Sea, and that there is a yearly pulsation due to a variation in the height of the level of the north Pacific, reaching the maximum in November and the minimum in March, by which the flowing of the surface water of the Pacific through the Aleutian channels is increased during the late spring, summer and early autumn, decreasing in the winter and early spring. While the flow of water of comparatively high salinity from the Pacific into the Bering Sea is undoubtedly constant, and toward the western part of the sea always strong, its eastward extension is probably governed by an annual variation, expanding and contracting with more or less regularity.

Toward the eastern part of the Bering Sea the density decreases very slowly; the 1.0240 line crosses long. 164° W. in lat. 57° 30′ N., running toward the southeast; crossing long. 163° W. in lat. 55° 15′ N. it turns south running to a point fifteen miles north of Point Blaine on the Alaska peninsula, then turns southwest and follows the coast to Cape Mordvinof on Unimak where it reaches its southwestern limit.

South of the Alaska peninsula the 1.0250 line runs in a northeast-southwest direction slightly to the northwest of lat. 54° N. long. 158° W.

SYNOPSIS OF THE SALINITIES OBSERVED DURING THE 1906 CRUISE OF THE "ALBATROSS"

Locality	Observation No.	Density
Near San Francisco Bay	(1)	1.0212
From San Francisco to the Columbia River	(2-10)	1.0255
Off the Columbia River	(11)	1.0218
Off Clearwater, Washington	(12)	1.0252
Strait of Juan de Fuca	(13)	1.0243
At Tacoma	(14)	1.0211
Strait of Georgia	(15)	1.0214
Union Bay, Vancouver Island	(16-17)	1.0221
Queen Charlotte Sound	(18)	1.0224
Provost I. to long. 145° W	(19-26)	1.0250
Long. 145° W. to long. 158° W	(27-30)	1.0253
South of the Shumagin Is	(31)	1.0240
Eastern end of the Aleutian Is	(32-33)	1.0247
Near Bogosloff	(34)	1.0250
Unimak to Seguam	(35-38)	1.02525
Atka to Semisopochnoi	(39-42)	1.0254
South Central Bering Sea	(43-52)	1.0253
Vicinity of Semisopochnoi Is	(53-55)	1.0254
South of Amchitka	(56)	1.0250
Kyska to Copper (Myedni) Island	(57-68)	1.0253
Copper I. to and about Bering I	(69-76)	1.0252
Between Bering I. and Kamchatka	(77-78)	1.0250
Near Starichkof I	(79-80)	1.0246
Off Cape Asacha, Kamchatka	(81)	1.0248
About southern Kamchatka	(82-86)	1.0252
Vicinity of Simushir, Kurils	(87-90)	1.0255
Urupp, Kurils, to Cape Yerimo, Yezo	(91 95)	1.0253
Strait of Tsugaru	(96)	1.0255
Eastern part of the Sea of Japan	(97-104)	1.0260

Locality	Observation No.	Density
Toyama Bay (1.0216-1.0261)	(105-114)	1.0253
Near Waijima	(115)	1.0261
Komatsu to Kioga Saki	(116-124)	1.0256
Oki Is.	(125-126)	1.0255
Between Oki Is. and Hornet I. (Liancourt Rocks)	(127)	1.0252
Between Oki Is. and Hornet I.	(128)	1.0258
South of Hornet I. and Matsushima I.	(129-131)	1.0261
Coast of Korea, and the Korean Straits to Tsu-Shima and Ikki-Shima	(132-139)	1.0248
South of Hirado I. and near Nagasaki	(140-141)	1.0253
South of Goto Is.	(142)	1.0252
South of Goto Is. and West of Koshiki I.	(143-148)	1.0247
West of Uji-Shima and South of Kusakaki-Shima	(149-151)	1.0252
South of Tanega-Shima	(152-153)	1.0262
West of Tanega-Shima	(154)	1.0257
Off Kagoshima Gulf	(155)	1.0251
In Kagoshima Gulf	(156)	1.0239
Van Dieman Strait, and eastward to the Inland Sea	(157-162)	1.0261
Inland Sea	(163-164)	1.0241
South of the Kii Channel	(165)	1.0259
In Oshima-Ko	(166)	1.0238
Off Oshima-Ko and South of Hamamatsu	(167-172)	1.0257
Near No-Shima	(173)	1.0259
Northeast of Choshi	(174)	1.0254
From Choshi to Tsugaru Strait	(175-179)	1.0255
From Iwanai Bay to Rebunshiri I., and west of Southern Sakhalin	(180-183)	1.0258
Eastern part of the Gulf of Tartary	(184-185)	1.0256
Aniva Bay, Sakhalin Island	(186)	1.0245
Near Cape Siretoko	(187)	1.0243
Southeastern Sakhalin to Cape Patience	(188-191)	1.0235
Sea of Okhotsk	(192)	1.0239
Sea of Okhotsk	(193)	1.0245
Sea of Okhotsk	(194)	1.0247
Sea of Okhotsk	(195)	1.0256
Sea of Okhotsk	(196)	1.0255
South of Kunashir and Otsu Saki	(197-198)	1.0253
Near Cape Yerimo, Yezo	(199)	1.0252
Off Urakawa and west of Urakawa	(200-201)	1.0258
From southeast of Mororan to Sendai	(202-204)	1.0254
Off Sendai	(205)	1.0259
Northeast of Choshi	(206)	1.0249
Vicinity of No-Shima	(207-208)	1.0255
Suruga Gulf	(209-215)	1.0250
Off Suruga Gulf	(216-218)	1.0256
West of Nii Jima	(219)	1.0254
Sagami Bay	(220-221)	1.0253

NARRATIVE

Our first observation, made not long after leaving San Francisco Bay, showed water of a comparatively low density (1.0212), possibly indicating the influence of the bay water. From Marin county to the mouth of the Columbia River we passed through water varying in density from 1.0251 to 1.0259, with an average of 1.0255; this variation was probably due to our crossing closely approximated isohalines running more or less parallel to the shore line, though possibly part of it was due to the effect upon the surface water of the various rivers which enter the ocean along this coast. Off the mouth of the Columbia River the density was, as would naturally be expected, very low (1.0218); it rose to 1.0252 further north and fell to 1.0243 in the Straits of Fuca.

At Tacoma, in the Straits of Georgia, and at Union Bay, Vancouver Island, the density was low, ranging between 1.0211 (at Tacoma) and 1.0221 (at Union Bay), on account of the drainage from the land; but in Queen Charlotte Sound we found it to be again about the same (1.0244) as it was in the Straits of Fuca.

From the Queen Charlotte Sound as far as long. 145° W. the density was very uniform (1.0250); at that point a slight rise was noted (1.0253) which was maintained to long. 158° W., beyond which locality, in the vicinity of the Shumagin Islands, it dropped to 1.0240, rising again south of the eastern end of the Aleutian chain to 1.0247.

Near Bogosloff the density was slightly greater (1.0250), and on the course from Unimak to Siguam a further slight increase was noticed, which was augmented between Atka and Semisopochnoi. In the south central part of the Bering Sea the density was very slightly less, but on returning to the vicinity of Semisopochnoi we found the same figure which we had previously observed between Atka and Semisopochnoi. Our observation south of Amchitka is rather low, and may possibly be incorrect. Between Kyska and Copper Island the readings were the same as those in the south central Bering Sea (1.0253), and slightly less than those between Atka and Semisopochnoi. From Copper Island to and about Bering Island a slightly lessened density (1.0252) was noted, and a further decrease was observed between Bering Island and Kamchatka (1.0250).

Near Starichkof Island a comparatively low density was found (1.0246), which rose off Cape Asacha (1.0248) and again about the southern extremity of Kamchatka where, both in the Pacific and in the Okhotsk Sea, it was again the same as between Copper and Bering Islands (1.0252).

In the vicinity of Simushir the salinity was notably high (1.0255), falling again on the course between Urupp and Cape Yerimo, Yezo, to the same figure we had observed in the south central Bering Sea and between Kyska and Copper Islands (1.0253).

In the Strait of Tsugaru the same density was observed as in the vicinity of Simushir (1.0255), but we found it greatly increased in the eastern part of the Sea of Japan (1.0260).

In Toyama Bay we determined salinities ranging from 1.0216 (in the southern part) to the normal salinity for the eastern part of the Sea of Japan, 1.0260 (in the more northern part). Near Wai-jima we found the same salinity as in the same general region further to the north (1.0261); but between Komatsu and the Oki Islands it was considerably less (1.0256), and we noted a further drop in the vicinity of the Oki Islands (1.0255).

Between the Oki Islands and Hornet Island (Liancourt Rocks), we determined two quite different readings, 1.0252 and 1.0258, while south of Hornet Island and south of Matsushima we found the high density characteristic of the east coast of the Sea of Japan (1.0261).

Along the Korean coast and in the Korean Strait about Tsu-Shima and Ikki-Shima we found water of a very low density (1.0248), which was the same as that previously observed off Cape Asacha, Kamchatka, and in general comparable to that along the east Kamchatka coast. South of Hirado Island and near Nagasaki the density was greater (1.0253), and was the same as that in the south central Bering Sea, between Kyska and Copper Islands and along the southern Kurils, and almost the same as that between the Oki Islands and Hornet Island. South of the Goto Islands and west of Koshiki Island (except in one spot in the former locality where we found a density of 1.0253, or practically the same as that south of Hirado Island and near Nagasaki) the density was 1.0247, or approximately the same as that along the Korean coast and about Tsu-Shima and Ikki-Shima. West of Uji-Shima and south of Kusakaki-Shima the density was about the same as that south of Hirado Island and near Nagasaki (1.0252), and the same as that about southern Kamchatka.

South of Tanega-Shima the salinity became much higher (1.0262), reaching about the same figure as in the eastern portion of the Sea of Japan. West of Tanega-Shima it was less (1.0257), and off Kagoshima Gulf much less, while within Kagoshima Gulf we found the water comparable to that in Toyama Bay, though only one observation (1.0239) was taken.

In van Dieman Strait and along the coast to the Inland Sea the same density (1.0261) was found as near Waijima and generally in the eastern part of the Sea of Japan.

The two observations in the Inland Sea showed a water of low salinity (1.0241); but south of the Kii channel we found again approximately the same salinity as that normal for the Japanese current (1.0259).

In the little land-locked harbor of Oshima-Ko the water was quite fresh (1.0238), while in the vicinity of that harbor and south of Hamamatsu we found it somewhat less saline than in the Japanese current (1.0257).

Near No-Shima the salinity rose to 1.0259, and on our journey northward along the east coast of Japan to the Strait of Tsugaru we found the density varying between 1.0252 and 1.0258, with an average of 1.0255.

In Iwanai Bay and in Ishikan Bay on the west coast of Yezo, and west of Rebunshiri Island and southern Sakhalin, the salinity was comparatively high (1.0258), dropping further to the northward in the eastern part of the Gulf of Tartary to 1.0256. Our single observation in Aniva Bay in southern Sakhalin gave 1.0245, while off Cape Siretoko we found 1.0243. Between Cape Siretoko and Cape Patience the salinity varied between 1.0243 and 1.0227, the average being 1.0235, and on our course between Cape Patience and the southeastern corner of the Sea of Okhotsk it rose regularly through 1.0239, 1.0245 and 1.0247 to 1.0256 and 1.0255, falling to 1.0253 south of Kunashir and south of Otsu-Saki, and to 1.0252 off Cape Yerimo. Off Urakawa and west of Urakawa we found a salinity of 1.0258, southeast of Mororan to Sendai a salinity of 1.0254, while another observation off Sendai gave 1.0259. Northeast of Choshi we found a salinity of 1.0249, and in the vicinity of No-Shima a salinity of 1.0255.

As was to be expected the water in Suruga Gulf proved to be less saline than that of the open sea, especially in the more remote portions, varying from 1.0236 to 1.0256, with an average of 1.0250; off shore in this region we found 1.0256.

West of Nii Jima we found a salinity of 1.0254, and in Sagami Bay our two observations gave 1.0253.

AN OBSERVATION ON THE INTERMINGLING OF RIVER AND OCEAN WATER

It has long been known that the water from a shallow river upon entering the sea spreads out fan-like over the surface of the salt water for a very considerable distance with little intermingling. While dredging one day in Suruga Gulf we had striking optical evidence of the truth of this. Though the day was clear there had been during the preceding night heavy rains over the land and the rivers were all swollen and very muddy. It happened that one of the localities in which we wished to work was within the area covered by the extremely muddy water from a small river. The water was so muddy that small objects disappeared from view at a depth of a few inches. On hauling up the trawl a dark hole of clear black water was made through the muddy surface layer, which was then seen to be but a few feet in thickness.

COMPARISON OF OUR FIGURES WITH THOSE PREVIOUSLY PUBLISHED

As far as southern Kamchatka our figures agree very well with those of "Vega," "Vitiaz," "Variag" and "Predpriatie" for the same region. From this point our course was through territory for which there are no previous records, though the "Vitiaz" established a line of observations somewhat further to the eastward. We found the specific gravity of the water in the Kuril chain higher than would be expected, reaching a maximum in the middle of the group; these comparatively high figures undoubtedly represent a purely local condition, the result, as explained by Makároff, of the upthrust of the abyssal water of the Okhotsk Sea (or of the Pacific, or of both) to the surface.

About Yezo our figures again agree with those previously published. There are no records for the west coast of Nipon, and here our observations seem to indicate a belt of water of comparatively low salinity near the coast, probably a very thin and superficial layer resulting from the drainage from the land, intervening between the heavy water of the eastern part of the Sea of Japan and the shore line.

In the region of the Korean Straits and off the Korean coast our figures do not quite agree with those of Makaroff, though, generally speaking there is but little difference; our figures for southern and eastern Japan more nearly coincide with his.

On the west coast of Yezo, where no previous observations have been taken, we found water of a somewhat lesser density than is indicated for the region further off shore; this would naturally be expected, and agrees with the conditions found on the west coast of Nipon.

Along the coasts of Sakhalin our observations agree with those of the Russian investigators.

For the southern and southeastern part of the Sea of Okhotsk there are no previous records; we found conditions approximately what would be expected and, agreeing with our observations further to the northward, found a local area of comparatively high salinity near the Kuril chain.

TABLE SHOWING THE SPECIFIC GRAVITIES OF THE SEA WATER AS OBSERVED DURING THE 1906 CRUISE OF THE "ALBATROSS."

Serial No.	Date (1906)	Time of day	Latitude (N)	Longitude	General location	Specific gravity at surface	Specific gravity below surface	Specific gravity corrected by the addition of 0.00175		Accept'd specific gravity
								At surface	Below surface	
			° ′ ″	° ′ ″						
1	May 3	8.00 p. m.	37 54 30	122 51 40 W	Off Marin County, California.	1.01904	1.01946	1.02079	1.02121	1.0212
2	4	8.00 a. m.	....	....	....	1.02446	1.02404	1.02621	1.02579	1.0257
3	4	10.02 a. m.	39 18 00	123 58 00 W	About 20 miles off coast of Cal.	1.02387	....	1.02562	....	1.0256
4	4	8.00 p. m.	40 18 30	124 27 00 W	Off Point Gorda. Cal.........	1.02454	1.02424	1.02629	1.02599	1.0259
5	5	8.00 a. m,	41 09 00	124 50 00 W	Off Trinidad Head Cal......	1.02504	1.02385	1.02679	1.02560	1.0256
6	5	8.00 p. m.	41 50 30	124 42 40 W	Off Crescent City, Cal........	....	1.02406	....	1.02581	1.0258
7	6	8.00 a. m.	42 30 00	124 55 00 W	Off Goldbeach, Oreg.........	1.02395	1.02360	1.02570	1.02535	1.0257
8	6	8.00 p. m.	42 50 15	124 52 00 W	Off Cape Blanco, Oreg.......	1.02360	....	1.02535	....	1.0254
9	7	8.00 a. m.	43 35 00	124 35 00 W	Off Empire, Oreg............	1.02050	1.02336	1.02225	1.02511	1.0251
10	7	8.00 p. m.	44 47 50	124 08 20 W	Off Yaquina Head, Oreg.....	1.02389	1.02348	1.02564	1.02523	1.0252
11	8	8.00 a. m.	46 10 00	124 07 30 W	Off the Columbia River......	1.02007	1.01942	1.02182	1.02117	1.0218
12	8	8.00 p. m.	47 35 30	124 31 00 W	Off Clearwater, Wash........	1.02352	1.01967	1.02527	1.02142	1.0252
13	9	8.00 a. m.	48 17 30	123 53 50 W	Strait of Juan de Fuca.......	1.02264	1.02241	1.02439	1.02416	1.0243
14	10	8.00 a. m.	....	....	Tacoma, Wash..............	....	1.01937	....	1.02112	1.0211
15	13	8.00 p. m.	48 52 30	123 06 30 W	Strait of Georgia............	....	1.01963	....	1.02138	1.0214
16	14	8.00 a. m.	....	....	Union Bay, Vancouver Island.	....	1.02038	....	1.02213	1.0221
17	14	8.00 p. m.	....	....	....do......................	....	1.02030	....	1.02205	1.0220
18	18	8.00 p. m.	51 15 00	129 32 00 W	Queen Charlotte Sound.......	1.02250	1.02270	1.02425	1.02445	1.0244
19	19	8.00 a. m.	51 54 00	132 23 30 W	Off Prevost Island...........	1.02327	1.02330	1.02502	1.02505	1.0250
20	19	10.21 a. m.	52 02 00	132 53 00 W	70 m. W. of Queen Charlotte I.	1.02310	....	1.02485	....	1.0249
21	19	8.00 p. m.	52 32 00	135 06 00 W	Off Moresby Island..........	1.02337	....	1.02512	....	1.0251
22	20	8.00 a. m.	53 01 00	138 01 30 W	Off Graham Island...........	1.02345	1.02326	1.02520	1.02501	1.0250
23	20	10.15 a. m.	53 05 00	138 31 00 W	....	1.02330	....	1.02505	....	1.0250
24	20	8.00 p. m.	53 28 00	141 02 00 W	W. of Queen Charlotte Islands	1.02330	1.02330	1.02505	1.02505	1.0250

25	May	21	8.00 a. m.	53 50 00	144 19 00 W	W. of Queen Charlotte Islands	1.02324	1.02330	1.02499	1.02505	1.0250
26		21	10.20 a. m.	53 53 00	144 53 00 W	....do......................	1.02333	....	1.02508	....	1.0250
27		21	8.00 p. m.	54 09 00	147 42 00 W	Gulf of Alaska.............	1.02370	1.02388	1.02545	1.02563	1.0254
28		22	8.00 a. m.	54 15 00	150 56 15 W	....do......................	1.02340	1.02363	1.02515	1.02538	1.0253
29		22	8.00 p. m.	54 10 00	154 41 00 W	S. of Kodiak Island, Alaska..	1.02347	1.02350	1.02522	1.02525	1.0252
30		23	8.00 a. m.	53 54 00	157 59 00 W	S. of Semidi Islands.........	1.02350	1.02341	1.02525	1.02516	1.0252
31		23	8.00 p. m.	53 56 00	160 24 00 W	S. of Shumagin Islands......	1.02225	....	1.02400	....	1.0240
32		24	8.00 a. m.	53 44 00	164 12 00 W	S. of Unimak...............	1.02296	1.02310	1.02471	1.02485	1.0247
33		28	8.00 a. m.	54 03 30	166 44 00 W	Near Unalaska..............	1.02302	....	1.02477	....	1.0247
34		28	4.19 p. m.	53 57 00	168 06 00 W	Near Bogosloff Islands.......	1.02330	....	1.02505	....	1.0250
35		28	8.00 p. m.	53 52 00	168 33 00 W	N. of Unimak...............	1.02359	....	1.02534	....	1.0253
36		29	8.00 a. m.	53 20 00	171 00 00 W	N. of Amukta Island.........	1.02350	....	1.02525	....	1.0252
37		29	2.22 p. m.	53 12 00	171 37 00 W	....	1.02350	....	1.02525	....	1.0252
38		29	8.00 p. m.	52 58 00	172 24 00 W	N. of Siguam Island.........	1.02357	....	1.02532	....	1.0253
39		31	8.00 a. m.	52 22 00	173 58 00 W	Near Atka..................	1.02365	....	1.02540	....	1.0254
40		31	8.00 p. m.	52 55 00	175 25 00 W	....do......................	1.02355	1.02364	1.02530	1.02539	1.0253
41	June	1	8.00 a. m.	52 32 00	177 35 00 W	N. of Kanaga...............	1.02370	1.02329	1.02545	1.02504	1.0254
42		1	8.00 p. m.	53 58 30	179 43 00 W	N. of Semisopochnoi Islands.	1.02370	1.02359	1.02545	1.02534	1.0254
43		3	8.00 a. m.	54 07 30	179 02 30 E	South Central Bering Sea....	1.02355	1.02340	1.02530	1.02515	1.0253
44		3	9.54 a. m.	54 12 00	179 07 30 E	....do......................	1.02346	....	1.02521	....	1.0252
45		3	1.58 p. m.	54 20 30	179 09 30 E	....do......................	1.02361	....	1.02536	....	1.0253
46		3	8.00 p. m.	54 32 30	179 16 00 E	....do......................	1.02352	1.02357	1.02527	1.02532	1.0253
47		4	7.02 a. m.	54 30 00	179 17 00 E	....do......................	1.02361	....	1.02536	....	1.0253
48		4	8.00 a. m.	54 30 00	179 16 00 E	....do......................	1.02355	....	1.02530	....	1.0253
49		4	3.53 p. m.	54 33 30	178 44 00 E	....do......................	1.02355	....	1.02530	....	1.0253
50		4	8.00 p. m.	54 18 00	178 47 00 E	....do......................	1.02355	1.02352	1.02530	1.02527	1.0253
51		5	8.00 a. m.	52 44 00	179 29 00 E	N. of Semisopochnoi Islands.	1.02352	1.02355	1.02527	1.02530	1.0253
52		5	1.04 p. m.	52 11 00	179 43 00 E	Near Semisopochnoi Islands..	1.02359	....	1.02534	....	1.0253
53		5	1.35 p. m.	52 11 00	179 49 00 E	....do......................	1.02369	....	1.02544	....	1.0254
54		5	4.31 p. m.	52 11 00	179 57 00 W	....do......................	1.02375	....	1.02550	....	1.0255
55		5	8.00 p. m.	51 53 20	179 44 00 W	....do......................	1.02369	....	1.02544	....	1.0254
56		6	8.00 a. m.	51 11 00	179 02 00 E	S. of Amchitka Island........	1.02330	....	1.02505	....	1.0250
57		6	8.00 p. m.	51 30 00	177 00 00 E	S. of Kyska Island..........	1.02355	1.02360	1.02530	1.02535	1.0253
58		7	8.00 a. m.	51 51 00	174 39 00 E	SE. of Agattu Island.........	1.02355	....	1.02530	....	1.0253
59		7	11.17 a. m.	52 01 00	174 39 00 E	....do......................	1.02350	....	1.02525	....	1.0253

TABLE SHOWING THE SPECIFIC GRAVITIES OF THE SEA WATER AS OBSERVED DURING THE 1906 CRUISE OF THE "ALBATROSS."—CONTINUED.

Serial No.	Date (1906)	Time of day	Latitude (N)	Longitude	General location	Specific gravity at surface	Specific gravity below surface	Specific gravity corrected by the addition of 0.00175: At surface	Specific gravity corrected by the addition of 0.00175: Below surface	Accept'd specific gravity
			° ′ ″	° ′ ″						
60	June 8	8.00 p. m.	52 25 00	173 49 00 E	E. of Agattu Island..........	1.02335	1.02365	1.02510	1.02540	1.0254
61	9	8.00 a. m.	52 33 00	173 58 00 E	S. of Semichi Islands........	1.02359	1.02354	1.02534	1.02529	1.0253
62	11	8.00 p. m.	52 44 00	173 35 00 E	E. of Attu Island............	1.02354	1.02364	1.02529	1.02539	1.0253
63	11	5.47 p. m.	52 55 40	173 26 00 E	....do......................	1.02354	....	1.02529	....	1.0253
64	12	8.00 a. m.	52 40 00	171 41 00 E	SW. of Attu Island..........	1.02354	1.02354	1.02529	1.02529	1.0253
65	12	4.18 p. m.	53 20 00	170 33 00 E	Off Attu Island..............	1.02354	....	1.02529	....	1.0253
66	12	8.00 p. m.	53 39 00	170 02 00 E	Between Attu and Copper I..	1.02354	1.02370	1.02529	1.02545	1.0253
67	13	8.00 a. m.	54 44 00	167 52 30 E	Near Copper Island..........	1.02357	....	1.02532	....	1.0253
68	14	8.00 a. m.	54 54 00	167 28 00 E	....do......................	1.02354	....	1.02529	....	1.0253
69	14	11.12 a. m.	54 49 45	167 12 30 E	....do......................	1.02340	....	1.02515	....	1.0251
70	14	2.52 p. m.	54 36 15	166 58 15 E	Near Bering Island..........	1.02354	....	1.02529	....	1.0252
71	14	3.30 p. m.	54 36 15	166 57 15 E	....do......................	1.02354	....	1.02529	....	1.0252
72	14	8.00 p. m.	54 39 30	166 36 30 E	Near Cape Manati, Bering I..	1.02364	1.02348	1.02539	1.02523	1.0252
73	15	8.00 a. m.	55 09 45	165 47 00 E	W. of Bering Island..........	1.02352	1.02352	1.02527	1.02527	1.0252
74	15	8.00 p. m.	....	....	Nikolskoi Bay, Bering Island.	....	1.02345	....	1.02520	1.0252
75	16	8.00 a. m.	54 58 00	165 21 00 E	W. of Bering Island..........	1.02352	....	1.02527	....	1.0252
76	16	10.14 a. m.	54 48 00	164 54 00 E	Nikolskoi Harbor, Bering I...	1.02364	....	1.02539	....	1.0253
77	16	8.00 p. m.	54 01 00	162 56 00 E	Bet. Bering I. and Avacha Bay	1.02325	....	1.02500	....	1.0250
78	17	8.00 a. m.	53 02 00	160 36 00 E	Off C. Chipunski, Kamchatka	1.02344	....	1.02519	....	1.0251
79	20	11.25 a. m.	52 47 00	158 43 00 E	Near Starichkof Island......	1.02303	....	1.02478	....	1.0247
80	20	2.57 p. m.	52 37 30	158 50 00 E	....do......................	1.02293	....	1.02468	....	1.0246
81	20	8.00 p. m.	52 08 00	158 53 00 E	Off Cape Asacha, Kamchatka	1.02310	1.02313	1.02485	1.02488	1.0248
82	21	8.00 a. m.	50 52 00	156 46 00 E	E. of northern Paramushir...	....	1.02335	....	1.02510	1.0251
83	21	8.00 p. m.	51 27 00	155 56 00 E	W. of Kurile Lake, Kamchatka	1.02354	1.02344	1.02529	1.02519	1.0251

84	June	22	8.00 a. m.	50 04 00	154 03 00 E	W. of southern Paramushir..	1.02350	1.02344	1.02525	1.02519	1.0252
85		22	4.12 p. m.	49 06 00	153 06 00 E	Near Chirinkotan Island......	1.02354	....	1.02529	....	1.0252
86		22	8.00 p. m.	....	....	....	1.02360	1.02354	1.02535	1.02529	1.0253
87		23	8.00 a. m.	....	....	Off Milne Bay, Simushir.....	1.02364	....	1.02539	....	1.0254
88		24	10.37 a. m.	46 46 40	151 41 00 E	Near Simushir...............	1.02382	....	1.02557	....	1.0256
89		24	1.07 p. m.	46 42 00	151 45 00 E	....do......................	1.02384	....	1.02559	....	1.0256
90		24	2.09 p. m.	46 42 00	151 47 00 E	....do......................	1.02374	....	1.02549	....	1.0255
91		24	8.00 p. m.	46 10 00	150 58 00 E	E. of Urupp.................	1.02348	1.02352	1.02523	1.02527	1.0253
92		25	8.00 a. m.	44 50 00	149 19 00 E	E. of Iturup.................	1.02379	1.02360	1.02554	1.02535	1.0253
93		25	8.00 p. m.	43 41 00	147 43 00 E	E. of Shikotan...............	1.02354	1.02362	1.02529	1.02537	1.0253
94		26	8.00 a. m.	42 55 00	145 47 00 E	E. of Yezo..................	1.02316	1.02372	1.02491	1.02547	1.0254
95		26	8.00 p. m.	41 58 00	143 48 00 E	Near Cape Yerimo, Yezo.....	1.02359	....	1.02534	....	1.0253
96		27	8.00 a. m.	41 40 40	141 19 20 E	Tsugaru Strait..............	1.02379	....	1.02554	....	1.0255
97	July	17	8.00 a. m.	40 51 00	139 58 00 E	Near Aomori................	1.02418	1.02510	1.02593	1.02685	1.0260
98		17	8.00 p. m.	39 26 00	139 20 30 E	Near Tobi Shima............	1.02406	....	1.02581	....	1.0260
99		18	8.00 a. m.	38 33 00	138 40 00 E	N. of Sado Island...........	1.02458	1.02665	1.02633	1.02840	1.0263
100		18	9.29 a. m.	38 35 00	138 41 00 E	Near Sado Island...........	1.02447	....	1.02622	....	1.0262
101		18	11.07 a. m.	38 32 00	138 43 00 E	....do......................	1.02385	....	1.02560	....	1.0256
102		18	3.59 p. m.	38 12 00	138 52 00 E	Near Niigata	1.02403	....	1.02578	....	1.0257
103		19	3.43 p. m.	37 37 00	138 19 00 E	Near Sado Island...........	1.02444	....	1.02619	....	1.0261
104		19	8.00 p. m.	37 33 00	138 12 00 E	S. of Sado Island...........	1.02443	....	1.02618	....	1.0261
105		20	8.00 a. m.	37 08 20	137 10 00 E	Toyama Bay.................	1.01989	....	1.02164	....	1.0216
106		21	10.04 a. m.	37 08 35	137 10 05 E	....do......................	1.02199	....	1.02374	....	1.0237
107		21	4.11 p. m.	37 27 30	137 32 20 E	....do......................	1.02413	....	1.02588	....	1.0258
108		21	4.53 p. m.	37 25 00	137 32 00 E	....do......................	1.02403	....	1.02578	....	1.0257
109		21	8.00 p. m.	37 24 00	137 43 00 E	....do......................	1.02437	....	1.02612	....	1.0261
110		22	8.00 a. m.	37 23 00	137 36 00 E	....do......................	1.02441	1.02418	1.02616	1.02593	1.0261
111		22	8.06 a. m.	37 23 00	137 36 00 E	....do......................	1.02420	....	1.02595	....	1.0259
112		22	9.54 a. m.	37 20 00	137 41 30 E	....do......................	1.02427	....	1.02602	....	1.0260
113		22	11.13 a. m.	37 16 00	137 40 00 E	....do......................	1.02413	....	1.02588	....	1.0258
114		22	1.47 p. m.	37 22 30	137 47 00 E	....do......................	1.02431	....	1.02606	....	1.0260
115		22	8.00 p. m.	37 31 00	137 04 10 E	Near Waijima...............	1.02444	1.02406	1.02619	1.02581	1.0261
116		23	8.32 a. m.	36 14 30	135 56 30 E	Near Komatsu...............	1.02365	....	1.02540	....	1.0254
117		23	9.12 a. m.	36 13 40	135 56 30 E	....do......................	1.02410	....	1.02585	....	1.0258
118		23	11.15 a. m.	36 03 30	135 54 00 E	Near Takefu................	1.02395	....	1.02570	....	1.0257

TABLE SHOWING THE SPECIFIC GRAVITIES OF THE SEA WATER AS OBSERVED DURING THE 1906 CRUISE OF THE "ALBATROSS."—CONTINUED.

Serial No.	Date (1906)	Time of day	Latitude (N)	Longitude	General location	Specific gravity at surface	Specific gravity below surface	Specific gravity corrected by the addition of 0.00175		Accept'd specific gravity
								At surface	Below surface	
			° ′ ″	° ′ ″						
119	July 23	1.06 p. m.	36 03 30	135 52 30 E	Near Takefu	1.02410	....	1.02585	....	1.0258
120	23	8.00 a. m.	36 14 40	135 56 30 E	Near Fukui	1.02400	1.02382	1.02575	1.02557	1.0257
121	23	1.21 p. m.	35 56 30	135 39 15 E	Wakasa Bay	1.02385	....	1.02560	....	1.0256
122	24	2.44 p. m.	35 57 45	135 34 00 E	....do	1.02392	....	1.02567	....	1.0256
123	24	4.09 p. m.	36 02 00	135 30 00 E	....do	1.02395	....	1.02570	....	1.0257
124	24	8.00 p. m.	36 04 00	135 02 30 E	Off Kioga Saki	1.02410	1.02418	1.02585	1.02593	1.0258
125	25	8.00 a. m.	36 11 00	133 24 30 E	Oki Islands	1.02375	....	1.02550	....	1.0255
126	26	9.30 a. m.	36 13 00	133 27 00 E	Near Dogo Island	1.02375	....	1.02550	....	1.0255
127	26	8.00 p. m.	36 43 30	132 23 30 E	Between Oki I. and Hornet I.	1.02347	....	1.02522	....	1.0252
128	27	8.00 a. m.	36 40 30	132 30 00 E	....do	1.02407	....	1.02582	....	1.0258
129	27	8.00 p. m.	36 56 00	132 00 00 E	S. of Hornet Island	1.02423	1.02444	1.02598	1.02619	1.0260
130	28	8.00 a. m.	37 29 00	131 13 00 E	S. of Matsushima	1.02448	....	1.02623	....	1.0262
131	29	8.00 p. m.	37 13 00	130 45 00 E	....do	1.02427	....	1.02602	....	1.0260
132	30	8.00 a. m.	36 06 30	129 50 00 E	Off Unkofski Bay, Korea	1.02340	....	1.02515	....	1.0251
133	30	8.00 p. m.	36 08 00	129 46 00 E	....do	1.02310	....	1.02485	....	1.0248
134	31	8.00 a. m.	36 17 00	129 40 00 E	....do	1.02335	....	1.02510	....	1.0251
135	31	8.00 p. m.	36 23 00	129 58 00 E	Off Yeng-hai, Korea	1.02310	....	1.02485	....	1.0248
136	Aug. 1	8.00 a. m.	36 32 00	129 58 00 E	....do	1.02299	....	1.02474	....	1.0247
137	1	8.00 p. m.	36 06 00	130 45 00 E	Between Korea and Oki I.	1.02302	....	1.02477	....	1.0247
138	2	8.00 a. m.	34 32 30	129 59 00 E	E. of Tsu-Shima	1.02320	....	1.02495	....	1.0249
139	2	8.00 p. m.	34 09 00	130 05 00 E	NE. of Iki-Shima	1.02237	....	1.02412	....	1.0241
140	3	8.00 a. m.	33 03 20	129 22 30 E	S. of Hirado I.	1.02372	....	1.02547	....	1.0254
141	8	8.00 p. m.	32 26 00	129 22 00 E	Near Nagasaki	1.02365	....	1.02530	....	1.0253
142	9	8.00 a. m.	32 26 30	128 36 30 E	S. of Goto Islands	1.02347	....	1.02522	....	1.0252

143	Aug.	9	8.00 p. m.	32 32 30	128 30 00 E	S. of Goto Islands	1.02313	......	1.02488	......	1.0248
144		10	8.00 a. m.	32 33 00	128 19 00 E	....do.	1.02293	......	1.02468	......	1.0246
145		10	8.00 p. m.	32 22 30	128 41 00 E	....do.	1.02300	......	1.02475	......	1.0247
146		11	8.00 a. m.	31 39 30	129 19 00 E	W. of Koshiki Island	1.02272	......	1.02447	......	1.0244
147		11	8.00 p. m.	31 38 00	129 26 00 E	....do.	1.02303	......	1.02478	......	1.0247
148		12	8.00 a. m.	31 38 30	129 19 00 E	....do.	1.02313	......	1.02488	......	1.0248
149		12	8.00 p. m.	31 13 20	129 21 40 E	W. of Uju-Shima	1.02347	......	1.02522	......	1.0252
150		13	8.00 a. m.	30 25 00	129 06 40 E	S. of Kusakaki-Shima	1.02351	......	1.02526	......	1.0252
151		13	8.00 p. m.	30 23 30	129 36 30 E	....do.	1.02351	......	1.02526	......	1.0252
152		14	8.00 p. m.	29 57 00	130 41 00 E	S. of Tanega-Shima	1.02454	......	1.02629	......	1.0262
153		15	8.00 a. m.	29 51 00	131 02 00 E	....do.	1.02464	......	1.02639	......	1.0263
154		15	8.00 p. m.	30 31 00	130 45 00 E	W. of Tanega-Shima	1.02402	......	1.02577	......	1.0257
155		16	8.00 a. m.	30 59 00	130 29 50 E	Off Kagoshima Gulf	1.02343	......	1.02518	......	1.0251
156		16	8.00 p. m.	....	....	Off Chirin Jima, Kagoshima G.	1.02216	......	1.02391	......	1.0239
157		21	8.00 a. m.	31 19 00	131 22 00 E	In van Dieman Strait	1.02437	......	1.02612	......	1.0261
158		21	8.00 p. m.	31 19 30	132 14 30 E	E. of van Dieman Strait	1.02432	......	1.02607	......	1.0260
159		22	8.00 a. m.	31 39 00	132 54 30 E	S. of Shikoku Island	1.02467	......	1.02642	......	1.0264
160		22	8.00 p. m.	32 32 00	132 39 00 E	S. Entrance, Bungo Channel	1.02425	......	1.02600	......	1.0260
161		23	8.00 a. m.	32 32 00	132 25 00 E	....do.	1.02415	......	1.02590	......	1.0259
162		23	8.00 p. m.	32 58 00	132 10 40 E	Bungo Channel	1.02428	......	1.02603	......	1.0260
163		24	8.00 a. m.	34 09 00	132 56 50 E	Inland Sea	1.02212	......	1.02387	......	1.0238
164		24	8.00 p. m.	34 17 30	133 33 45 E	....do.	1.02266	......	1.02441	......	1.0244
165		28	8.00 a. m.	33 51 45	135 02 45 E	S. of the Kii Channel	1.02419	......	1.02594	......	1.0259
166		28	....	....	....	In Oshima-Ko	1.02212	......	1.02387	......	1.0238
167		29	8.00 a. m.	33 25 00	135 42 10 E	Off Oshima-Ko	1.02396	......	1.02571	......	1.0257
168		30	8.00 a. m.	33 24 20	135 42 00 E	....do.	1.02385	......	1.02560	......	1.0256
169		31	8.00 a. m.	33 21 00	135 43 00 E	....do.	1.02408	......	1.02583	......	1.0258
170		31	8.00 p. m.	33 24 50	135 57 00 E	....do.	1.02402	......	1.02577	......	1.0257
171	Sept.	1	8.00 a. m.	34 04 30	137 48 00 E	S. of Hamamatsu	1.02412	......	1.02587	......	1.0258
172		1	8.00 p. m.	33 25 30	138 35 00 E	....do.	1.02395	......	1.02570	......	1.0257
173		14	8.00 p. m.	34 59 30	140 16 00 E	Near No-Shima	1.02424	......	1.02599	......	1.0259
174		15	8.00 a. m.	36 11 00	141 03 00 E	NE. of Choshi	1.02371	......	1.02546	......	1.0254
175		15	8.00 p. m.	37 33 30	141 28 30 E	S. of Sendai	1.02353	......	1.02528	......	1.0252
176		16	8.00 a. m.	38 49 00	142 02 00 E	Off Kesennuma	1.02374	......	1.02549	......	1.0254
177		16	8.00 p. m.	39 37 30	142 09 00 E	Off Nambu Minato	1.02394	......	1.02569	......	1.0256

TABLE SHOWING THE SPECIFIC GRAVITIES OF THE SEA WATER AS OBSERVED DURING THE 1906 CRUISE OF THE "ALBATROSS."—CONTINUED.

Serial No.	Date (1906)	Time of day	Latitude (N)	Longitude	General location	Specific gravity at surface	Specific gravity below surface	Specific gravity corrected by the addition of 0.00175		Accept'd specific gravity
								At surface	Below surface	
			° ′ ″	° ′ ″						
178	Sept. 17	8.00 a. m.	41 14 00	141 44 00 E	Off Idzuto	1.02414	......	1.02589	......	1.0258
179	18	8.00 p. m.	41 55 00	139 49 00 E	Off E. Entrance, Tsugaru St.	1.02398	......	1.02573	......	1.0257
180	20	8.00 a. m.	43 05 50	140 23 50 E	Iwanai Bay	1.02414	......	1.02589	......	1.0258
181	21	8.00 p. m.	43 43 30	140 57 00 E	Ishikari Bay	1.02414	......	1.02589	......	1.0258
182	22	8.00 a. m.	45 23 00	140 48 00 E	W. of Rebunshiri I.	1.02417	......	1.02592	......	1.0259
183	22	8.00 p. m.	46 02 30	141 29 00 E	W. of South'rn end of Sakhalin	1.02411	......	1.02586	......	1.0258
184	23	8.00 a. m.	47 39 00	141 24 00 E	......	1.02391	......	1.02566	......	1.0256
185	23	8.00 p. m.	47 05 30	141 40 40 E	......	1.02385	......	1.02560	......	1.0256
186	24	8.00 a. m.	46 03 20	142 24 30 E	Aniva Bay, Sakhalin	1.02275	......	1.02450	......	1.0245
187	25	8.00 p. m.	46 00 30	143 31 20 E	Near Cape Siretoko	1.02262	......	1.02437	......	1.0243
188	26	8.00 a. m.	46 46 00	144 00 00 E	......	1.02232	......	1.02407	......	1.0240
189	26	8.00 p. m.	47 00 00	144 10 40 E	......	1.02259	......	1.02434	......	1.0243
190	27	8.00 a. m.	48 33 00	145 05 30 E	......	1.02102	......	1.02277	......	1.0227
191	28	8.00 a. m.	48 41 30	144 57 30 E	......	1.02140	......	1.02315	......	1.0231
192	28	8.00 p. m.	47 52 00	145 36 30 E	......	1.02221	......	1.02396	......	1.0239
193	29	8.00 a. m.	46 24 00	145 42 00 E	......	1.02282	......	1.02457	......	1.0245
194	29	8.00 p. m.	45 52 50	145 50 00 E	......	1.02303	......	1.02478	......	1.0247
195	30	8.00 a. m.	44 30 00	145 35 00 E	......	1.02394	......	1.02569	......	1.0256
196	30	8.00 p. m.	44 26 00	145 52 00 E	S. part of Sea of Okhotsk	1.02384	......	1.02559	......	1.0255
197	Oct. 1	8.00 a. m.	43 38 40	145 57 00 E	S. of Kunashir	1.02361	......	1.02536	......	1.0253
198	1	8.00 p. m.	42 48 30	145 26 30 E	S. of Otsu Saki	1.02359	......	1.02534	......	1.0253
199	2	8.00 a. m.	41 53 00	143 20 00 E	Near Cape Yerimo	1.02354	......	1.02529	......	1.0252
200	2	8.00 p. m.	42 01 50	142 32 00 E	Off Urakawa	1.02411	......	1.02586	......	1.0258
201	3	8.00 a. m.	42 11 00	141 57 00 E	W. of Urakawa	1.02410	......	1.02585	......	1.0258

202	Oct.	3	8.00 p. m.	42 10 00	141 33 30 E	SE. of Mororan	1.02371	....	1.02546	....	1.0254
203		9	8.00 a. m.	38 51 30	142 02 00 E	E. of Kesennuma	1.02369	....	1.02544	....	1.0254
204		10	8.00 a. m.	38 15 15	141 38 30 E	Off Sendai	1.02365	....	1.02540	....	1.0254
205		10	8.00 p. m.	37 55 00	142 02 30 E	....do	1.02422	....	1.02597	....	1.0259
206		11	8.00 a. m.	36 14 30	141 15 00 E	NE. of Choshi	1.02316	....	1.02491	....	1.0249
207		11	8.00 p. m.	34 49 30	139 59 00 E	Off No-Shima	1.02382	....	1.02557	....	1.0255
208		12	8.00 a. m.	34 49 30	138 40 15 E	Near O-Shima	1.02390	....	1.02565	....	1.0256
209		13	8.00 a. m.	35 02 10	138 57 50 E	Suruga Gulf	1.02232	....	1.02407	....	1.0240
210		15	8.00 a. m.	35 02 10	138 38 00 E	....do	1.02194	....	1.02369	....	1.0236
211		16	8.00 a. m.	34 47 15	138 24 15 E	....do	1.02369	....	1.02544	....	1.0254
212		17	8.00 a. m.	34 52 00	138 36 40 E	....do	1.02369	....	1.02544	....	1.0254
213		17	8.00 p. m.	34 27 50	138 14 30 E	....do	1.02370	....	1.02545	....	1.0254
214		18	8.00 a. m.	34 36 00	138 25 30 E	....do	1.02370	....	1.02545	....	1.0254
215		19	8.00 a. m.	34 48 00	138 26 30 E	....do	1.02387	....	1.02562	....	1.0256
216		19	8.00 p. m.	34 14 00	138 07 30 E	Off Suruga Gulf	1.02387	....	1.02562	....	1.0256
217		20	8.00 a. m.	34 05 00	137 59 00 E	....do	1.02399	....	1.02574	....	1.0257
218		20	8.00 p. m.	34 06 30	138 05 30 E	....do	1.02391	....	1.02566	....	1.0256
219		21	8.00 a. m.	34 36 50	139 02 40 E	W. of Nii Jima	1.02369	....	1.02544	....	1.0254
220		22	8.00 a. m.	35 07 30	139 15 00 E	Sagami Bay	1.02357	....	1.02532	....	1.0253
221		23	8.00 a. m.	35 07 40	139 15 40 E	....do	1.02354	....	1.02529	....	1.0253