Lieut. Ch. H. Davis
from his friend the Author

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MAURY'S

SAILING DIRECTIONS,

THIRD EDITION,

IMPROVED AND ENLARGED.

NOVEMBER, 1851.

EXPLANATIONS AND SAILING DIRECTIONS

TO ACCOMPANY THE

WIND AND CURRENT CHARTS,

APPROVED BY

COMMODORE LEWIS WARRINGTON,

CHIEF OF THE BUREAU OF ORDNANCE AND HYDROGRAPHY;

AND PUBLISHED BY AUTHORITY OF

HON. WILLIAM A. GRAHAM,

SECRETARY OF THE NAVY.

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SUPERINTENDENT OF THE NATIONAL OBSERVATORY.

WASHINGTON:
C. ALEXANDER, PRINTER,
F STREET, NEAR NAVY DEPARTMENT,
1851.

National Oceanic and Atmospheric Administration

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WIND AND CURRENT CHARTS.

The great demand for these charts among seamen, and the interest which they have excited among philosophers, make it proper that I should give a more detailed account than I have yet given as to the progress of the work, the objects in view, and the prospects ahead.

This is the more proper because I hope thereby to impress seafaring men and others, who have it in their power to facilitate or retard the work, with the importance of the undertaking.

"In the present condition of the surface of our planet," says the most celebrated traveller and philosopher of the age, "the area of the solid is to that of the fluid parts as 1 to 2⅘, (according to Rigaud, as 100 to 270.) The islands form scarcely $\frac{1}{23}$ of the continental masses, which are so unequally divided that they consist of three times more land in the northern than in the southern hemisphere; the latter being, therefore, pre-eminently oceanic. From 40° South Latitude, to the Antartic Pole, the Earth is almost entirely covered with water. The fluid element predominates in like manner between the eastern shores of the old, and the western shores of the new continent, being only interspersed with some few insular groups. The learned hydrographer, Fleurieu, has very justly named this vast oceanic basin which, under the tropics, extends over 145° of Longitude, the Great Ocean, in contradistinction to all other seas. The southern and western hemispheres (reckoning the latter from the meridian of Teneriffe) are, therefore, more rich in water than any other region of the whole earth.

"These are the main points involved in the consideration of the relative quantity of land and sea, a relation which exercises so important an influence on the distribution of temperature, the variation in atmospheric pressure, the direction of the winds, and the quantity of moisture contained in the air, with which the development of vegetation is so essentially connected. When we consider that nearly three-fourths of the upper surface of our planet are covered with water, we shall be less surprised at the imperfect condition of meteorology before the beginning of the present century; since it is only during the subsequent period that numerous accurate observations on the temperature of the sea at different latitudes, and at different seasons, have been made and numerically compared together."—*Cosmos*.

"I beg you to express to Lieut. Maury, the author of the beautiful Charts of the Winds and Currents, prepared with so much care and profound learning, my hearty gratitude and esteem. It is a great undertaking, equally important to the practical navigator and for the advance of meteorology in general. It has been viewed in this light in Germany by all persons who have a taste for physical geography. In an analogous way anything of isothermal countries (countries of equal annual temperature,) has for the first time become really fruitful, since Dove has taught us the isotherms of the several months chiefly on the land; since two-thirds of the atmosphere rests upon the sea, Maury's work is so much the more welcome and valuable because it includes at the same time the oceanic currents, the course of the winds and the temperature. How remarkable are the relations of temperatures, in Sheet No. 2, South Atlantic, East and West of Longitude 40; how much would this department of meteorology gain if it were filled up according to Maury's proposition in Commodore Lewis Warrington's Log Book. The shortening of the voyage from the United States to the Equator, is a beautiful result of this undertaking. The bountiful manner in which these Charts are distributed raises our expectations still higher."—*Baron Von Humboldt to Dr. Flügel, U. S. Consul, Leipsic.*

It is not for the benefit of navigation alone that seamen are invited to make observations and collect materials for the Wind and Current Charts; other great interests besides those of commerce have their origin in the ocean or the air; and these interests are to be benefitted by a better knowledge than we now have of the laws which govern the circulation of the atmosphere, and regulate the movements of the aqueous portions of our planet.

The truth of the proposition is so obvious, that the agricultural capacities of any place are as dependent upon the hygrometrical as upon the thermometrical condition of the atmosphere, needs only to be stated as a proposition to secure the assent of all.

Each kind of plant requires for its most perfect development a certain degree of moisture, and the winds which bring it that moisture can only get it from the sea or other evaporating surfaces.

It is often argued because wine and olives, or other staples are produced upon a given parallel of latitude, that therefore they should be produced upon the same parallel wherever the proper soil is to be found.

Whereas, the consideration as to the route which the winds from the ocean have to pursue in order to reach the situation of the supposed parallel, has much to do with the case.

Virginia and California are between the same parallels, yet how different their agricultural resources, the character and the flavor of their fruits, all owing not so much to difference of soil as to the way the winds blow, the quantity of moisture they bring with them, the proportion of clouds and sunshine allotted to each place.

The system of researches embraced by the Wind and Current Charts, therefore it would appear, concern the philosopher and the husbandman, as well as the mariner, the merchant and the statesman.

A wider field, or one more rich with promise, has never engaged the attention of the philosopher. Though much trodden and often frequented, it has never been explored, if we take exploration to mean the collecting and grouping all those phenomena which mariners observe in relation to the ocean and the air above it, with the view of tracing, in the true spirit of inductive philosophy, fact into effect, and effect up to cause.

The mariner, therefore, should bear it always in mind when he is making and recording out upon the wide ocean an observation in connection with these Charts, that upon the fidelity with which that observation and the record of it are made, depends the ability here to read aright the workings of those physical agents that are employed in the grand scheme of creation, to produce those results which are the subject of observation with him.

The wind and rain; the vapor and the cloud; the tide, the current, the saltness and depth, and temperature and color of the sea; the shade of the sky; the temperature of the air; the tint and shape of the clouds; the height of the tree on the shore, the size of the leaves, the brilliancy of the flowers;—all may be regarded as the exponents of certain physical combinations, and, therefore, as the expressions in which nature chooses to announce her own meaning, or if we please, as the language in which she writes down the operation of her own laws. No fact gathered in such a field as this is can come amiss to those who tread the walks of inductive philosophy; for every such fact is a syllable in the hand book of nature, and it is by patiently collecting fact after fact, and by joining syllable after syllable together, that we may finally seek to read aright from the great volume before us.

Dr. Buist, a learned and eminent *savant* of India, has drawn a picture of the field in which navigators are so earnestly invited to labor and lend their help, which is so true and so glowing that I beg leave to hold it up here for their contemplation.

In the report on the affairs of the "Bombay Geographical Society," presented by the Secretary at the annual meeting, in May 1850, it is remarked: "The Assistant Secretary of your Society,* Mr. Macfarlane, has made considerable progress in the construction of Wind and Current Charts, founded on the information supplied by ship's logs, and on the principle of Lieutenant Maury. It is more than probable that besides the currents occasioned by the trade-winds, monsoons, and sets of the tides, we have a group of movements intermingled with these dependant mainly on evaporation. When it is remembered that on the western shore of the Arabian sea, including in this the Red sea and Persian gulf, from the line northward, we have an expanse of coast of no less than 6,000 miles, and a stretch of country of probably not less than 100 miles inland from this, where the average fall of rain does not amount to four inches annually, where not one-half of this ever reaches the sea, and where, to the best of our knowledge, the evaporation over the ocean averages at least a quarter of an inch daily, all the year round, or close on eight feet annually, some idea of the enormous abstraction of water in the shape of vapor may be formed. On the assumption that this extends no further, on an average, than 50 miles out to sea, we shall have no less than 39 cubic miles of water raised annually in vapor from the northern and northwestern side of the basin, which must be supplied from the open ocean to the South, or the rains on the East. The fall of rain on the western side of the ridge of the mountain chain, from Cape Comorin to Cutch, averages pretty nearly 180 inches annually, and of this at least 160 is carried off to the sea: that on the Concan to 70 inches, of which probably 30 flow off to the ocean: or betwixt the two, over an area of twenty miles from the sea-shore to the ghauts, and about 1200 miles from the North to the South, or an area of 24,000 square miles in all, we shall probably have an average discharge of nine feet, or close on forty cubic miles of water,—an amount sufficient, were it not diffused, to raise the sea on our shores three feet high, over an area of 72,000 square miles. * * *

"The waters of the ocean cover nearly three-fourths of the surface of the globe; and of the thirty-eight millions of miles of dry land in existence, twenty-eight millions belong to the northern hemisphere. The mean depth of the ocean is somewhere about four miles—the greatest depth the sounding line has ever reached

* Vide Transactions Bombay Geographical Society, Vol. IX—1850, p. LXXX, et seq.

is five and a quarter miles.* The mean elevation of the land, again, is about one thousand feet—the highest point known to us, is nearly as much above the level of the sea, as the greatest depth that has been measured, is below it. The atmosphere, again, surrounds the earth like a vast envelope: its depth, by reason of the tenuity attained by it, as the superincumbent pressure is withdrawn, is unknown to us,—but is guessed at somewhere betwixt fifty and five hundred miles. Its weight, and its constituent elements, have been determined with the utmost accuracy. The weight of the mass is equal to that of a solid globe of lead sixty miles in diameter. Its principal elements are oxygen and nitrogen gases, with a vast quantity of water suspended in them in the shape of vapor, and commingled with these a quantity of carbon in the shape of fixed air, equal to restore from its mass, many fold the coal that now exists in the world. In common with all substances, the ocean and the air are increased in bulk, and consequently diminished in weight, by heat; like all fluids, they are mobile, tending to extend themselves equally in all directions, and to fill up depressions in whatever vacant spaces will admit them; hence, in these respects, the resemblance betwixt their movements. Water is not compressible or elastic, and it may be solidified into ice or vaporized into steam: air is elastic—it may be condensed to any extent by pressure, or expanded to an indefinite degree of tenuity by pressure being removed from it—it is not liable to undergo any change in its constitution beyond these, by any of the ordinary influences by which it is affected. These facts are few and simple enough—let us see what results arise from them. As the constant exposure of the Equatorial regions of the Earth to the Sun must necessarily here engender a vast amount of heat,—and as his absence from the polar regions must in like manner promote an infinite accumulation of cold,—to fit the entire Earth for a habitation to similar races of beings, a constant interchange and communion, betwixt the heat of the one and the cold of the other, must be carried on. The ease and simplicity with which this is effected, surpass all description. The air heated near the Equator by the overpowering influences of the Sun, is expanded and lightened: it ascends into upper space, leaving a partial vacuum at the surface to be supplied from the regions adjoining. Two currents from the poles towards the Equator, are thus established at the surface, while the sublimated air, diffusing itself by its mobility, flows in the upper regions of space from the equator towards the poles. Two vast whirlpools are thus established, constantly carrying away the heat from the torrid towards the icy regions, and these becoming cold by contact with the ice, carry back their gelid freight to refresh the torrid zone. Did the Earth, as was long believed, stand still while the Sun circled round it, we should have had two sets of meridianal currents blowing at the surface of the Earth, directly from North and South, towards the Equator, in the upper regions flowing back again to the place whence they came. On the other hand, were the heating and cooling influences, just referred to, to cease, and the Earth to fail in impressing its own motion on the atmosphere, we should have a furious hurricane rushing round the globe, at the rate of 1,000 miles an hour,—tornadoes of ten times the speed of the most violent now known to us, sweeping everything before them. A combination of the two influences, modified by the friction of the Earth, which tends to draw the air after it, gives us the trade winds, which

* Lieutenant Walsh, U. S. N., while co-operating in the U. S. Schooner "Tany," with me in these researches, reports a sounding in the North Atlantic of 6½ miles, (5700 fathoms,) without bottom. M.

sweep round the equatorial region of the globe unceasingly, at the speed of from ten to twenty miles an hour, the ærial current, quitting the polar regions with the comparatively tardy speed, from East to West, imposed on it by the velocity due to the 70th parallel, is left behind the globe, and deflected into an oblique current, as it advances southward, till, meeting the current from the opposite pole near the equator, the two combine and form the vast stream known as the trades,—separated in two, where the air ascends by the belt of variable winds and rains. Impressed with the motion of the air, constantly sweeping its surface in one direction, and obeying the same laws of motion, the great sea itself would be excited into currents similar to those of the air, were it not walled in by continents, and subjected to other control. As it is, there are constant currents flowing from the torrid towards the frigid zone, to supply the vast mass of vapor there drained off; while other whirlpools and currents, such as the gigantic Gulf Stream, come to perform their part in the same stupendous drama. The current just named, sweeps from the Cape of Good Hope, across the South Atlantic, to the Gulf of Mexico, and by the Straits of the Bahamas. Here it turns to the eastward again, travelling along the coast of America at the rate of from forty to a hundred miles a day; it now stands once more across the Atlantic, and divides itself into two branches;—one finds its way into the northern sea, warming the adjoining waters as it advances, and turning back, most likely to form a second great whirlpool, re-joining the original stream near Newfoundland. The main branch seeks the northern shores of Europe, and, sweeping along the coast of Spain and Portugal, travels southward by the Azores to rejoin the main whirlpool. The waters of this vast Ocean river, are to the North of the tropic greatly warmer than those around; the climate of every country it approaches is improved by it, and the Laplander is enabled by its means to live, and cultivate his barley, in a latitude which everywhere else, throughout the world is condemned to perpetual sterility. But there are other laws which the great sea obeys, which peculiarly adapt it as the vehicle of interchange of heat and cold betwixt those regions where either exists in excess. Water which contracts regularly from the boiling point downwards, at a temperature of 40°, has reached its maximum of density, and thence begins to grow lighter and expand. But for this most beneficent provision, the vast recesses of the northern ocean would be continually occupied with a fluid at the freezing point, which the least access of cold would convert into one solid mass of ice. The non-conducting power of water, which at present acts so valuable a part in the general economy, so far from being a blessing would be a curse. No warmth could ever penetrate to thaw the foundations of the frozen mass—no water find its way to float it from its foundations, so that, like the everlasting hills themselves, rooted immoveably in its place, every year adding to its mass; the solid structure would continually advance to the southward, hermetically sealing the polar ocean thus condemned to utter desolation, and encroaching on the North sea itself. Under existing circumstances, so soon as water is cooled down to 40°, it sinks to the bottom, and, still eight degrees warmer than ice, it attacks the bases and saps the foundations of the icebergs—themselves gigantic glaciers, which have fallen from the mountains into the sea, or which have grown to their present size in the shelter of bays and estuaries, and by accumulations from above. Once forced from their anchorage, the first storm that arises drifts them to sea, where the beautiful law which renders ice lighter than the warmest water enables it to float,—and drifts southward a vast magazine of cold to cool the tepid water which bears it along,—the evaporation at the equator causing a deficit, the melting and accumulation of the ice in the frigid zone giving rise to an excess of accumulation, which tends along with the action of the air, and other causes, to institute and maintain the transporting current. These stupendous masses, which have been seen at sea in the form of church spires and gothic towers, and minarets, rising to the height of from 300 to 600 feet, and extending over an area of not less than six square miles, the masses above water being only one-tenth of the whole, are often to be found within the tropics. A striking fact dependant on this general law, has just been brought to light; their is a line extending from pole to pole, at or under the surface of the ocean, where an invariable temperature of 39.5 is maintained. The depth of this varies with the latitude; at the equator it is 7,200 feet—at latitude 56° it ascends to the surface, the temperature of the sea being here uniform throughout. North and South of this the cold water is uppermost, and at latitude 70° the line of uniform temperature descends to 4,500. But these, though amongst the most regular and magnificent, are but a small number of the contrivances by which the vast and beneficent ends of nature are brought about. Ascent from the surface of the Earth, produces the same change in point of climate, as an approach to the poles; even under the torrid zone, mountains reach the line of perpetual congelation at nearly a third less altitude than the extreme elevation which they sometimes attain: at the poles, snow is perpetual at the ground, and at the different intervening latitudes, reaches some intermediate point of congelation, betwixt one and 20,000 feet. In America, from the line south to the tropics, as also, as there is now every reason to believe, in Africa, within similar latitudes, vast ridges of mountains covered with perpetual snow, run northward and southward in the line of the meridian right across the path of the trade winds. A similar ridge, though of less magnificent dimensions, traverses the peninsula of Hindoostan, increasing in altitude as it approaches the line,—attaining an elevation of 8,500 feet at Dodabetta, and above 6,000 in Ceylon. The Alps in Europe, and the gigantic chain of the Himalayas in Asia, both far South in the temperate zone, stretch from East to West, and intercept the ærial current from the North. Others of lesser note, in the equatorial or meridianal, or some intermediate direction, cross the paths of the atmospherical currents in every direction, imparting to them fresh supplies of cold, as they themselves obtain from them warmth in exchange; in strictness, the two operations are the same. Magnificent and stupendous as are the effects and results of the water and of air acting independently on each other, in equalising the temperature of the globe, they are still more so when combined. One cubic inch of water when invested with a sufficiency of heat, will form one cubic foot of steam—the water before its evaporation, and the vapor which it forms, being exactly of the same temperature, though in reality, in the process of conversion, 1,700 degrees of heat have been absorbed or carried away from the vicinage, and rendered latent or imperceptible; this heat is returned in a sensible and perceptible form the moment the vapor is converted once more into water. The general fact is the same in the case of vapor carried off by dry air, at any temperature that may be imagined, for down far below the freezing point, evaporation proceeds uninterruptedly, or raised into steam by artificial means. The air, heated and dried as it sweeps over the arid surface of the soil, drinks up by day myriads of tons of moisture from the sea—as much indeed as would, were no moisture restored to it, depress its whole surface at the rate of four feet annually over the surface of the globe. The quantity of heat thus converted from a sensible or perceptible, to an insensible or latent state, is almost incredible. The action equally goes on, and with the like results, over the surface of the Earth, as over that of the sea, where there is moisture to be withdrawn. But night, and the seasons of the year, come around, and the surplus temperature thus withdrawn and stored away, at the time it might have proved superfluous or inconvenient, is reserved, and rendered back so soon as it is required; and the cold of night, and the rigor of winter, are modified by the heat given out at the point of condensation, by dew, rain, hail, and snow.

"There are, however, cases in which were the process of evaporation to go on without interruption and without limit, that order and regularity might be disturbed which it is the great object of the Creator apparently for an indefinite time to maintain, and in the arrangements for equalizing temperature the equilibrium of saltness be disturbed in certain portions of the sea, and that of moisture under ground in the warmer regions of the earth. To prevent this, checks and counterpoises interpose just as their services come to be required. It could scarcely be imagined that in such of our inland seas as were connected by a narrow strait with the Ocean, and were thus cut off from free access to its waters, the supply of fresh water which pours into them from the rivers around would exactly supply the amount carried away by evaporation. Salt never rises in steam, and it is the pure element alone that is drawn off. We have in such cases as the Black and Baltic seas an excess of supply over what is required, the surplus in the latter case flowing off through the Dardanelles, in the former through the Great and Little Belts. The vapor withdrawn from the Mediterranean exceeds by about a third the whole amount of fresh water poured into it; the difference is made up by a current through the straits of Gibraltar in the latter: and a similar arrangement, modified by circumstances, must exist in all cases where circumstances are similar,—the supply of water rushing through the strait from the open ocean being in exact proportion to the difference betwixt that provided from rain or by rivers, and that required by the efflux of vapor; seas wholly isolated, such as the Caspian and the Dead sea, attain in course of time a state of perfect equilibrium—their surface becoming lowered in level and diminished in area, till it becomes exactly of the proper size to yield in vapor the whole waters poured in. The Dead sea, before attaining this condition of repose, has sunk thirteen hundred feet below the Mediterranean, the Caspian about one-fourth of this. Lakes originally salt, and which to all appearance, are no more than fragments severed from the sea by the earthquake or volcano, and which have no river or rain supplies whatever, in process of time dry up and become a mass of rock salt in their former basin. Such is the formation in progress in the lake near Tadjurra, nearly five hundred feet below the level of the sea, its waters having been this much depressed by evaporation, having now almost altogether vanished, one mass of salt remaining in their room. As it is clear in a case such as that of the Mediterranean, that where salt water to a large extent was poured in and fresh water only was drawn off, a constant concentration of brine must occur, the proposition was laid down by the most distinguished of our Geologists, and long held unquestionable, that huge accumulations of salt in mass larger than all that Cheshire contains, were being formed in its depths. The doctrine eminently improbable in itself, is now met by the discovery of an outward under-current, in all likelihood of brine. It is matter of easy demonstration, that without some such arrangement as this, the Red sea must long ere now have been converted into one mass of salt, its upper waters at all events being known in reality to differ at present but little in saltness from those of the Southern ocean. The Red sea forms an excellent illustration of all kindred cases. Here we have salt water flowing in perpetually through the straits of Babelmandeb, to furnish the supplies for a mass of vapor calculated, were the strait shut up, to lower the whole surface of the sea eight feet annually,—and even with the open strait, to add to its contents a proportionate quantity of salt. But an under-current of brine, which from its gravity, seeks the bottom, flows out again to mingle with the waters of the Great Arabian sea, where swept along by currents, and raised to the surface by tides and shoals, it is mingled by the waves through the other waters which yearly receive the enormous monsoon torrents, the Concan and the Ghaut's supply, become diluted to the proper strength of sea water and rendered uniform in their constitution, by the agitation of the storms which then prevail. Flowing back again from the coasts of India, where they are now in excess, to those of Africa, where they suffer from perpetual drainage, the same round of operations go on continually; and the sea, with all its estuaries and its inlets, retains the same limit, and nearly the same constitution, for unnumbered ages. A like check prevents on shore the extreme heating and desiccation from which the ground would otherwise suffer. The earth is a bad conductor of heat: the rays of the Sun which enter its surface, and raise the temperature to 100 or 150°, scarcely penetrate a foot into the ground; a few feet down, the warmth of the ground is nearly the same night and day. The moisture which is there preserved free from the influence of currents of air, is never raised into vapor: so soon as the upper stratum of earth becomes thoroughly dried, capillary action by means of which all excess of water was withdrawn, ceases, and even under the heats of the tropics, the soil two feet down will be found on the approach of the rains sufficiently moist for the nourishment of plants. The splendid flowers and vigorous foliage which burst forth in May, when the parched soil would lead us to look for nothing but sterility, need in no way surprise us: fountains of water, boundless in extent and limited in depth by the thickness of the soil which contains them, have been set aside and sealed up for their use, beyond the reach of those thirsty winds or burning rays which are suffered only to carry off the water which is superfluous, and would be pernicious, removing it to other lands where its agency is required, or treasuring it up in the crystal vault of the firmament, as the material of clouds and dew—and the source when the fitting season comes round again, of those deluges of rain which provide for the wants of the year.

"Such are some of the examples which may be supplied of general laws operating over nearly the whole surface of the terraqueous globe. Amongst the local provisions ancillary to these, are the monsoons of India and the land and sea-breezes prevalent throughout the tropical coasts. When a promontory such as that of India intrudes iuto the region of the trade winds, the continuous western current is interrupted, and in its room appear alternating currents from the northeast and southwest, which change their direction as the Sun passes the latitude of the place. On the Malabar coast, as the Sun approaches from the southward, clouds and variable winds attend him, and his transit northward is in a week or ten days followed by that furious burst of thunder and tempest which heralds the rainy season. His southward transit is less distinctly marked;

it is the sign of approaching fair weather, and is also attended by thunder and storm. The alternating land and sea-breezes are occasioned by the alternate heating and cooling of the soil, the temperature of the sea remaining nearly uniform. At present, when most powerfully felt, the earth by noon will often be found to have attained a temperature of 120°, while the sea rarely rises above 80°.* The air, heated and expanded, of course ascends, and draws from the sea a fresh supply to fill its room: the current thus generated constitutes the breeze. During the night the earth often sinks to a temperature of 50° or 60°, cooling the conterminous air, and condensing in the form of dew, the moisture floating around. The sea is now from 15° to 20° warmer than the earth—the greatest difference between the two existing at sunrise; and in then rushes the air, and draws off a current from the shore.

"We have not noticed the tides, which obedient to the Sun and Moon, daily convey two vast masses of water round the globe, and which twice a month, rising to an unusual height, visit elevations which otherwise are dry. During one-half of the year the highest tides visit us by day, the other half by night, and at Bombay, at Springs, the depths of the two differ by two or three feet from each other. The tides simply rise and fall in the open ocean, to an elevation of two or three feet in all: along our shores, and up gulfs and estuaries, they sweep with the violence of a torrent, having a general range of ten or twelve feet—sometimes, as at Fundy in America, at Brest and Milford Haven in Europe, to a height of from forty to sixty feet. They sweep our shores from filth and purify our rivers and inlets, affording to the residents of our Islands and Continents the benefits of a bi-diurnal ablution, and giving a health and freshness and purity wherever they appear. Obedient to the influences of bodies many millions of miles removed from them, their subjection is not the less complete: the vast volume of water capable of crushing by its weight the most stupendous barriers that can be opposed to it, and bearing on its bosom the navies of the world, impetuously rushing against our shores, gently stops at a given line, and flows back again to its place when the word goes forth—'thus far shalt thou go, and no farther;' and that which no human power or contrivance could have repelled, returns at its appointed time so regularly and surely, that the hour of its approach, and measure of its mass, may be predicted with unerring certainty centuries beforehand. The hurricanes which whirl with such fearful violence over the surface, raising the waters of the sea to enormous elevations, and submerging coasts and islands, attended as they are by the fearful attributes of thunder and deluges of rain—seem requisite to deflagrate the noxious gases which have accumulated—to commingle in one healthful mass the polluted elements of the air, and restore it fitted for the ends designed for it. It is with the ordinary, not with the exceptionable, operations we have at present to deal, and the laws which rule the hurricane form themselves the subject of a treatise.

"We have hitherto dealt with the sea and air,—the one the medium through which the commerce of all nations is transported, the other the means by which it is moved along,—as themselves the great vehicles of moisture, heat, and cold, throughout the regions of the world—the means of securing the interchange of these inestimable commodities, so that excess may be removed to where deficiency exists, deficiency substituted for excess, to the unbounded advantage of all. We have selected this group of illustrations for our views, be-

* The temperature of certain parts of the Indian Ocean—the hottest sea in the world—is 90°.—M.

cause they are the most obvious, the most simple, and the most intelligible and beautiful, that could be chosen. Short as our space is, and largely as it has already been trenched upon, we must not confine ourselves to these.

"We have already said that the atmosphere forms a spherical shell, surrounding the Earth to a depth which is unknown to us, by reason of its growing tenuity, as it is released from the pressure of its own superincumbent mass. Its upper surface cannot be nearer to us than fifty, and can scarcely be more remote than five hundred miles. It surrounds us on all sides, yet we see it not: it presses on us with a load of fifteen pounds on every square inch of surface of our bodies, or from seventy to one hundred tons on us in all, yet we do not so much as feel its weight. Softer than the finest down—more impalpable than the finest gossamer,—it leaves the cobweb undisturbed, and scarcely stirs the lightest flower that feeds on the dew it supplies; yet it bears the fleets of nations on its wings around the world, and crushes the most refractory substances with its weight. When in motion, its force is sufficient to level the most stately forests, and stable buildings, with the Earth—to raise the waters of the ocean into ridges like mountains, and dash the strongest ships to pieces like toys. It warms and cools by turns the Earth and the living creatures that inhabit it. It draws up vapors from the sea and land, retains them dissolved in itself, or suspended in cisterns of clouds, and throws them down again as rain or dew, when they are required. It bends the rays of the Sun from their path, to give us the twilight of evening and of dawn—it disperses and refracts their various tints to beautify the approach and the retreat of the orb of day. But for the atmosphere, sunshine would burst on us and fail us at once—and at once remove us from midnight darkness to the blaze of noon. We should have no twilight to soften and beautify the landscape—no clouds to shade us from the scorching heat, but the bald earth as it revolved on its axis, would turn its tanned and weakened front to the full and unmitigated rays of the lord of day. It affords the gas which vivifies and warms our frames, and receives into itself that which has been polluted by use, and is thrown off as noxious. It feeds the flame of life exactly as it does that of the fire,—it is in both cases consumed, and affords the food of consumption—in both cases it becomes combined with charcoal, which requires it for combustion, and is removed by it when this is over. 'It is only the girdling encircling air,' says a writer in the North British Review, 'that flows above and around all that makes the whole world kin. The carbonic acid with which to-day our breathing fills the air, to-morrow seeks its way round the world. The date trees that grow round the falls of the Nile will drink it in by their leaves; the cedars of Lebanon will take of it to add to their stature; the cocoanuts of Tahiti will grow rapidly upon it; and the palms and bananas of Japan, will change it into flowers. The oxygen we are breathing was distilled for us some short time ago by the magnolias of the Susquehanna, and the great trees that skirt the Orinoco and the Amazon—the giant rhododendrons of the Himalayas contributed to it, and the roses and myrtles of Cashmere, the cinnamon tree of Ceylon, and the forests older than the flood, buried deep in the heart of Africa far behind the mountains of the Moon. The rain we see descending was thawed for us out of the icebergs which have watched the Polar Star for ages, and the lotus lillies have soaked up from the Nile and exhaled as vapor, snows that rested on the summits of the Alps.' 'The atmosphere,' says Maun, 'which forms the outer surface of the habitable world, is a vast reservoir, into which the supply of food designed for living creatures is thrown—or, in one word, it is itself the food in its simple form of all living creatures. The animal grinds down the fibre and the tissue of the plant, or the nutricious store that has been laid up within its cells, and converts these into the substance of which its own organs are composed. The plant acquires the organs and nutricious store thus yielded up as food to the animal, from the invulnerable air surrounding it.' But animals are furnished with the means of locomotion and of seizure—they can approach their food, and lay hold of and swallow it; plants must await till their food comes to them. No solid particles find access to their frames; the restless ambient air, which rushes past them loaded with the carbon, the hydrogen, the oxygen, the water—everything they need in the shape of supplies, is constantly at hand to minister to their wants, not only to afford them food in due season, but in the shape and fashion in which alone it can avail them."

Surely a more tempting field for philosophical research, for useful and honorable labor, or a field more abounding with the elements of useful and practical results, never engaged the attention of man.

By studying the winds at sea we might expect to find them blowing there more conformably than on the land to the general laws which govern the circulation of the atmosphere. At sea, we may look for the rule, and on the land for the exceptions. It might therefore, be expected that this undertaking to group the observations of mariners upon the winds in all parts of the ocean, and at all seasons of the year would be regarded, as the illustrious Humboldt says it is, and as the learned Dr. Buist shows it is, with no little interest by philosophers and philanthropists, by good and wise men in all conditions of life, and in all parts of the world.

In the progress of this undertaking, many new facts of the highest interest to science have been brought to light, or their existence suggested. Our knowledge of the laws which govern the circulation of the atmosphere, which control the currents of the sea, which regulate climates, and by which heat and moisture, clouds and sunshine, are distributed over the surface of the Earth, has been greatly enlarged even by the results so far obtained.

Navigation has already reaped a rich reward from this undertaking, and commerce is profiting by it. In consequence of the increase of knowledge which it has given to the practical navigator, with regard to the prevailing winds and currents of the sea, the average sailing passage between distant points has been materially shortened.

Practically, for commercial purposes, these investigations have lifted up, as it were, the markets of the southern hemisphere, and placed them nearer to our doors by several days' sail—and in many cases, weeks' sail—than they were before; for the time which it required a ship to carry a cargo from one hemisphere to the other, has been shortened more than two weeks at some seasons of the year; and it is not going too far to say that the voyage hence to California has been shortened to a more remarkable extent. The average passage out is 180 days; but vessels with these charts on board have made it in 107, in 97, and in 96 days; and their masters ascribe this great success to the information which they derived from these charts as to the winds and currents by the way.

The merchants and shipmasters of India, perceiving the great benefits which American commerce and American merchants, shipmasters and owners, were deriving from this system of investigations as developed in part only for the Atlantic ocean, have promptly stepped forward, raised a subscription for the purpose, and directed a set of Wind and Current Charts upon the plan of these, to be undertaken for the Indian ocean; and the Geographical Society of Bombay composed of men eminent for their virtue and learning, have given the undertaking their countenance, and the work is now conducted under the auspices of that Society. A similar move is under discussion in Calcutta also.

It is urged by the merchants of India, that these charts which have already been constructed for the Atlantic ocean, are enabling American citizens to gain still more rapidly upon British subjects in the glorious race for the commercial supremacy of the seas, which is "now coming off." It is, therefore, proposed by those public spirited merchants to construct charts upon the plan of these, for the Indian ocean.

They are right. There is no part of the sea where there is a wider field for improvement in its navigation than in the Indian ocean. A patient and faithful discussion of Log books in regard to the winds and currents of that ocean, and the publication of properly constructed charts of the results, will no doubt be attended with a great gain and saving of time in the navigation of it. Merchants and ships owners will reap many and important advantages from the work.

This ocean was already embraced in the original plan, and our investigations had been extended to it. But Log books of voyages there are scarce, and the materials in quantities sufficient were wanting, else charts of that ocean would have been published from this office more than a year ago. The labor upon them was suspended for the want of Log books.

I am, therefore, so much the more pleased at the Bombay move. It is rivalry of the right sort. The field is a fair one; it presents a noble object as a prize, which is well calculated to excite the emulation of good men; competition is inspiring. I have, therefore, witnessed the move in India with gratification, and have given it a second with great pleasure, and the more so because we are by this work assisting in some sort to pay off a kind of national debt, which of all classes, American navigators feel with most obligation, and which they of all classes most desire to repay. I mean the obligations under which the British people have placed us by their contributions to hydrography and navigation.

Whatever be the sea upon which the American navigator sails, or whatever the shore that he visits, he he has with but few exceptions, for his guidance, British surveys or the works of English hydrographers. They have conducted him in safety through many difficult passes, and made plain and easy to him, the dangerous paths of the sea.

Therefore, when I commenced these charts, I commenced them with the desire—and I am sure every "true Yankee sailor" will appreciate the feeling out of which it grew—that they should be exclusively the work of American navigators—that American seamen should furnish all the materials that were peculiar to and characteristic of the work, and that the charts should go forth to the world as a production exclusively American.

I have been nobly seconded in this attempt by many true-hearted Americans. But there are many who have looked upon the undertaking with indifference, and a few I fear, from misconception, with hostility. At any rate, there is a considerable number of American navigators from whom I have derived no sort of co-operation, aid or information whatever.

And as there are many parts of the ocean with regard to which Abstract Logs are scarce, and materials hard to get, I have felt myself constrained, under all the circumstances of the case, to depart from the original intention of constructing these charts exclusively upon information furnished by American navigators, and to invite all of all nations who will, to co-operate and contribute.

The field is as wide as the world, and as broad as the ocean, and the work is for the benefit of all who use the sea, and therefore it appeared appropriate that all who use the sea should be invited to contribute, each his quota towards its safe and easy navigation. Every right-minded seaman will, I am sure, be glad of the invitation, because it affords him the privilege of increasing the value of this great magazine of nautical information.

The merchantmen of India have, therefore, owing to the difficulty of procuring from American navigators materials in sufficient quantities for the Indian ocean, been especially requested to furnish their observations and "abstracts," to this office, also.

The materials which I have from that ocean, and which have been furnished by American navigators, at present engaged in its commerce, are just sufficient to show that there is a rich harvest to be gathered there.

A Gulf Stream, nearly if not quite equal to our own in the Atlantic, has its genesis there. Its waters are nearly at blood heat; they frequently reach a temperature of 90°. Between the shores of China and one of the sources of this hot stream, but counter to it, is a current of cold water.

In this system of aqueous circulation thus detected, and in the prevailing winds of the Pacific, are to be found the conditions which cause the climates of the Atlantic States to be repeated along the coasts of China; the climate of Western Europe to be reduplicated in Northwestern America. Here in the tepid waters of India which this stream conveys towards the Fox Islands—the Newfoundland of the Pacific ocean—is to be found the origin of the fogs of the north Pacific, and the European-like climate of Oregon. It may be expected that the storms which take their rise near the western margin of the Pacific ocean will also follow this stream in their course.

The passage from China to San Francisco is now made in 54 days. But with the knowledge which these Charts promise us, with regard to this stream and the winds of that ocean, there is reason to believe that the average passage under canvass may be yet still further, and considerably reduced.

There is a part too of the north Pacific which answers to our Sargasso sea of the Atlantic. In it, sea-weed and drift-wood will probably be found, though not in such quantities as in the Atlantic. I have already received some information concerning a sort of Sargasso sea in the Pacific.

Bottles containing a paper with the date and place of the ship, and requesting the finder to cause the same to be published in the nearest newspaper, and forwarded to the Superintendent of the National Observatory, at Washington, with an account of the time and place at which it may be picked up, would, in many cases, afford much useful, valuable and interesting information concerning the currents of the Pacific Ocean.

The practice of throwing bottles thus freighted, overboard in that and the Indian Ocean is recommended to navigators who are co-operating with me in these investigations, and a frequent resort to this practice is earnestly commended to their attention.

The Indian ocean is the fountain of another stream of warm water which flows south, and a branch of which is the well known Lagullas current.

With the information to be derived from the Abstract Log books with which I hope *every* American navigator that visits those seas will furnish me, I see reason for the anticipation of great improvements in the navigation there—particularly in the navigation between New Holland and India; and between India, China and the Cape of Good Hope.

The discovery has already been made, that in certain parts of the China seas, each month almost has a system of winds peculiar to itself. Thus the winds between the parallels of 15° and 20° N, and the meridians of 110° and 115° E. are:

In Dec.,	between	N. and N. E. inclusive.
Jan.,		N. and E.
Feb.,		N. N. E. and E.
March and April,		N. E. and S. E.
May,		N. by way of E. to S. W.
June,	between	S. E. and S. S. W.
July,	"	S. and S. W.
August,	"	S. and W. S. W.
Sept.,		around the Compass.
Oct. and Nov.,	btw.	N. and E.

5° and 10° N. 105° and 110° E.

Dec., Jan. & Feb.,	btw.	N. and N. E.
March,	steady from	N. E.

Lat. 5° and 10° N., Long. 105° and 110° E.

April,	between	N. E. and E. inclining to v'bl.
May,		around the Compass.
June,	between	S. E. and S. W.
July,	"	S. and S. W.
Aug. and Sept.	"	S. and W. N. W.
Oct. and Nov.		Variable, around the Compass. *See plate* 1.

Lat. 15° and 20° N., Long. 115° and 120° E.

Dec. to April,	btw.	N. and E.
May and June,		Variable.
July and Aug.,	btw.	S. S. W. and S. W.
Sept. and Oct.,		Variable.

These facts have been clearly brought out by these investigations; and that such are the differences with regard to the winds in different parts of this ocean, and at different seasons of the year, there is no more doubt than there is as to the fact that the monsoons change.

Some few masters of merchantmen, I am aware, have refused or withheld co-operation in this undertaking upon the plea that I have some theory of my own which I am seeking to build up by these charts.

They are mistaken: I set out with no theory; and I have none to build up. I set out with the view of collecting facts, of gathering and presenting side by side the experience of every navigator with regard to the winds and currents, and the phenomena of the sea—of taking the records thereof from all the Log books I could obtain—and of discussing them, that I might ascertain not from the reports of one or two seaman, but of a multitude, the prevailing winds for every month, in every part of the ocean; and in the manner of doing this, I have been governed altogether by the principles of inductive philosophy.

And to satisfy navigators as to the confidence which is due the results thus obtained and announced, I will explain the process by which the results above quoted as to the winds in the China sea, were arrived at;

for this purpose I present for their examination a fac simile taken from the sheet upon which Lieut. Forrest is engaged marking the direction of the winds recorded in their Logs.

The entire ocean is divided out into districts of 5° of lat. × 5° of long. each, and in whatever part of one of these districts a navigator may be when he records the direction of the wind in his Log, from that direction the wind is assumed to be blowing at that time all over that district; and this is the only assumption that is permitted in the whole course of the investigations.

Now if the navigator will draw or imagine to be drawn in any such district, 12 vertical columns for the 12 months—and then 16 horizontal lines through the same district for the 16 points of the compass, i. e. for N., N. N. E., N. E., E. N. E., and so on, omitting the *by*-points, he will have before him a picture of the "Investigating Chart," out of which the "Pilot Charts" are constructed. In this case, the alternate points of the compass only are used; because when sailing free, the direction of the wind is seldom given for such points as N. by E., W. by S., &c. Bearing this in mind, the intelligent navigator will have no difficulty in understanding the annexed diagram, (Plate 1;) and in forming a correct opinion as to the degree of credit due to the results afforded by it.

Instead of entering the wind in the Log as from the *point* of the compass from which it blows, many seamen were too much in the habit, particularly when the wind was a little variable, to enter it as from the "Sd. and Wd.," "Nd. and Ed.," and so on, by quadrants.

In such cases we are at a loss to know how to enter such winds on the sheet; we do not know whether in the case of the entry "Nd. and Ed.," for example, to enter it on the N. N. E., the N. E. or the E. N. E line, for these are all "Nd. and Ed."

As soon as the attention of those who were keeping abstracts for me was called to this, they with great promptitude and fidelity, I have reason to believe, remedied the defect and adopted the plan recommended, by entering the wind for the first, middle and latter part—3 times a day—as from that point of the compass from which it most prevailed during each part. Thus three entries or scores are made on the sheet for every day—these scores are made in the column standing for the month, and on the line standing for the point of the compass from which the wind prevailed.

As the compiler wades through Log book after Log book, and scores down in column after column, and upon line after line, mark after mark, he at last finds that under the month and from the course upon which he is about to make an entry, he has already made four marks or scores thus: (IIII). The one that he has now to enter will make the fifth, and he "scores and tallies;" and so on, until all the abstracts relating to that part of the ocean upon which he is at work has been gone over, and his materials exhausted. These "fives and tallies" are exhibited on plate 1.

He then sums up the number of winds entered from each point for each month, and enters the same expressed in figures—in its appropriate place on the "Wind-rose" of the Pilot chart.

The courses of the winds as given in the abstracts are compass courses, and they are entered on his working sheet accordingly. If the variation be more than one point, and less than three, the compiler makes the correction for all at once, when he goes to transfer results to the Pilot Chart, so that the Pilot Chart may shew the true courses of the winds as nearly as possible.

Thus, suppose that, in the district which the compiler is about to transfer, the variation be 2 points East; what he has recorded in his working sheet as north winds for instance, are transferred to the Pilot Chart as N. N. E. winds, and so on, correcting every course for variation. If the variation be 1 point or less, then the transfer is made without any correction.

Now with this explanation it will be seen that in the district marked A, (Plate 1,) there have been examined the logs of vessels that, giving the direction of the wind for every eight hours, have altogether spent days enough to enable me to record the calms and the prevailing direction of the wind for eight hours, 2,144 times;—of these, 285 were for the month of August; and of these 285 observations for August, the wind is reported as prevailing from N. 3 times; from N. N. E. 1; N. E. 2; E. N. E. 1; E. 0; E. S. E. 1; S. E. 4; S. S. E. 2; S. 24; S. S. W. 45; S. W. 93; W. S. W. 24; W. 47; W. N. W. 17; N. W. 15; N. N. W. 1; Calms (the little 0's) 5; total 285 for this month in this district.

Now the only question to be asked and answered, as expressive of doubt with regard to these results are: were these observations made under the usual condition of things? and if so, are there enough of them to afford a fair average as to the prevailing direction of the winds in that district?

The Log books are taken at random, examined with care and quoted with fidelity, and, therefore, as the observations were made by mariners as they chanced to pass to and fro through this part of the ocean, the presumption is a fair one that their records shew fairly.

Are the observations sufficiently numerous to afford the data for a fair average?

The answer in this case depends upon the opinion of him who undertakes to reply; but to be sure of erring on the right side, if err I must, I have aimed to get at least, on the average, 100 observations for every month in every district. This is my aim; but practically I have found it difficult to accomplish it. In some districts I have obtained as many as 1800 observations for a single month; whereas, in another month in a neighboring district, I have not been enabled to obtain a single observation; such is liable to be the case as long as some parts of the ocean, as there must be, are frequented more than other parts, or as long as crops come to market at different periods of the year, and commerce has its seasons of annually recurring activity and repose.

There is then this satisfaction to the practical navigator, when he sees a blank Wind-rose in the Pilot Chart: he wants most to use the parts of the ocean that are the most frequented and are the great highways, while those parts which lie out of the paths of commerce possess so little practical interest to him, that he does not care to know which way the winds blow there. The navigator, therefore, stands a very good chance of getting all he wants from these Charts—it is the philosopher who wishes to trace in "his circuit" the winds in the unfrequented parts of the ocean, and for his sake it is desirable to have records extending over all parts of the ocean in all seasons alike.

But plate 1, incomplete as it is, affords much that is interesting to the philosophical navigator; though it has been said in high places that philosophical research and the pursuits of the sailor are incompatible. As seamen become philosophers they "lose the qualities and habits necessary for command at sea." So says one high in office.

There is no calling of men that has done more for philosophy than the mariner, and any one who will take the trouble to examine plate 1, which is made up entirely of observations by this much abused class, will find it abounding with philosophical truths, principles and instruction. More than any other class, the sailor is accustomed to observe upon the great deep the workings of nature, and he, to be fit for his calling, must be a philosopher in the truest sense of the term.

Upon this plate he sees marked out in the most beautiful and striking manner, the path of the "wind in his circuits" over this part of the ocean. He perceives by examination that the law which governs the wind in district A is not the law which governs it in district B.

That in the former, the month of September is remarkable for the constancy and steadiness with which the wind clings to the S. W. quadrant. That in the latter, it is all around the compass for September, inclining to prevail most from the N. E. quadrant. After looking at A, he will conclude that every season of the year, winter, spring, summer and autumn, may be said there to have each its own monsoons or peculiar system of winds. The winds take almost from December to September, gradually to get round from northward and eastward, to southward and westward; and they leap back almost at a single bound, it may be said, in the month of October.

There are many other respects in which the philosophical navigator, and I hold every properly qualified navigator to be a philosopher, will find himself interested with regard to this plate.

The number expressed in figures denotes the whole number of observations of calms and winds together, that are recorded for each month and district.

In C the wind in May *sets* one third of the time at West. But in A, which is between the same parallels, the favorite quarter for the same month is from S. to S. W., the wind setting one third of the time in that quarter, and only 10 out of 221 times from the West; or on the average, it blows from the West only 1⅓ days during the month of May.

In B, notice the great "Sun Swing" of the winds in September, indicating that the change from summer to winter is sudden, violent; from winter to summer gentle and gradual.

The proposition to collect a great number of Log books with the view of patiently examining them all, one by one, of taking from each an exact account of the winds and currents mentioned, and of carefully collecting all the information to be gathered from such sources, touching the industrial pursuits of the sea, and of so presenting that information as to embody the united experience of every navigator, could not fail to commend itself most favorably to every intelligent and public spirited mariner. The manner in which shipmasters and owners finally received this proposition has been highly gratifying; and, on account of the co-operation which I have received at the hands of this class of my fellow citizens, the undertaking, though but just begun, has, nevertheless, been crowned with results which I dared not anticipate.

These results have been beneficial to commerce and navigation in a high degree. Wherever the Charts have been extended, there has been a great gain of knowledge as to winds, &c., consequently a shortening of voyages, and a saving of time, by rendering passages to and fro less uncertain.

During the course of these investigations facts, in many instances, have been elicited to confirm what philosophers already knew, and had been teaching touching the winds and currents of the sea. In other instances, facts and circumstances have been revealed, which may be regarded as new, and in some cases as amounting to valuable and important discoveries.

As all the results derived from these Charts, whether in confirmation of what was already suspected, or in evidence of increasing knowledge as to the laws of nature, have been obtained by a new and independent system of research, they or the most striking of them deserve to be enumerated, in order that the importance of the undertaking may be the better appreciated by those upon whom I have called for help and co-operation.

These are some of them:

1st. The discovery of a new and a better route hence to the Equator.

2d. A system of southwardly monsoons in the equatorial regions of the Atlantic ocean.

3d. Ditto, off the west coast of America in the Pacific.

4th. The vibratory motion of the trade wind zones, with their belts of calms.

5th. The limits of these have been determined, and the parallels between which those limits are to be found for any month, pointed out to the mariner.

6th. The fact has also been made clear, and brought within the compass of demonstration, that the S. E. trade winds are stronger than the N. E., that they cover a broader belt on the ocean, and move a greater volume of atmosphere. That at a mean in the Atlantic, the breadth of the band of trade winds is about 22° for the N. E.; 29° for the S. E.

7th. That in the general system of atmospherical circulation, the prevailing winds of the southern are stronger than the prevailing winds of the northern hemisphere.

9th. That the mean temperature of the northern is higher than that of the southern hemisphere.

10th. That the greatest density or specific gravity of the surface waters of the Atlantic ocean, is near the parallels of 17° North and 15° South.

11th. The causes of the rainy and dry seasons, and the means of telling wherever on the Earth's surface the seasons are so divided by nature.

12th. The parts of the ocean in which sperm and right whales most resort have been discovered and pointed out.

13th. The interesting fact in the natural history of this animal has been brought to light, viz: that the species known to fishermen as the right whale cannot cross the torrid zone.

14th. And that there is a species of whale peculiar to the Arctic ocean; and probably another to the coast of California.

15th. That in certain parts of the Indian ocean, the waters are warmer than in any other sea.

16th. That there is a cold current along the coast of China.

17th. And that there are many highly interesting and beautiful anomalies touching the Gulf Stream, the cold and warm currents of the sea, and the distribution of heat over the surface of the land and water, for an account of which, I refer to the Charts themselves.

I have intimation of other results: that if this system of interrogating nature touching the laws by which the circulation of the air and water is regulated, be patiently pursued, many instructive replies, and much information that is truly valuable will be elicited.

And in order to encourage the large corps of mariners who are co-operating in this work, I may be excused for enumerating some of the most striking of the probable results, which these investigations encourage us to anticipate, or induce us to inquire for.

1st. These investigations will probably show that the mean temperature of the ocean for any parallel is higher than that of the air for the same parallel at sea, even though a cold current be present.

2d. They afford room to suppose, and themselves suggest the supposition, that the air which the S. E. trade winds discharge into the belt of equatorial calms, after ascending there, flows for the most part over into the northern hemisphere; while that which the N. E. trades discharge there passes in like manner over into the southern hemisphere.

3d. That the calms of Cancer and of Capricorn are caused by the meeting of two upper currents; the one from the pole being dry, the other from the equator being charged with vapor.

4th. That there is a region of calms near the poles in which the barometer on a level with the sea, stands lower than on the sea-level elsewhere; and the inquiry is suggested whether the magnetic pole be not within this region.

5th. That the trade wind regions are the evaporating regions; and that we ought to inquire whether the lightning displayed in our thunder storms does not come from the trade wind regions and go up into the clouds with the vapor from the sea.

6th. That the waters of the Mississippi River and the great American Lakes are rained from clouds, the vapor for which was taken up from the South Pacific Ocean, while the waters of the Amazon and Oronoco are evaporated exclusively from the Atlantic.

7th. That the springs in the ocean which supply the sources of all the great rivers of the northern hemisphere are, for the most part, to be found where the S. E. trade winds blow, in the Pacific and Indian oceans.

8th. That magnetism is a powerful agent in giving direction to the circulation of the atmosphere; and the question is raised, if it be not concerned in the currents of the ocean also.

9th. That the "red fogs" of the Cape Verde Islands, and the so-called "African dust" of the North Atlantic, is dust from the basins of the Amazon and Oronoco, taken up by the winds in the dry season, and transported in the upper current from the equator towards the pole, that is counter to the N. E. trade wind. This "dust" is known to consist, for the most part, of infusoria, from the river basins of South America, and the microscopic examinations of Prof. Ehrenberg go far to prove that such is the origin of the "red fogs and sea-dust."

10th. That the basin which holds the Gulf of Mexico, is about a mile deep, on the average;* the North Atlantic more than 6 miles; the South at least three; and the Gulf Stream in the Florida Pass, 500 fathoms.

11th. Agencies have been revealed which suggest the conjecture that at the head of the Red sea near the isthmus of Suez, the waters are lower, salter and heavier, than they are near its mouth. That at its head there is a winter and a summer level, and that there is a strong under current from it into the Indian ocean.

12th. That the same whale is found in Behring's Strait, and Baffin's Bay, and the fact is proved that this fish cannot get from the one place to the other except through the Arctic Ocean.

I do not wish to be understood as claiming this catalogue of phenomena as actual results already derived from the investigations of Log books; nor do I intend by this enumeration of them to commit myself with regard to them further than I have done in the body of this work. Whether they be regarded as questions for further research, as probabilities, as actual discoveries, or as confirmations of known truths, I have enumerated them for the purpose of showing those who are laboring in connection with this work, that the field is both rich and wide; that good use is made of the materials which are furnished; that the plan of treating these materials is a good one, because, resting on an independent and separate system of observations, the manner of discussion is such as to confirm almost all that was known before with regard to the winds and currents of the sea; and I have enumerated them for the purpose also of showing that though much that is valuable and important has been done, much that is inviting remains yet to be done.

Neither do I mean to embarrass this beautiful system of investigations by implying that all these indications are to be established, and all these questions to be answered in the affirmative. But inasmuch as they are indications and questions which mark the progress of the Charts, and which the Charts themselves have revealed or suggested, I expect the Charts will throw more light upon most of them, and enable us to give some conclusive answer, pro or con, with regard to them.

In a system of research such as this is, questions will arise, and there are many such which are continually pressing themselves upon the philosopher, to which a satisfactory answer, whether in the negative or the affirmative is equally desirable, and will be equally conducive to the great end in view, viz: progress in the collection of physical facts and advancement in studying the laws of nature. Such is the character of many of the questions which these Charts move us to propound.

For the materials from which these results have been obtained, or are promised, I am mainly indebted to the voluntary co-operation of American shipmasters and owners; for the results themselves, I am indebted, first to the countenance which the Navy Department and the Chief of the Bureau of Ordnance and Hydrography have extended to the work; and next to the fidelity and zeal with which those of my brother officers of the Navy, who, from time to time, have been engaged with me upon it, have carried out my views with regard to the manner of conducting it.

Ever since Log books have been kept at sea, and preserved in old sea chests and garrets on shore, the materials for such a system of investigations as this is, have existed. But the labor of collecting from such

* See the deep sea soundings of the U. S. Ship "Albany," Commander Platt, and sounding journal of Lt. Wm. Rogers Taylor, U. S. N.

records, the remarks on the wind and weather, and of collecting the experience of each one in relation thereto, of classifying it, and arranging it side by side with the experience of all the rest, and of presenting the combined result in such a manner as to be obvious at a glance and available to all, appeared a Herculean task, which no one before had offered to undertake.

In 1842, the first official move was made with regard to the subject. In that year, I called it to the notice of the late Commodore Wm. M. Crane, the Chief of the Bureau of Ordnance and Hydrography, himself an officer of the most exalted worth. He at once appreciated the importance of the undertaking, and entered, as he always did with regard to everything that was useful in his profession, or beneficial to the great interests of navigation, most heartily into the spirit of it.

A circular letter was accordingly prepared, and being approved by him, was addressed under his signature to American shipmasters, requesting them to furnish this office with all kinds of information touching navigation, that might come in their way.

Copies of this circular were furnished to the collectors of the customs at the principal sea ports, with instructions to deliver one to every American shipmaster at the time of his clearance.

From some cause, to me unknown, this circular letter was not regarded. No response whatever was elicited, and the appeal passed by unnoticed; this was disheartening.

I then went to the old Log books of the Navy, and obtained authority to construct from the materials afforded by them, a set of "Wind and Current Charts."

Upon examination it was found that many of these old Logs were wanting, and the number on hand no large.

But though slender the data and meagre the materials, it was determined that a beginning should be made.

It was made, but the requisite data and means were wanting. It proved an uphill business, and so we balked.

I then brought the subject to the notice of the men of science of the country, with the view of procuring their countenance to the work; and, in papers read on the currents of the sea before the National Institute, and the Association of American Geologists and Naturalists, now the American Association, I explained the meagre state of our information with regard to the currents of the sea, urged the value of what was locked up in the old sea chests of mariners, and pressed the importance to science, commerce, and navigation, of the information which navigators might give concerning the phenomena of the ocean.

These institutions expressed an interest in the matter, and resolved to second my efforts by appointing committees to press the subject upon the attention of the Government.

In the mean time I obtained the assistance of Lieut. Wm. B. Whiting, United States Navy, a most accomplished draftsman and hydrographer. He was ordered to report for duty at this office in 1845.

The labor was commenced anew; more Log books had been procured from our men-of-war. It was now seen that we should obtain more and better materials than we had before: all the former work was therefore rubbed out, and we began anew.

But our men-of-war seldom went to England or the north of Europe, therefore nothing was to be done in that quarter. The only other directions was down towards the equator and the West Indies.

The beginning of 1848, found three sheets—those which correspond to Nos. 1, 2, and 3 of the present Track Charts, series A—engraved and published.

They contained only the tracks of men-of-war, but though there were few of these, I was satisfied that the work, so far, enabled me to point out a shorter and a quicker, and a better route to Rio than the one usually pursued. This was a discovery; and as such, I announced it. The barque W. H. D. C. Wright, Jackson, of Baltimore, was the first to try this new route. She crossed the Line in Longitude 31° West, the 24th day out, (it has since been done in 19 days, the usual time before was 41 days,) and made the trip to Rio and back, in 75 days. A remarkable quick voyage it was, and a complete demonstration of the problem that I had so long endeavored to prove.

Navigators now appeared for the first time to comprehend clearly what it was I wanted them to do, and why; they appreciated the importance of the undertaking, and came forward readily with offers of hearty, zealous, and gratuitous co-operation.

In a short time a large fleet, without the promise or hope of reward, was found engaged in collecting materials for the work; more than a thousand navigators are now busied night and day in all parts of the world, in making observations and gratuitously collecting materials of great value to science, commerce and navigation; never before has there been such a corps of observers scattered over the world, yet laboring together and acting in concert, with regard to any system or subject of philosophical research.

This fact speaks volumes in favor of the intelligence and public spirit of American navigators, and as a sailor, I mention it with proud satisfaction.

Being now fairly underway with new and more abundant materials, and having the assistance of such a large, able, and zealous corps of observers in collecting more, it was again found necessary to rub out and begin afresh.

The third trial was more successful. It has placed us where we are.

As, therefore, these charts, so far, are the results of the joint labors of American navy officers and ship-masters, and as each one who has contributed to them, may be supposed to feel more or less interest in the progress of the work, as well as in the results obtained, it is proper that for the satisfaction of those concerned, if for no other purpose, I should give an account somewhat in detail of the manner in which the work has been conducted, and of the results, step by step, as they have been obtained and announced to the public.

The manner in which the investigations for each set of charts have been conducted, is fully explained in another part of this paper; and this will be readily understood by a reference to the plates and diagrams which accompany this volume.

The results so far as they have appeared satisfactory and conclusive to my own mind, have for the most part already been made public; sometimes as official reports; sometimes in the shape of letters; sometimes in public lectures, or in scientific papers; and sometimes directly to mariners as a notice in the newspapers.

I shall therefore recapitulate, as I go along, the substance of these announcements, taking care to present the results first announced, not as they appear now, but as they appeared at the time; so that those who have helped to raise the structure to its present proportions, may have an opportunity of contemplating the scaffolding also. They will thus be enabled to retrace the work, and to follow it in its progress, step by step, realizing as they advance how it is, that our views enlarge, and the horizon expands as we ascend from one fact to another, and rise higher and higher as fact is traced to effect, and effect to cause.

The first Log books that were used in the construction of these Charts, not being kept with the view of ever being so used, gave the winds generally, and especially when sailing free, as from the *quadrant* instead of from the point of the compass.

Thus vessels on the homeward track from Rio, after meeting the N. E. trades, generally recorded the winds as "Northward and Eastward." This induced me to suppose that the winds were from the N. E. *point* of the compass, instead of the N. E. quadrant, and to infer, after the brushes by which the course and direction are represented on the "Track" Charts were drawn, that these winds were for the most part fair winds for going to the Equator also.

So understanding the entries in the Log, I saw that it was practicable for a vessel under canvass to sail on a great circle from New York to Cape St. Roque in Brazil; I therefore recommended a more direct route than had hitherto been pursued, and it is this route, which, with the additional information and the modifications and exceptions which subsequent researches have enabled us to make with regard to it, has proved so short and successful.

Seeing this defect in the old Log books, a form was prepared expressly for those navigators who were volunteering to co-operate with me. In this form they are requested particularly, always to note the *point* of the compass from which the wind comes; and when it is variable, to note and enter, at the time, the point of the compass from which it may have most prevailed during each of the "three parts" into which mariners are accustomed to divide the 24 hours. *When a navigator fails to do this, he returns to me a useless Log.*

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*Influence of the Gulf Stream on the Trade of Charleston.**

Before the Gulf Stream was known to practical navigators, the course of trade between England and America was such as to make Charleston the half-way house between the mother country and the New England States, including Pennsylvania and New York, among the latter.

At that time, the usual route of vessels bound to America, was to run down on the other side of the Atlantic towards the Cape de Verdes, and until they got the N. E. trades, and with them to steer for America. This was the route taken by Columbus; this route brought them upon the coast of the Southern States, where

* See proceedings of the American Association, at Charleston, 1850—for a paper "On the influence arising from the discovery of the Gulf Stream on the commerce of Charleston."

their first landfall was generally made. Then steering to the northward, they drifted along with the Gulf Stream until they made the Capes of the Delaware, or other headlands to the North.

If now, as it often happened in the winter season, they were driven off the coast by snow storms and westerly gales—instead of running off into the Gulf Stream, as vessels now do, to thaw themselves, they stood back to Charleston, or the West Indies, where they would spend the winter, and wait until the spring before making another attempt to enter the northern ports.

It should be borne in mind that vessels then were not the sea boats, or the sailers they now are. I have in my collection, the Log-book of a West India trader in 1740. Her average rate of sailing per log, was about two miles the hour. I shall quote this Log, because it is instructive.

The instruments of navigation were rude, chronometers were unknown, and lunars were impracticable, and it was no uncommon thing for vessels in those days, when crossing the Atlantic, to be out of their reckoning 5°, 6°, and even 10°. And when it was announced that a vessel might know by consulting the water thermometer, when she crossed the eastern edge of the Gulf Stream, and again when she crossed the western edge, navigators likened the discovery to the drawing of blue and red streaks in the water, by which, when the mariner crossed them he might know his longitude.

The merchants of Providence, R. I., Dr. Franklin being in London, sent a petition to the Lords of the Treasury, asking that the Falmouth packets might run to Providence instead of to Boston; they maintained that though Boston and Falmouth were between Providence and London, yet that practically the two former were further apart, than the two latter, for it was shown in the memorial, that the average passage of the London traders to Providence, was fourteen days less than the average by the packet line from Falmouth to Boston.

Dr. Franklin, on being questioned as to this fact, consulted Captain Folger, an old New England Captain, who had been a whaler, and who informed the Doctor that the London traders to Providence were commanded for the most part by New England fishermen, who knew how to avoid the Gulf Stream, while the Falmouth packets were commanded by Englishmen who knew nothing about it.

These two drew a chart, which was published at the Tower, and limits of the Gulf Stream, as laid down there by that Yankee whaler, have been preserved upon our charts until within a few years.

It is yet within the recollection of most navigators, how the traders from the New England States to the West Indies used to find their way out, "by running down the latitude" as it was called: the practice was to steer South until the latitude of their port was reached, and then to steer due West until they made the land. Their track was, therefore, on the two legs, instead of along the hypothenuse of a triangle.

The cause of this practice was in the practical difficulty of finding longitude at sea; for the general use of chronometers on board ships is an innovation which the masters of that kind of craft had not learned, 20 years ago, to tolerate.

Well might thermometrical navigators, therefore, when the chart appeared from the Tower, giving the longitude of the inner and outer edge of the Gulf Stream, liken those two lines to blue and red streaks painted on the ocean to show mariners their longitude.

At the time that Dr. FRANKLIN made it known how navigators, simply by dipping a thermometer in the water, might know when they entered, and when they cleared, the Gulf Stream, Charleston had more commerce than New York, and all the New England States put together.

This discovery* changed the route across the Atlantic, shortened the passage from sixty to thirty days coming this way, and, consequently, changed the course of trade also.

Instead of calling by Charleston as they came from England, vessels, after this, went direct to the port o their destination; instead of running down to Charleston to avoid a New England snow storm, they stood off for a few hours, until they reached the tepid waters of the Gulf Stream, in the genial warmth of which the crew recovered their frosted energies, and as soon as the gale abated, they were ready for another attempt to make their haven.

In this way stations were shifted; the northern ports became the half-way house, and Charleston an outside station.

This revolution in the course of trade commenced about 1795. It worked slowly at first, but in 1816-17, it received a fresh impulse from JEREMIAH THOMPSON, ISAAC WRIGHT, and others, who conceived the idea of establishing a line of packets between New York and Liverpool. This was at a period when the scales of commercial ascendancy were vibrating between New York, Boston, Philadelphia, and other places. The packet ships of the staid New York quaker turned the balance. Though only of 300 tons burden, and sailing but once a month, they had their regular day of departure, and the merchants of Charleston, Philadelphia, etc., found it convenient to avail themselves of this regular and stated channel, for communicating with their agents in England, ordering goods, etc. Those packets went on increasing in numbers and size until now, at the present day, we have them measuring 2000 tons, sailing every day, and running between New York and every fifth-rate sea-port town in the United States, and to many foreign ports.

Thus an impulse was given to the prosperity of New York; one enterprise begat another, until that city became the great commercial emporium and centre of exchange of the new world. All these results are traceable to the use of the water-thermometer at sea.

Other causes, doubtless, have operated to take away from Charleston her relative commercial importance —but the primary cause was that discovery which removed Charleston from the way-side of commerce with Europe, and which placed her on the out-skirts of the great commercial thoroughfares, and away from the commanding position which she had before occupied.

In consequence of the improvements since made in navigation, ship-building, etc., a ship can now go from New York to England, and back in less time, than, when Charleston was the half-way house, she could get to Charleston from London.

I therefore submit, whether this fact be not sufficient to turn the scales of commerce, and I claim the

* Though it was Dr. Franklin and Captain Folger, who first turned the Gulf Stream to Nautical account, the discovery that there was a Gulf Stream cannot be said to belong to either of them, for its existence was known to Anghiera, and to Sir Humphrey Gilbert, in the sixteenth century.

result as one that is due to the influence of the Gulf Stream upon the course of trade, and the use of the water-thermometer by mariners is the key to it all.

I have now in the process of construction at the National Observatory, a series of charts relating to the thermal state of the Atlantic ocean, that when completed, will give us more information with regard to the temperature of that sea, than we now possess with regard to the temperature of any district on shore for one tenth part of the extent.

I shall now quote "*the first Log-book of the 'Celia,' on the voyage from Jamaica to Bristol, in great Britain*, 1740." From it the mariner, the merchant, and the statesman, the political economist, and the philosopher, may all draw instruction.

If this Log-book be a fair sample of the Log-books of that day, and there is no reason to suppose it otherwise, the wonder is, not that the philosopher in arranging the different avocations of mankind, should have been doubtful whether to class the mariner at sea with the living or the dead; but that men should have been found rash enough to become mariners at all, or merchants bold enough to make ventures abroad.

This voyage was performed without any other means of finding the way across the Atlantic, than such as are afforded by the Log and Line.

It was performed under circumstances which forcibly remind one of the buccaneers, the sea-robbers, the obstructions to commerce, and the dangers to navigation, with which the ocean swarmed in those days. Ships had then to sail in company, and beg convoy for protection. The speed of the fastest in the fleet was regulated by the dullest sailer of them all; and under such a state of things, naval architecture must needs be in a rude state. The enterprising merchant had no inducement to incur the expense of building a fast sailing ship, because her speed would be practically regulated by the snail's pace of the dullest ship, and most indolent master in the convoy. The "Celia," we may infer from the air of exultation with which when going 4 knots, the entry is made in the Log: "ahead of all the fleet," was at least a fair sailer for her day: and the most that they got out of the "Celia" that voyage, was five knots.

The better to appreciate the advantages, which we of the present day enjoy, in consequence of so many of the obstructions and trammels which fettered commerce, having been stricken off from its various departments, and in consequence of the advances which have been made since that day towards free trade, we have but to suppose a decree ordaining that our ships, sailors, implements, means, circumstances, and conditions of navigation and commerce, should suddenly be reversed and become such as they were in 1740. The ruin that would follow, would not only swamp merchants, but would sit heavily upon governments and nations.

Captain "John of the Celia," evidently had had something, though not a great deal to do with the Latin Grammar in the days of his youth. He appears to have been fully impressed with the dangers of a voyage across the Atlantic, and with the difficulties which political economists would have during his absence—the doubt in which they would be as to whether they should class him "with the living or the dead;" for on the back of his Log, he wrote in a clear, legible hand, "*Memento Mora*:" So his Log is styled.

"*Memento Mora.*"

First Log Book for the Celia, on Her voiage from Jamacai to Bristel, In great Briton. John ——

Sunday July ye 27 Edwarde Burke and Tho: Osborne tooke ye yall and went on board the Cathrine, Capt. ——— and at 10 ye Capt. went on board ye do. with ye Leftennat of ye Greenwich and Goot them again and Put them on board ye do.

The Man Is Blest
That hath a chest.

H.	Cours.	K.	HK.	Winds and Weath.
2	—	—	—	Weighed with the Land wind at five.
4	—	—	—	
6	—	1	—	W. N. W.
8	—	1	—	Seetts steering Sails.
10	—	1	—	Little wind, Down Steering Sails.
12	—	2	—	Seet Do.

H.	Cours.	K.	HK.	Winds and Weath.
2	—	2	1	Steadey Breese.
4	S. E.	2	1	E. N. E. Squaly and Rains H. T. G. S.
6	—	3	—	
8	S. S.	2	1	
10	do.	2	1	Veerey Flattring Stood To ye Nor
12	do.	3	—	

The Remark's on Munday July ye 28th 1740.

H.	Cours.	K.	HK.	Winds and Weath.
2	N. N. E.	2	1	½ past 1 TK to ye ne East.
4	do.	2	1	
6	do.	2	—	
8	do.	2	—	TK ship to ye So.
10	E. S. E.	2	1	N E
12	S. E. b E.	2	—	

Tuese Day.

H.	Cours.	K.	HK.	Winds and Weath.
				30
2	E. S. E.	2	1	
4	do.	2	1	
6	N. E.	2	1	At I. TK. Ship No.
8	S. E.	2	—	TK. at 7 o'clock.
10	S. E.	2	—	
12	S. S. E.	1	1	TK. ship to. ye Notherd.

Whednessday July ye 30th 1740.

H.	Cours.	K.	HK.	Winds and Weath.
2	N. N. E.	3	1	Fresh brease.
4	do.	3	1	H. B. T. G. Sails.
6	E. S. E.	—	—	TK.Ship Stood of; TK.ShipStood on.
8	S. E. b S.	—	—	at 7 TK. S. Stood of S. E. b E., modarte gale.
10	S. E. b E.	3	—	Starlight.
12	—	3	—	Moonlight

Wednesday.

H.	Cours.	K.	HK.	Winds and Weath.
2	S. E. b E.	2	1	D. R. TS. S. R. M. TS.
4	S. E.	2	1	H. Mizen Top-sail.
6	S. E.	3	—	Squaly, Some rain.
8	S. E.	3	—	Do. TK. & Stood in.
10	N. N. E.	3	1	Makes great deal water—from every glass a long spell.
12	N. by E.	3	—	

Remark's on Thursday, July 31, 1740.

H.	Cours.	K.	HK.	Winds and Weath.
2	—	—	—	
4	—	—	—	Modrate
6	—	—	—	N.
8	—	—	—	
10	—	—	—	
12	—	—	—	
2	—	—	—	
4	—	—	—	
6	—	—	—	
8	—	—	—	
10	—	—	—	
12	—	—	—	

Remarks on Fryday, August 1st, 1740.

H.	Cours.	K.	HK.	Winds.	Fridy Aug. 1st, 1740.
2	N. N. E.	3	1	E.	Stood in for the Land; for Morant pt.
4	S. E. by S.	3	—	E. N. E.	Head Sea Tkd in
6	N. by E.	2	1	E. by N.	Tkd of all ships to windward.
8	S. E.	3	—	E. N. E.	Saw six sails to windward;
10	—	2	1	—	some on w'r bow,
12	—	3	—	—	some wr qt tr. ——
2	—	2	1	—	
4	S. E. by E.	2	1	—	
6	—	3	—	—	
8	S. E.	3	—	—	
10	—	3	—	—	
12	—	2	—	E. by N.	
	N. by W.	1	1		

½ past 11 P. M. the Men-of-war out of sight, to windard, and has been ever since we came out.

Satterdy Aug. 2nd, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N. b W.	3	—	E. b N.	Modrate gale.
4	N. N. W.	3	—	E. N. E.	TK. at half past 5.
6	N. N. W.	3	—	—	Morant point, Bore N. E. dist. 5 leg.
8	E.	3	1	N. N.E.	
10	E. b S.	3	—	N. E. b N.	
12	S. E. b E.	3	—	N. E. b E.	Fine and modrate.
2	S. E.	2	1	E. N. E.	Head sea.
4	S. E. by E.	2	1	N. E. by E.	
6	—	2	1	—	Saw two sails to windwrd
8	S. S. E.	2	1	—	5, TK. to Noward.
		1	1		Slt head sails & Driver.
10	N. b E.	1	1	—	
12	—	2	1	—	

Only two Sails in sight, a Sloop and a Brig to windward, our Suporters at the Main mast had worked of from under of the crosstrees, got a lashing round them to confine them in. Moderate.

"Memento Mora."

H.	Cours.	K.	HK.	Winds.	Sunday, Aug. 3, 1740.
2	N. N. E.	1	1	E.	Small gale.
3	N.	1	—	E. N. E.	Little Wind.
4	—	1	1	—	
6	N. b W.	1	—	N. E. by E.	Est end K. Jama bore W. N. W. dis. 6 lgs.
8	E. by N.	1	1	—	Saw 3 sails to Leeward.
10	—	1	1	N. b E.	
12	E. S. E.	1	—	—	
2	E. S. E.	1	1	N. E.	Fine, moonlight, Little wind.
4	E. b S.	2	—	N. E. b N.	Saw 2 sails, a Sloop and Brig to the eastward of us.
6	S. E.	1	1	E. N. E.	
8	S. E. by E.	1	—	N. E. by E.	
10	N. E. ½ E.	2	—	S. b W.	
12	do.	2	—	S. E. b E.	Little wind.

Monday, August 4, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N. E. by N.	2	—	E. by. S. E.	
4	N. N. E.	1	1		At 5 saw Navasaw bore N. N. E., dis. 3 lgs.
6	—	1	1	—	Saw a sloop Baring S. E., dis. 4 lgs.
8	—	2	—	—	
10	N. E.	2	—	E. S. E.	Modrate Gale.
12	S. E.	2	1	—	TKt Ship.
2	S. E. by E.	2	—	—	TKed to Nothwad.
4	N. E.	2	—	E. S. E.	
6	—	2	—	—	
8	N. E. b N.	3	—	E. b S.	
10	—	2	1	—	Saw all the fleet, bore N. N. E. dis 4 Leags.
12	—	2	1	—	Cape Tuberon, bore E. ½ S. Dis. 5 Leags.

Tuesdy, Augs 5th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	—	—	—	—	Calme, folowed with Rain.
4	—	—	—	—	wind round the compas and then calme, folowed with hard Rain and thunder.
6	—	—	—	—	Cape Tiberon Bore E. b S. ½ S., Dist. 4 Leag.
8	N. N. E.	1	—	E.	Little wind.
10	Calme.	—	—	—	& Cloudy.
12	—	—	—	—	Raine Looks very water spouty.
2	S.	—	—	—	A. B. T. S.
4	N. E.	1	—	S. E.	Little wind.
6	N. b E.	1	—	E. by W.	The griniy and hamton coot, and Most of the fleet, at anchor in Donomora.
8	—	1	—	—	
10	N. W.	2	1	—	
12	—	2	1	—	Varable winds.

H.	Cours.	K.	HK.	Winds.	wedy, augs. 6th, 1740.
2	—	—	—	—	at 3 anchored In Donomara bay stern Hamton Coot.
4	—	—	—	—	
6	—	—	—	—	A ship to n. a comin in.
8	—	—	—	—	Hard Raine.
10	—	—	—	—	Starlight.
12	—	—	—	—	Modrate Breese.
2	—	—	—	—	the white Clift In the Bay Bore E. S. E.
4	—	—	—	—	
6	—	—	—	—	
8	—	—	—	—	Borowed Capt. Lee Boat.
10	—	—	—	—	
12	—	—	—	—	filled five casks of watter.

Thursday, Aug. 7th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	—	—	—	—	Came on Board, Capt. Lee and Capt. Berry.
4	—	—	—	—	
6	—	—	—	—	Came to saile ye wind at N. E.
8	N. N. W.	1	—	N. E.	
10	N. E.	1	1	S. S. W.	Little wind.
12	—	1	1	—	Set stud sails.
2	N. E. b E.	1	1	S. W.	Starlight.
4	—	1	—	—	
6	—	1	1	—	Hauled down the sails.
8	—	1	1	—	
10	N. W.	1	—	—	Little wind and variable.
12	—	1	—	—	

Fryday, Aug. 8th,

H.	Cours.	K.	HK.	Winds.	
2	N. E.	2	1	N. N. W.	head of all the fleet, east of the island of Commeto, bore S.S.E. dis. 7 leagus.
4	N. E. by N.	2	1	N. W.	
6	do.	2	1	—	
	T. K. ⅓ glases				
8	E.	1	1	—	At 8 wind at S. S. E.
10	N. N. E.	4	1	E.	Hard Squall, much rain, clewd up Topsails.
12	N. b E.	3	—	—	
2	N. E. by N.	3	—	S. E. by S.	Saw a light Like a fire, bore N. N. E., very Large.
4	N. N. E.	2	1	E.	
6	—	2	—	—	
8	N.	2	1	E.	Cloudey.
10	N. b E.	4	—	S. E. by E.	Head of all fleet.
12	—	3	1	—	

At 12 at Noon Light gails, some of the Ships came up.

Satterday, Aug 9th,

H.	Cours.	K.	HK.	Winds.	
2	No.	—	1	E. S. E.	Little wind.
4	—	—	1	—	
6	N. N. W.	2	—	E. b S.	Cp Maze, bore N. W. b W., dis 7 lgs.
8	W. b W. ¼ W.	1	1	—	In R. B. T. S. set M. top g sail.

"*Memento Mora.*"

H.	Cours.	K.	HK.	Winds.	Satterday, Aug. 9th.
10	W. N. W.	2	—	E. S. E.	Small bres and Cloody.
12	—	1	1	—	
2	N. b W.	1	1	E. b S.	Small bress.
4	N. N. W.	1	1	—	
6	N.	1	—	—	Saw a sail head Men-war crouding after him.
8	N. b W. ½ W.	2	1	N. b W.	
10	N. b W.	3	—	—	
12	do.	2	1	W. b S.	

Sunday, Aug. 10th.

H.	Cours.	K.	HK.	Winds.	
2	N.	1	—	S. W.	Men-war mand boats as sailors.
4	—	1	1	S. S. W.	Set str sails.
6	—	1	—	—	The sail yt stood In. a sloop hald down sails.
8	N. b W.	1	—	—	Little wind.
10	N. N. W.	2	1	S. E.	A Fine brese. Flying clouds.
12	No.	3	—	E. S. E.	
2	—	3	1	—	Starlight.
4	—	3	—	—	Shortned sail for the Man-war.
6	—	3	—	—	
8	N. b E.	3	1	N. E. b E.	Sett Small Sails.
10	—	4	—	S. E.	Made Ancoga Bore N. E. b E. Dist 5 leagues.
12	No.	4	1	S. S. E.	Sot ster sails.

at 10 hamton Coot TK To Soothard and left us. At 12 haneago Bore aboot S. E. Dis. 6 or 7 Lgs., the west end.

Monday, Augst 11th.

H.	Cours.	K.	HK.	Winds.	
2	No.	4	1	E. b S.	A Fine Gale.
4	—	4	—	E.	
6	N.N.W. ½ W.	4	—	—	hogthies Bore N. by W. dis. 3 lgs. fleet bogt to. At 7 md sail.
8	N.N.W. ¼ W.	3	1	E.	Hd Miz' and do top-sail.
10	N. by W.	3	1	—	
12	N. ½ W.	3	—	—	
2	N. ½ W.	3	—	Do.	Shortned In Saile.
4	—	2	1	—	hald up MS. Came up with fleet. ½ pas 4, saw the Land, bore N. dis. 9 miles; when starbord, hald along.
6	S.W. by S. & S. S. W.	3	—	—	
8	S.W. by S.	3	1	E. S. E.	Sot top g. sails. The farthest poin of ye Key bore S. W. by W. ½ W., 2 lgs.
10	W. S. W.	3	—	—	
12	W. b N. ½ N.	2	1	S. E. b S.	The Westmost point of Attlina Cay Bore S. E. b S. dist. 1 League.

H.	Cours.	K.	HK.	Winds.	Tuesday, Aug. 12, 1740.
2	N. N. W.	2	1	S. E.	Sot ster sails.
4	N. N. W.	2	—	—	
6	N. N. W.	3	2	S. E. b E.	at 6, Down ster. sails. the west end of well key Bore N. b W., D. 3 Leagus.
8	—	2	1	E. S. E.	
10	—	3	—	—	Starlight night.
12	—	3	—	—	
2	—	3	—	S. E.	Sot ster sails.
4	—	2	1	—	Crooked Island Bore S. b S., Distance 5 Leg. halld down M. T. S. Studensal.
6	N. N. E.	3	—	—	
8	N. E. ½ N.	3	—	S. E.	
10	N. E. ½ N	2	—	—	Little wd.
12	—	2	—	—	Calme.

65 Miles pr Log.

11.50
11.21
―――
23.11 79 Miles.
21.52
―――
1.19

Whednessday, Aug 13, 1740.

H.	Cours.	K.	HK.	Winds.	
2	—	—	1	Calm.	
4	N. N. E.	1	—	E. b S.	At 3, made Saile.
6	—	1	—	—	
8	N. E. ½ E.	1	1	S. E.	Modrate gale.
10	N. E.	1	1	—	
12	—	2	1	—	Little wind.
2	N. N. E.	2	1	—	
4	—	1	1	—	
6	N. E. b N.	1	1	E. S. E.	Small breeze.
8	N. E.	2	1	S. E. b E.	Convoy 2 Mile head.
10	—	1	1	—	The vesals bound to America StandingMore to Norward 17 sail, for voyage:
12	—	1	1	—	

12.50
11
―――
23.50

Thirsday, Aug ye 14th.

H.	Cours.	K.	HK.	Winds.	
2	N. N. E.	—	1	E. S. E.	Allmost calme.
4	—	—	1	E.	Broke of to N. N. W.
6	N. ½ E.	1	1	N. E. ½ N.	Little wind.
8	N. N. E.	2	—	E.	Ye schoner bore N. D. 3 L. Sloop N. W.
10	—	—	1	—	
12	—	—	1	—	

"Memento Mora."

H.	Cours.	K.	HK.	Wind.	Thirsday, Aug. 14, 1740.
2	—	—	—	Calm.	
4	—	—	—	do.	
6	N. N. W.	1	1	N. E.	made Watlin Island,
8	N. W.	1	1	N. N. E.	bore W. N. W., D. 4
10	E. b N.	1	—	N. E. b N.	Leag. Watlin's bore
12	—	1	—	—	W. b N. ½ N., Dis. 3 Lg., Tked Estward.
		19			

Fridy, Aug the 15th, 1740.

H.	Cours.	K.	HK.	Wind.	
2	N. E.	2	—	N. N. W.	Modrate Gale.
4	N. E. b E.	2	—	do.	
6	E. N. E.	1	1	N.	Hd. T. g. sails, large R. B. T. S.
8	N. E. b E.	1	—	N. b W.	Looks sqly.
10	—	1	1	—	
12	—	1	—	—	Sot top glls., small rain.
2	N. E.	2	—	N. N. W.	Variable wind & Rain.
4	N. E. b N.	1	1	N. W.	
6	—	1	1	—	Little wind.
8	N. E.	1	—	S. W.	calme.
10	—	1	1	S. S. E.	Sett suding sailes.
12	—	2	1	—	

Satterday, Aug ye 16th.

H.	Cours.	K.	HK.	Wind.	
2	N. E. b N.	2	—	S. S. W.	
4	—	1	1	S. W. b S.	Small Bres.
6	—	1	1	S. W. b W.	Tombling sea—the commander Bore N. W. bW. Dt. 3 Leages.
8	—	1	1	—	fine brez Now springing up.
10	—	2	1	—	Flying clouds.
12	—	2	1	—	Starlight.
2	—	2	1	—	Light brezes.
4	—	2	—	—	
6	N. E.	2	1	S. S. E.	Set Stering Sails.
8	N. N. E.	2	1	do.	Fine Brees.
10	N. b E.	2	1	—	
12	—	2	1	—	
		51			

Sunday Augt the 17th, 1740.

H.	Cours.	K.	HK.	Wind.	
2	N. b E.	2	1	S. S. W.	A modrate Brease.
4	N. N. E.	2	1	So.	
6	—	3	—	S. S. E.	fleet Bore N. b E. Dis. 5 Mils.
8	—	2	1	—	hald Down studing sals.
10	N. N. E. ½ E.	3	—	—	fine Little gail.
12	—	3	—	—	
2	N. N. E.	2	1	S. E.	
4	—	2	—	—	
6	N. b E.	1	1	E. b N.	fleet under our Larbord.
8	—	1	1	—	
10	N. ½ E.	3	—	—	Cloudy.
12	N. b E.	4	—	—	

H.	Cours.	K.	HK.	Wind.	Monday, Aug. 18, 1740.
2	N. b E.	3	1	E. b N.	fine gailes, Tho Light and smoth water.
4	—	3	—	E.	
6	—	4	—	E. b S.	Squaly and some Rain.
8	—	4	1	—	Clear Moon light night.
10	—	3	—	—	Modrate.
12	—	2	—	—	Gale and stare Light.
2	—	2	—	E. S. E.	
4	—	2	—	—	fleet on our Bow.
6	N. E. b N.	2	—	—	
8	N. E.	2	1	—	Fare and clear weather.
10	—	2	—	—	
12	—	2	—	—	
		65			

Tuesday, Augt 19th, 1740.

H.	Cours.	K.	HK.	Wind.	
2	N. E.	2	—	S. E. b E.	Smooth water.
4	—	2	—	E. S. E.	all ye fleet out of sight, only 2 s——
6	N. E. b N.	3	1	—	fleet bares in, dis. about 5 lgs., Sd them from Mast head.
8	—	3	—	—	
10	N. E. ½ N.	2	1	—	Light night.
12	N. E.	2	—	—	
2	N. E.	2	1	—	Starlight night.
4	—	2	—	—	
6	—	2	1	—	Saw one sail from mast head bor N. b E.
8	—	2	—	—	
10	—	3	—	S. W.	Little wind, allmost calm.
12	—	1	1	—	

the Remarkes of this 24 hours.

Whednessday, August 20, 1740.

H.	Cours.	K.	HK.	Wind.	
2	N. E.	1	1	S. W.	
4	—	2	1	—	Sd the fleet bore N. b W. Dis. 5 Lgs.
6	—	1	1	W. S. W.	Hald Down Ster. Sails.
8	—	2	1	—	
10	—	1	1	S.	Fine moon Light night.
12	—	1	—	S. S. W.	
2	—	1	—	S. W.	
4	—	1	—	—	
6	—	1	1	—	Saw the fleet from Masthead, Bore a Boot W. N. W.
8	—	1	1	—	
10	N. E. b E.	1	1	—	Head keeps to Estwad tho' calme.
12	—	1	1	—	Sott up all our Rigin a Low & a Loft.

Thirsday, Augt 21.

H.	Cours.	K.	HK.	Wind.	
2	—	—	1	Calm.	Calm.
4	—	—	1	do.	Fleet out sight.
6	—	—	—	—	S. with head wind Broched hogthed water

"Memento Mora."

H.	Cours.	K.	HK.	Winds.	Thirsday, Aug. 21, 1740.
8	N. W. b N.	1	1	N. E. b N.	Some rain—Little wind—
10	N. N. E.	2	1	E.	smooth watter.
12	N. E. b N.	3	—	E. b S.	fine Light Night.
2	N. E.	3	—	—	
4	—	2	1	—	
6	N. E. b N.	3	—	—	fleet not to Be seen from
8	—	2	1	—	Masthead. hazy.
10	N. E.	2	1	E. S. E.	
12	—	3	1	—	

Fryday, Augt ye 22, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N. E. ½ E.	2	1	S. E. b E.	Modorate.
4	N. E. b E.	3	—	—	faire weather.
6	—	3	—	—	Saw a sail upon our Star-
8	N. E. ½ E.	3	—	—	board Beam, about 4 Leags Dis.
10	N. E.	3	—	—	Fine moon Light Night—
12	N. E. b E.	2	1	—	Smooth watter.
2	N. E. ½ E.	2	1	—	Litle wind.
4	—	2	1	—	flying cloods.
6	N. E. b E.	3	—	—	Saw ye saile Bore S. S.E.
8	N. E. b E.	2	1	—	Dt 3 Leagues.
10	N. E. ½ E.	2	1	—	the Sail goes ahead of
12	—	3	1	—	us, Bares E. N. E.,
					Dis. 2 Leags.
		61			

Satterday, Augt 23, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N. E. b. E.	2	1	S. E.	A Fine Breese—Smooth
4	E. N. E.	2	1	S. E. b S.	Wattr.
6	—	3	—	—	
8	—	2	—	S. b E.	Little Wind.
10	E.	1	—	—	do.
12	E. N. E.	1	1	S. W. b S.	
2	—	1	1	—	
4	—	2	1	—	Hard Showr Raine.
6	—	2	1	—	Sot Ster Sails.
8	—	3	—	—	
10	—	3	1	—	
12	—	2	1	—	

Sunday, 24.

H.	Cours.	K.	HK.	Winds.	
2	E. N. E.	3	—	S. W.	
4	—	2	1	—	Little wind—Smooth wa-
6	—	1	1	—	ter—filed hogthed wa-
8	—	1	1	—	ter, out of a nother
10	—	2	1	—	Bot., and hald wheel-
12	—	3	—	—	Rope taught.
2	—	3	1	—	Raine.
4	—	3	—	—	Looks sqly with Raine.
6	—	3	1	—	
8	—	3	—	—	
10	—	3	—	—	
12	—	2	1	—	
		65			

H.	Cours.	K.	HK.	Winds.	August ye 25th, 1740.
2	N. N. E.	2	1	S. W. b S.	Little wind.
4	—	2	1	—	Smooth Wattr.
6	—	2	—	—	hard Raine.
8	—	—	1	Calme.	
10	—	—	1	do.	
12	—	1	1	S.	Little wind.
2	—	1	—	—	
4	—	1	—	—	Moonlight night.
6	—	1	—	—	Head to E. S. E.
8	Calme.	—	—	—	Raine—flatrin.
10	do.	—	—	—	Small brez Round the
12	E. ½ S.	1	—	—	compass.

Aug. ye 26th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N. E. b E.	1	1	S. W. b S.	Calked Round her Deck.
4	—	1	1	—	
6	—	1	1	—	
8	—	1	1	—	But Little wind.
10	—	2	1	—	Small Bres of wind.
12	—	2	1	—	a swell from ye E. S.E.
2	—	2	—	—	
4	—	1	1	—	allmost Calme.
6	—	1	1	—	
8	—	1	—	—	
10	N. b E.	2	—	E. b N.	
12	N. N. E.	3	—	E. b S.	

Whednesday, Aug. ye 27th.

H.	Cours.	K.	HK.	Winds.	
2	N. E. b N.	2	1	E. S. E.	
4	—	2	—	—	
6	—	2	—	—	
8	N. N. E.	2	1	E.	Little wind.
10	N. b E.	2	1	E. b N.	
12	—	2	—	—	do.
2	N. N. E.	2	—	E.	
4	—	1	1	—	
6	N. b E.	1	1	E. b N.	Mod.
8	—	2	—	—	Little winde.
10	N. ½ W.	2	—	E. N. E.	
12	N. b W.	2	1	N. E. b E.	
		50			

Thirsday, Augt 28th.

H.	Cours.	K.	HK.	Winds.	
2	N. ½ E.	3	—	E. N. E.	
4	—	3	1	—	Light Breez.
6	—	3	1	—	
8	—	3	1	—	
10	N.	3	—	E. N. E.	Some Small Raine—a
12	—	2	1	—	Fine moon Light Night —Sqly.
2	—	4	1	—	
4	—	4	—	—	
6	—	4	—	—	
8	N. b E.	3	1	E. b N.	
10	—	3	—	—	
12	N. N. E.	2	1	E.	

"Memento Mora."

H.	Cours.	K.	HK.	Wind.	fridy, 29.
2	N. b E.	2	1	E. b N.	Sqly D. R.
4	—	2	1	—	Hdt T. sails—hard Ry.
6	N.	2	—	E. N. E.	till ½ past 5 TKed, hard
8	N. N. E.	—	1	N. E.	Raine, wore ship att 7
	N. N. E.	—	1	E.	clook.
10	—	2	1	E. S. E.	Sot D. R. T.S., head sea.
12	N. E. b N.				
2	N. E. b E.	2	—	S.E.	
4	—	2	—	—	
6	N. N. E.	1	1	—	
8	N.	1	1	E. N. E.	Tomblin sea—sqly, like
10	—	2	—	E. N. E.	and foll Raine.
12	—	3	—	—	

H.	Cours.	K.	HK.	Wind.	Satterday, 30.
2	N. ½ E.	2	—	E. b N.	Saw a Sloop, Bore N. b
4	—	2	—	—	E., Dis 4 miles, stood
6	—	2	—	—	to S. E.
8	N. b E. ½ E	3	—	E. b N.	Starlight.
10	N. b E.	2	1	—	Smooth water.
12	—	2	—	—	Fine, moon Light.
2	N.	1	—	E. N. E.	
4	N. N. W.	2	1	N. E.	Hd top gal sails.
6		2	1	—	a Tumbling Sea from
8	—	2	—	—	Et.
10	N. N. W.	3	1	N. E.	
12	—	3	—	—	
		56			

H.	Cours.	K.	HK.	Wind.	Sunday, Augt. ye 31st.
2	N. N. W.	3	1	N. E.	Hard raine and variable wind.
4	—	2	—	—	Squaly.
6	—	3	—	—	S. E. swell.
8	N. b W.	3	—	—	Sing. R. T. sails.
10	N. N. W.	3	1	N. E.	
12	—	3	—	—	
2	—	3	—	—	
4	N. W.	2	1	N. N. E.	Variable wind.
	E. b S.	—	1	—	TK. at ½ past 3.
6	E. b S. ½ E.	2	1	N. E.	
8	—	3	—	N. E. b N.	head sea.
10	E. b. S.	2	1	—	Cloudy.
12	—	2	1	—	Double R. B. Top. S.

H.	Cours.	K.	HK.	Wind.	Monday, Sept. ye 1st, 1740.
2	E. b. S.	2	1	N. E. b N.	A Large head sea, H. B.
4	E.	2	1	N. N. E.	T.S. Sett, M.T.G.—It
6	E. S. E.	2	1	—	blows hard and sqly.
8	—	4	1	N.	
10	—	4	1	—	
12	—	4	1	N. b W.	Do., some raine.

H.	Cours.	K.	HK.	Wind.	Monday, Sept. 1, 1740.
2	E. ½ N.	4	1	—	Hard Raine with hard squals.
4	E. b N. ½ N.	4	1	N. W.	
6	E. N. E.	4	1	N. W.	
8	—	4	—	—	
10	N. E.	4	—	—	
12	—	3	1	—	Head sea still.
		92			

H.	Cours.	K.	HK.	Wind.	Tuesday, Sept. ye 2d, 1740.
2	N. E.	3	—	N.W. b W.	
4	—	3	—	—	First HR. B. T. S., sett
6	—	4	—	—	F. T. S. head sea yet.
8	—	3	1	—	
10	—	4	1	W. b N.	
12	—	4	1	S.W. b W.	Head sea.
2	—	4	—	—	
4	—	5	—	—	
6	N. E.	4	1	S.W. b W.	Sot stering sails.
8	—	4	—	—	
10	—	4	1	—	Modrate Gale and faire
12	—	4	—	—	weather.

H.	Cours.	K.	HK.	Wind.	Whednessday, Sept. ye 3d, 1740.
2	N. E	4	—	S. W.	Mod. gaile.
4	—	3	1	—	fine weather.
6	—	3	1	—	
8	—	3	1	—	Hald Down str. sls.
10	—	3	1	—	Head sea-not lost as yet.
12	—	3	—	—	do.
2	—	3	—	—	
4	—	2	1	—	Head Sea.
6	—	2	—	—	
8	N E. b E.	1	1	N. W.	Variable wind and Rain.
10	Calme.	—	—	—	
12	N. E. b E.	1	—	—	Raine, sqoly with Raine, Looks all Round cloody.
		62			

H.	Cours.	K.	HK.	Wind.	Thirsday, Sept. ye 4th.
2	N. E.	1	—	W.	Variable wind—almost calm.
4	—	1	—	—	
6	Calme.	—	—	—	
8	S. S. E.	—	1	E.	Wore ship at 7 clock.
	N. E.	—	1	E. S. E.	
10	—	1	—	—	
12	—	1	1	S. W.	But little wind.
2	—	2	—	—	
4	—	1	1	—	
6	—	1	—	—	
8	Calme.	—	—	—	
10	do.	—	—	—	
12	do.	—	—	—	
		20			

"Memento Mora."

H.	Cours.	K.	HK.	Winds.	Fryday, Sept. ye 5, 1740.
2	Calme at 3.	—	—	—	
4	N. N. E. ½ E.	1	—	S. S. W.	Small breze.
6	—	1	—	—	Do.
8	—	1	—	—	
10	—	1	1	W. S. W.	Fine Stare Light Night.
12	—	1	1	S. S. W.	
2	—	2	—	S. W.	Bot Little wind.
4	—	2	—	—	Still.
6	—	2	—	—	
8	—	2	—	S. S. W.	Smooth Watter, Little wind.
10	—	2	—	—	Set Ster. sails.
12	—	2	1	—	
		37			

Satterday, Sept. ye 6th.

H.	Cours.	K.	HK.	Winds.	Remarks
2	N. N. E. ½ E.	2	1	S. W. b S.	A Fine Brease of Wind.
4	—	2	1	S. W.	
6	—	3	—	—	Hald Down Ster. sails.
8	N. E. ½ N.	2	1	S. W.	
10	N. E. b N.	3	1	S. W. b S.	Raine.
12	—	4	—	—	fine gaile.
2	—	4	—	—	Cloudy.
4	—	4	—	—	
6	—	4	—	—	Set ster sails and flying gib, and staysails for ster sails.
8	—	4	—	—	Saw a Sl, bo N. b W. dis. 3 lgs.
10	N. E.	4	—	—	Comes up with us fast.
12	N. E. b N.	4	1	—	The Saile comes up with us.

Faire and Cleare and So ends This 24 hours.

Sunday, Sept. ye 7th, 1740.

H.	Cours.	K.	HK.	Winds.	Remarks
2	N. E. b N.	4	—	S.W. b W.	The ship allmost up with us—shoted guns, of all sorts, hald up Coses, Stood on good Lofe. We hald upon wind—out ensign. So I stood our cors again–hd stered away E. b N. so pated.
4	N. N. E.	4	—	—	
6	N. E. b N.	4	—	do.	
8	—	4	—	—	
10	—	4	1	—	
12	—	4	—	—	
2	—	4	1	—	
4	—	4	1	—	fine gaile.
6	—	4	—	—	Cloody.
8	—	3	1	—	Some small Raine.
10	—	4	1	S.W. b S.	Sett Stering sails.
12	—	4	1	—	Sep. 7th, 1740.

at 5, In Morn, Saw a Sail B N. N. E., dis. aboot a Leag; a Brig standing By the wind to southward, She T K to the westwad and stood By the wind, so we Left him.

H.	Cours.	K.	HK.	Winds.	Monday, Sept. ye 8th.
2	N. E.	5	1	S. W. b S.	A Fine Gale.
4	do.	5	1	—	Cloudy—hald all sails up. Repad a tiler rope.
6	—	3	1	—	Sqly, D.R.T.S., Bells 1. H. T. S. Blows hard. Sot dubrf sail. Lay two ½ hoor to hall Tiler Rope tot—hard sqals with hard Raine.
8	—	3	1	—	
10	—	4	1	—	
12	—	4	1	—	
2	—	5	—	S. W.	
4	—	5	—	—	
6	—	4	1	—	hard Squal and Raine.
8	—	5	1	—	
10	—	5	—	—	Sot D. R. T. S.
12	—	5	—	—	It seams to clear a Little. Hard sql. with Hard Raine.
		116			

Somthing clear—This Time I find Mildewd sails.

Tuesday, Sept. ye 9th.

H.	Cours.	K.	HK.	Winds.	Remarks
2	N. E.	5	—	S. W.	Hard squals.
4	—	4	—	—	More modrate.
6	—	2	—	—	
8	—	1	—	—	A tumbling sea from S. E.
10	—	1	1	—	
12	N. E. b E.	1	—	N. b W.	
	E. N. E.	2	—	N.	Close weath and Small rain, Ot R. M. S. Sothim swayd up Miz. yard, set Mizern.
2	—	2	1	N.	
4					
	E. N. E.	2	—	N.	Fair and clear—W. Ot R. B.T.S.
6					
8	E.	2	—	N. b E.	Sett small sails.
10	E. N. E.	2	1	N.	
12	N. E. by E.	2	1	N.N.W.	Light gaile.

Whednesday, Sept. ye 10th, 1740.

H.	Cours.	K.	HK.	Winds.	Remarks
2	N. E. b E.	4	—	N. b W.	S. R. F. T. S.
4	E. N. E.	4	1	N.	Do. M. T. S.
6	—	4	1	N.N.W.	D. R. B. T. S.
8	—	4	1	—	hd Smll Sls.
10	N. E. b E.	4	1	—	Furled mizen.
12	E. N. E.	4	1	N. b W.	Sqoly.
2	—	4	—	—	
4	E. b N.	3	1	N. b E.	a Greate Short sea from ye north.
6	—	1	1	—	
8	—	1	—	—	almost calme with a ugly sea from Nowrd.
10	Calme.	—	—	—	
12	—	—	—	—	Sea gon down.

Thirsday, Sep. 11th, 1740.

H.	Cours.	K.	HK.	Winds.	Remarks
2	Calme.	—	—	—	It Looks calme-Like.
4	do.	—	—	—	A Small brease—maide Saile.
6	do.	—	—	—	
8	N. E.	—	1	W.S.W.	head to N. E. but hardly any wind.
10	—	—	1	—	
12	—	—	1	—	

"*Memento Mora.*"

H.	Cours.	K.	HK.	Winds.	Thirsday, Sep 11, 1740.
2	—	—	1	—	
4	E. N. E.	1	1	N.	
6	E.	—	1	N. N. E.	The wind inclines to ye East.—Tk.
8	—	—	1	E. K.	
10	N. b W.	1	—	E. N. E.	
12	—	1	1	—	
		14			

friday, Sep the 12th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N.	3	—	E. N. E.	Faire Wether and Smooth Wattr.
4	—	3	1	—	
6	N. b W.	4	—	—	
8	—	4	1	—	
10	N.	4	1	E. N. E.	Cloody—hd Sml sails, Singl R. B. T. S.
12	—	3	1	—	
2	N. b E.	4	—	E. b N.	Cloudy—wr Blowing fresh.
4	—	4	—	—	
6	N. b E.	4	—	E. b N.	
8	N. N. E.	4	—	E.	
10	N. E. b N.	4	1	E. b S.	at 11, Saw a Brig, Bore N. N.W., Dt. 4 miles, Bore away for him—Fired a Shoot at him—Brought him to at 12—came up with him—Spooke to him—a frenchman from Cape Briton, bound to Martinico.
12	N. b E.	3	—	—	

Satrdy, Sep 13th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	N. E.	4	—	S. E. b E.	
4	—	3	1	—	took oot 20 candels to last 12 nights.
6	N. E.	4	—	S. E.	More Modrate.
8	E. N. E.	2	1	S. b E.	Ot single R. M. T. saile, at 8, R. do.
10	—	2	1	—	Raine, Brt too sond, we got 16 fm.
12	—	3	—	—	
2	E. b S.	6	—	N. W.	hard raine and Squaly, ye tooke a Back N. W.; at 12 hd T. S.
4	—	6	—	—	
6	E.	6	—	N. W.	a hard Gale and large Sea, makes more water.
8	—	6	—	—	
10	S. E. b E.	6	—	N. N. W.	very hard gaile, and very large sea.
12	—	5	1	—	Under our corses, the sea Breaks over us fore and aft.
		110			

It is very hard gail and Large sea, and so Remaing.

H.	Cours.	K.	HK.	Winds.	Sunday, Sept. 14, 1740.
2	E.	4	—	N. N. W.	More modrate.
4	—	3	—	—	Large sea.
6	E.	2	—	—	do.
8	—	2	—	—	
10	E. b N.	1	1	—	Tomblin sea.
12	—	1	1	—	Sot top sails, Bot Little wind.
2	N. E.	2	—	—	
4	—	2	—	—	
6	N. E.	2	—	W. S. W.	Oot Rfs.
8	—	2	—	—	In the gail chafed and tored 2 holes in MS. put fore staysl in bolt Rope.
10	—	2	1	—	
12	—	3	1	—	

Monday, Sep 15th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	E. N. E.	5	—	S. S. W.	Cloody.
4	—	5	—	—	Small Raine.
6	—	5	—	—	It looks like gaile.
8	—	3	1	—	D. R. B. T. S. hand Do.
10	—	3	1	—	Squals and raine, R.M.S.
12	—	3	—	—	Wind shifted N. W.
2	E. b N.	4	1	N. W.	variable wind, hard gail and very squaly, with small Rn.
4	—	4	1	—	
6	E.	5	1	N. N. W.	a very hard Gale, Squaly and some raine, Large Sea, hail & Rain storm, at 9 Brought two under RMn sail, it Blows hard gail to hard to cary sail, to it a larg sea, so that she will not steer; sea breaks Dangerous. So Remains.
8	—	6	—	—	
10	—	3	—	—	
12	Up N. N E.	ofN.	E.	—	

Toosday, Sept. 16th, 1740.

H.	Cours.	K.	HK.	Winds.	
2	Try up N. b	E.of	N.	E. b E.	
4	do.	—	—	do.	A Large sea and hard Gaile.
6	do.	—	—	—	
8	do.	—	—	—	
10	do.	—	—	—	Excessive hard gaile.
12	—	—	—	—	Seas Break very large.
2	Try up N. N.	E.of	E. b	N.,	
4	—	—	—	—	More modrate.
6	—	—	—	—	More Mod., but Larg Sea. 45 fm water.
8	—	—	—	—	
10	E. N. E.	1		N. N. W.	Maide sail at 9 a'clook.
12	—	4	—	—	

This gail has Been very hard Storme and Longe, with Large seas Breaking strong and Dangeroos. we have Been bereyd with seas continyly.

"Memento Mora."

H.	Cours.	K.	HK.	Winds.	Wednessdy, Sept. 17, 1740.
2	E. N. E.	4	1	N. W.	Storm and a large sea.
4	—	4	1	W. N. W.	Looks windy, brought to to fish 30 fm.
6	E.	1	1	N. b W.	
8	E.	4	—	N.	Rocky grnd.
10	E. b N.	3	1	W. b N.	Modrate Gail.
12	—	4	—	—	Stare Light.
2	—	4	—	—	
4	—	4	—	—	
6	E.	4	—	—	Brought two In 40 fm. to fish.
8	—	4	—	—	
10	E. N. E.	1	1	—	Drifted as we lay too, as the Log Is Marked.
12	—	1	1	—	
		82			

H.	Cours.	K.	HK.	Winds.	Thrsdy 18 Sept. 1740.
2	E.	4	1	W.	Seet Stering sails.
4	—	5	—	—	Modrate gaile and smooth.
6	—	4	—	—	
8	—	4	1	—	fine Little gail and fine night.
10	—	4	—	—	
12	—	4	1	—	Hald Down ster. sails.
2	—	4	—	—	
4	—	3	—	—	Cloudy.
6	E.	1	1	—	
8	Calme.	—	—	—	Little wind, Driving E. N. E. ½ Not.
10	do.	—	—	—	
12	—	—	—	—	Caught fish In 45 fm. water. So Remains with fogey weather.
		70			

H.	Cours.	K.	HK.	Winds.	friday, Sept. 19, 1740.
2	Calme.	—	—	—	
4	E. b S.	1	—	—	3 Maied sail.
6	E. b S.	1	1	S. W.	fogy.
8	—	4	—	S. S. W.	Variable wind.
10	—	2	1	—	
12	—	2	1	S.	Foggy and some Raine—Little wind.
2	E. b N.	2	1	—	
4	—	2	1	—	Raine—Hd topglsail Miz. s.
6	E. ½ S.	4	1	S.	
8	E. b S.	4	1	S. b W.	Raine.
10	E. b N.	4	—	S. S. W.	Fogy Raine.
12	—	3	1	—	Hou Top.

H.	Cours.	K.	HK.	Winds.	Satrd, ye Sep. 20th, 1740.
2	E. b S.	4	1	S.	thick foog and Some raine.
4	—	4	1	—	Raine.
6	—	4	—	—	Foogy.
8	—	2	1	—	
10	—	1	1	—	
12	—	1	1	—	
2	—	1	1	S. W.	Little wind.
4	—	1	1	—	
6	—	1	—	—	foggy and Raine.
8	Calme.			—	
10	—	1	—	—	A Fine Brese Just sprung up—foggy.
12	—	2	1	W.N.W	

Currents of the Sea.

In studying the system of oceanic circulation, I have found it necessary to set out with the very obvious and simple principle, viz: that from whatever part of the ocean a current is found to run, to the same part a current of equal volume is obliged to return.

Upon this principle is based the whole system of currents and counter-currents of the air as well as of the water.*

It is not necessary to associate with oceanic currents the idea that they must of necessity, as on land, run from a higher to a lower level.

So far from this being the case, some currents of the sea actually run up hill, while others run on a level.

The Gulf Stream is of the first class. In a paper read before the National Institute in 1844, I showed why the bottom of the Gulf Stream ought, theoretically, to be an inclined plane, running *upwards.* If the Gulf Stream be 200 fathoms deep in the Florida pass,† and but 100 fathoms off Hatteras, it is evident that the bottom would be uplifted 100 fathoms within that distance; and, therefore, while the bottom of the Gulf Stream runs uphill, the top preserves the water-level, or nearly so; for its banks are of sea-water, and being in the ocean, are themselves on a water-level.

The currents which run from the Atlantic into the Mediterranean, and from the Indian ocean into the Red sea, are the reverse of this. Here the bottom of the current is probably a water-level, and the top an inclined plane, running *down-hill.*

Take the Red sea current as an illustration. That sea lies for the most part within a rainless and riverless district. It may be compared to a long and narrow trough.

Being in a rainless district, the evaporation from it is immense; none of the water thus taken up is returned to it either by rivers or by the rains.

It is about 1000 miles long; it lies nearly North and South, and extends from latitude 12° or 13° to the parallel of 30° North.

I am not able to state the daily rate of evaporation there;‡ but it may safely be assumed—and for the illustration I will assume it—at the rate of two-tenths (0.2 in.) of an inch a day.

* Vide paper "on the Currents of the Atlantic ocean," proceedings of the American Association, Charleston, March, 1850.

† Soundings made by order of Commodore Warrington, on board the U. S. ship Albany, Commander Charles T. Platt, U. S. N., a few weeks since, show it to be at least 500 fathoms deep in the Florida Pass.

‡ I learn from Johnston's beautiful Physical Atlas, that "from May to October, in the upper part of this sea, the water is two feet lower than in the other months;" and this he accounts for, by the wind which is said to prevail from the northward there, during this season of the year.

This is the hot season; it is the season when evaporation is going on most rapidly; and when we consider how dry, and how hot the winds are which blow upon this sea at this season of the year, we may suppose the daily evaporation to be immense:—not less, certainly, than half an inch, and probably twice that amount. We know that the waste from Canals by evaporation in the summer time is an element, which the Engineer, when taking the capacity of his feeders into calculation, has to consider. With him it is an important element; how much more so must the waste by evaporation from this sea be, when we consider the physical conditions under

Now, if we suppose the current which runs into that sea, to average from mouth to head 20 miles a day —and this is conjecture merely, but for the purpose of illustration also—it would take the water fifty days to reach the head of it. If it lose daily two-tenths of an inch from its surface, by evaporation, it would appear, that by the time it reached the isthmus of Suez, it would have lost ten inches from its surface.

Thus the waters of the Red sea ought to be lower at the isthmus of Suez than they are at the straits of Babelmandeb. They ought to be lower from two causes, viz: evaporation and temperature—for the temperature of that sea is necessarily lower at Suez, in latitude 30°, than it is at Babelmandeb, in latitude 13°.

To make this quite clear; suppose the channel of the Red sea to have no water in it, and a wave ten feet high to enter the straits of Babelmandeb, and to flow up its channel at the rate of twenty miles a day, for fifty days, losing daily, by evaporation, two-tenths of an inch;—it is easy to perceive that at the end of the fiftieth day this wave would not be so high, by ten inches, as it was the first day it commenced to flow.

The top of that sea, therefore, may be regarded as an inclined plane, made so by evaporation.

But the salt water, which has lost so much of its freshness by evaporation, becomes salter, and, therefore, heavier. The lighter water at the straits cannot balance the heavier water at the isthmus, and the colder and salter, and, therefore, the heavier water, must either run out as an under-current, or it must deposit its surplus salt in the shape of crystals, and thus gradually make the bottom of the Red sea a salt bed; or it must abstract all the salt from the ocean—and we know that neither the one process nor the other is going on. Hence we infer that there is from the Red sea an under or outer current, as from the Mediterranean through the straits of Gibraltar. Analysis would probably show the surface waters at the head, to be salter than those near the mouth of the Red sea, and it is hoped that some of my fellow laborers in the Red sea trade, will collect specimens of its waters, and afford us an opportunity of testing them.

And, to show why there should be an outer and under current from each of these two seas, let us suppose the case of a long trough, opening into a vat of oil, with a partition to keep the oil from running into the trough. Now, suppose the trough be filled up with wine, on one side of the partition, to the level of the oil on the other.

The oil is introduced to represent the lighter water, as it enters either of these seas from the ocean, and the wine the same water, after it has lost some of its freshness by evaporation, and, therefore, has become salter and heavier.

Now, suppose the partition to be raised, what would take place? Why, the oil would run in as an upper-current over-flowing the wine, and the wine would run out as an under-current.

The rivers which discharge in the Mediterranean, are not sufficient to supply the waste of evaporation—

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which it is placed: its feeder, the Arabian sea, is a thousand miles from its head—its shores are burning sands—the evaporation is *ceaseless;* and none of the vapors which the scorching winds that blow over it, carry away, are returned to it again in the shape of rains.

The Red sea vapors are carried off and percipitated elsewhere. The depression in the level of its head waters in the summer time therefore, it appears to me, is owing quite as much to the effect of evaporation as to the effect of the wind in blowing the waters back from it into the ocean. Analysis will probably show the surface water at the head, and the deep sea water at the mouth to be salter, and therefore heavier, than are the surface waters at the mouth of the Red sea.

Philosophers will acknowledge in grateful terms, the services of any traveller by the overland route to India, who will collect specimens of these waters, and afford Chemists an opportunity of testing them.

and it is by a process similar to this, that the salt which is carried in from the ocean is returned to it again; were it not so, the bed of that sea would be a mass of solid salt.

The equilibrium of the seas is preserved, beyond a doubt, by a system of compensations as exquisitely adjusted as are those by which "the music of the spheres" is maintained.

I have also, on a former occasion, pointed out the fact, that, inasmuch as the Gulf Stream is a bed of warm water, lying between banks of cold water—that as warm water is lighter than cold—therefore, the surface of the Gulf Stream ought, theoretically, to be in the shape of a double inclined plane, like the roof of a house, down which we may expect to find a shallow surface or roof current, running from the middle, towards either edge of the stream.

The fact that this roof-current does exist, has been fully established: A person, who had been engaged on the Coast Survey with observations on the Gulf Stream, informed me that when he tried the current in a boat, he found it sometimes East and sometimes West, but scarcely ever in the true direction; whereas, the vessel, which drew more water, showed it to be constantly in a northeasterly direction.

My object at present is, not to account for the currents of the Atlantic, but merely to mention the fact, to call attention to it: that, though there be well-known currents which bring immense volumes of water *into* the Atlantic, we know of none which carry it out again, and which, according to the principle with which I set out, ought to be found running back from that ocean.

The La Plata and the Amazon, the Mississippi and St. Lawrence, with many other rivers, and several large oceanic currents, run into this very small ocean, and it is not probable that all of these waters are taken up from it again by evaporation; "yet the sea is not full." Where does the surplus go? The ice-bearing current, from Davis' Straits, which is counter to the Gulf Stream, moves an immense volume of water down towards the equator.

The ice-bearing current which runs from the Antarctic regions, and passes near Cape Horn into the Atlantic, and the Lagullas current, which sweeps into it around the Cape of Good Hope, both move immense volumes of water, and bear it along also towards the equatorial regions of the Atlantic.

This water must get out again, or the Atlantic would be constantly rising.

A part of the Gulf Stream runs around North Cape into the Arctic ocean. The thermal charts of the Atlantic ocean now in process of construction, prove this, as also do the admirable charts of Prof. DOVE, of Berlin.

This current around North Cape probably performs its circuit of the Arctic ocean, and returns to the Atlantic with increased volume.

There are the rivers of Northern Europe, and all the great rivers of Asia and America, that empty into the Frozen ocean; also the current from the Pacific ocean, into Behring's Straits. All these sources of supply, serve, in my opinion, to swell the current down from Baffin's Bay through Davis' Straits into the Atlantic.

That there is an open water-communication, sometimes at least, from Behring's Straits to Baffin's Bay, has been all but proved by the results of investigations undertaken about two years ago, at the National Observatory, with regard to the habits, migrations, etc., of the whale.

These researches were commenced at this office by Lieutenant HERNDON, and they were conducted in such a manner, as to show by a glance at the chart, in what parts of the ocean, and in what months of the year, whales had and had not been seen.

These investigations soon led to the discovery, that to the right whale, the equator is as a wall of fire,—that that animal is never found near it, seldom or never within a thousand miles of it, on either side.

This fact induced me to inquire of the whalemen, whether the right whale of the northern and the right whale of the southern hemispheres was the same animal.

The answer was "No." The right whale of the latter region, as described by these men, is a small pale animal, the largest scarcely yielding more than fifty barrels of oil. Whereas, that of the northern region is a large dark animal, yielding frequently to the single fish upwards of two hundred barrels.

About this time the whale-ship Superior returned from a voyage through Behring's Straits, where she also found the right whale of the North Pacific.

This fact induced the further inquiry, as to whether the right whale of Behring's Straits, and the right whale of Davis' Straits were the same animal. For since the fact had been established that the right whale of the North Pacific could not cross the equator, and therefore could not get into the North Atlantic by either of the Capes, a reply in the affirmative to this inquiry would be another link in the chain of circumstantial evidence, going to prove the existence of a so called Northwest Passage.

The answer from the whalemen in this instance, was, in effect: "we have not had an opportunity of comparing the two animals, except after long intervals, but, so far as we can judge, they are the same fish." So far as other facts go, it would appear probable that there is, at times, at least an open water-communication between the two straits; for the instincts of the whale, one might suppose, would prevent him from sounding under icebergs, neither could he pass under barriers of great depth or breadth. Seeing that water runs through Behring's Straits from the Pacific, as well as around the Capes, into the Atlantic, where, therefore, is the escape-current from the Atlantic?

The Trade Winds, I am prepared to show, are the great evaporating winds. They are the winds, which, returning from the polar regions, deprived of all the moisture which the hyperborean dew point can compress from them, first come in contact with the surface of the earth, and consequently with an evaporating surface, where they are first felt as trades, and where, therefore, they are dry winds.

Now could the vapor taken up by these winds so increase the saltness of this sea in the trade wind region, as to make the water there though warmer, yet specifically heavier than that below, and also than that within the regions of the variable winds and of "constant precipitation?" If so, might we not have the anomaly of a warm under current in the South Atlantic ocean, for that almost seems to be the only place of escape for a counter current from the Atlantic?

Lieutenant WALSH, who was sent out by the Government, in the schooner *Taney*, to make certain observations in connection with these researches concerning the winds and currents of the ocean, was at my request instructed, among other things, to examine for such a current.

*On the General Circulation of the Atmosphere.**

Several years ago, I commenced to gather from old sea journals, such information as they might be found to contain, relating to the winds and currents of the sea, and to embody the information so obtained on a series of charts, in such a manner as to show by pictures, the prevailing direction of the winds and currents for every month, and in every part of the ocean. Indeed, the plan of the undertaking was to collect the experience of every navigator, and to present the combined results of the whole in such a manner, that each one might, with a glance, have the benefit of the experience of all who had preceded him in any of the frequented parts of the ocean.

This enterprise has been seconded by the government, and individuals. American ship-masters generally have come into it with great zeal. They make the observations required on every voyage, and send them to me at Washington. There are some thousand or more ships voluntarily co-operating with me in all parts of the ocean, and as it might be supposed, from such a number of active and intelligent observers, we are collecting materials of great value.

During the course of these investigations, many interesting facts have been developed, amounting, in some cases, to actual discoveries of great interest—such as a new route, which shortens the sailing distance to the equator, some fifteen or twenty per cent., and, of course, proportionately to all ports beyond;—the existence in the North Atlantic of a regular monsoon—and in the North Pacific near the West coast, of a perpetual southwest trade wind, near the equator—a unique phenomenon; also, the existence, near the same place, of a system of monsoons.

My present purpose, however, is not to speak of these discoveries, but rather to treat of the insight which these investigations, undertaken on such a large scale, afford as to the general system of atmospherical circulation over the earth.

They teach us to regard the atmosphere as a vast machine, that is tasked to its utmost; but as one that is always in order and never breaks down.

It is a sewer into which, with every breath, we cast vast quantities of dead animal matter. It is a laboratory, into which, when the light and heat enter, they act upon this dead matter, decompose it, and resolve it into gaseous substances, to be by the action again of the same light and heat, condensed into plants and trees.

If it were not for this condensation, the air would become tainted; it would send its impurities back into the lungs; and continually receiving back more in return, it would finally become unfit for the respiration of certain animals, and man would perish from the face of the earth.

We hunger: we take as food that which has been gathered from the vegetable kingdom, into the stomach, there we elaborate it into flesh and blood. After it has coursed through the system, and performed its office, it is

* See paper read before the American Association for the advancement of science, Charleston, S. C., March, 1850.

again cast forth into the atmosphere, to be reconverted into more vegetables, to serve as food for other animals. Doubtless the animal and vegetable kingdoms are in exact counterpoise: the one destroying, the other re-arranging and rendering fit for use again, this same dead matter. In Infinite Wisdom, the two kingdoms are so balanced that there is not an insect too much on one side, nor a green leaf too little on the other. The atmosphere is the compensation by which the proper porportions of each are maintained.

These are only some of the operations that are carried on daily and hourly through the atmosphere which we are breathing. How important and profitable therefore, does the study of its laws become!

It is an engine which pumps our rivers up from the sea, and carries them through the clouds to their sources in the mountains. Air and water are the great agents of the sun in distributing his heat over the surface of the globe, cooling this climate and tempering that; and in this light, I propose to consider the winds and the currents at this time.

Though the winds blow here from the four quarters, and sometimes with such violence as to fill the mind with emotions of terror, yet such winds, in comparison with the general system of atmospheric circulation, are but eddies to the main current. They have no more effect in deranging or disturbing that system of circulation, than the shower which they bring with them has in disturbing the course of the Gulf Stream, and other great currents of the sea.

From the parallel of about 30° North and South, nearly to the equator, we have two zones of perpetual winds, viz: the zone of northeast trades on this side, and of southeast on that. They blow perpetually, and are as steady and as constant as the current of the Mississippi river—always moving in the same direction.

As these two currents of air are constantly flowing from the poles towards the equator, we are safe in assuming that the air which they keep in motion must return by some channel to the place near the poles, whence it came in order to supply the trades. If this were not so, these winds would soon exhaust the polar regions of atmosphere, and pile it up about the equator, and then cease to blow for the want of air to make more wind of.

This return current, therefore, must be in the upper regions of the atmosphere, at least until it passes over those parallels between which the trade winds are always blowing on the surface. The return current must also move in the direction opposite to the direction of that wind which it is intended to supply. These direct and counter currents are also made to move in a sort of spiral or loxodromic curve, turning to the west from the poles to the equator, and in the opposite direction from the equator towards the poles.

This motion is caused by the rotation of the earth on its axis.

The earth, we know, moves from West to East. Now, if we imagine a particle of atmosphere at the North pole, where it is at rest, to be put in motion in a straight line towards the equator, we can easily see how this particle of air, coming from the pole, where it did not partake of the diurnal motion of the earth, would, in consequence of *vis inertia*, find, as it travels south, the earth slipping under it, as it were, and thus it would appear to be blowing from the northeast and going towards the southwest.

On the other hand, we can perceive how a like particle of atmosphere that starts from the equator to take the place of the other at the pole, would, as it travels North, and in consequence of its *vis inertia*, be going towards the East faster than the earth. It would, therefore, appear to be blowing from the southwest, and going towards the northeast, and exactly in the opposite direction to the other. Writing South for North, the same takes place between the South pole and the equator.

Now, this is the process which is actually going on in nature, and if we take the motions of these two particles as the type of the motion of all, we shall have an illustration of the great currents in the air, the equator being in a node, and there being two systems of currents—an upper and an under—between it and each pole.

Let us return now to our northern particle, and follow it in a round from the pole to the equator and back again, supposing it, for the present merely, to turn back after reaching the equator.

Setting off from the polar regions, this particle of air, from some reason, which does not appear to have been satisfactorily explained by philosophers, travels in the upper regions of the atmosphere, until it gets near the parallel of 30°. Here it meets, also in the clouds, the particle that is going from the equator to take its place at the poles.

About this parallel of 30°, then, these two particles meet, press against each other with the whole amount of their motive power, produce a calm and an accumulation of atmosphere sufficient to balance the pressure from the two winds North and South.

From under this bank of calms, two surface currents of wind are ejected, one towards the equator, as the northeast trades—the other towards the pole, as the southwest passage winds—supposing that we are now considering what takes place in this hemisphere only.

These winds come out at the lower surface of the calm region, and consequently the place of the air borne away in this manner is supplied by downward currents from the superincumbent air of the calm region.

Like the case of a vessel of water which has two streams from opposite directions running in at the top, and two of equal capacity discharging in opposite directions at the bottom—the motion of the water in the vessel would be downward: so is the motion of the air in this calm zone.

The barometer, in this calm region, stands higher than it does either to the North or to the South of it; and this is another proof as to the banking up here of the atmosphere and pressure from its downward motion.

Following our imaginary particle of air from the North across this calm belt, we now feel it moving on the surface of the earth as the northeast trade wind, and as such it continues on till near the equator, where it meets a like particle, which has blown as the southeast trade wind.

Here there is another meeting of winds, and another calm region, for a northeast and southeast wind cannot blow at the same time in the same place. The two particles have been put in motion by the same power; they meet with equal force, and, therefore, at their place of meeting, are stopped in their course. Here there is also a calm belt.

Warmed by the heat of the sun, and pressed on each side by the whole force of the northeast and southeast trades, they ascend—the reverse of the operation which took place at the other meeting near the parallel of 30°.

This imaginary particle now returns to the upper regions of the atmosphere again, and travels there until it meets its fellow particle from the North, where it descends as before, and continues to flow towards the pole as a surface wind from southwest.

Entering the polar regions obliquely, it is pressed upon by similar currents coming from every meridian, and approaching the higher parallels more and more obliquely, until our imaginary particle, with all the rest, is whirled about the pole in a continued circular gale, until, reaching the vortex, it is carried upwards to the regions of atmosphere above, in which it commences again its circuit to the South.

Now the course we have imagined an atom of air to take is—Plate II—an ascent P, at the North pole; an efflux thence as an upper current, until it meets G, (also an upper current,) over the calms of Cancer. Here there is a descent, as shown by the arrows, along the lines which envelope the circle. This upper current from the pole now becomes the N. E. trade wind B, on the surface, which rises up at the equator, and returns thence—we will suppose for the present only—back towards the North pole, as G, until it reaches the calms of Cancer, where it descends and is felt on the surface as H, the S. W. passage winds; and so the circuit is completed for the northern hemisphere.

The Bible frequently makes allusions to the laws of nature, their operation and effects. But such allusions are often so wrapped in the folds of the peculiar and graceful drapery with which its language is occasionally clothed, that the meaning, though peeping out from its thin covering all the while, yet lies, in some sense, concealed, until the lights and revelations of science are thrown upon it—then it bursts out and strikes us with the more force and beauty.

As our knowledge of Nature and her laws has increased, so has our understanding of many passages in the Bible been improved.

The Bible called the Earth "the round world," yet for ages it was a most damnable heresy for Christian men to say, the world is round; and, finally, sailors circumnavigated the globe, proved the Bible to be right, and saved Christian men of science from the stake.

"Canst thou tell the sweet influences of the Pleiades?"

Astronomers of the present day, if they have not answered the question, have thrown so much light upon it as to show that, if ever it be answered by man, he must consult the science of astronomy.

It has been recently all but proved, that the Earth and Sun, with their splendid retinue of comets, satellites and planets, are all in motion around some point or centre of attraction inconceivably remote, and that that point is in the direction of the star Alcyon, one of the Pleiades! Who but the astronomer, then, could tell their "sweet influences?"

And as for the general system of atmospherical circulation, which I have been so long endeavoring to describe, the Bible tells it all in a single sentence: "The wind goeth towards the South and turneth about unto the North; it whirleth about continually, and the wind returneth again according to his circuits." Ecc. i, 6.

A like operation takes place in the southern hemisphere. We now see the general course of the "wind in his circuits," as we see the general course of the water in a river. There be many abrading surfaces, irregularities, etc., which produce a thousand eddies to the main stream, yet, nevertheless, the general direction of the whole is not disturbed nor affected by those counter currents; so with the atmosphere and the variable winds which we find here in this latitude.

We see, also, that there must be about the habitable parts of the earth *at least* three zones or nodes, in which calms are the prevalent condition of the air. One of these zones is near the equator, where the northeast and southeast trade winds meet, and form what is called the equatorial calms.

The other zones lie between those parallels where the "wind that goeth towards the South" meets that which "turneth about unto the North." They are the calms of Cancer and of Capricorn. (See Plate II.)

About each pole we have, or, according to the views I have been endeavoring to make plain, we ought to have, a perpetual whirl of the wind in the ascending nodes there. I have endeavored to represent them by the direction of the curved arrows at the poles. P and P, (Plate II.) Here there are two more nodes: five in all.

The wind approaches the North pole by a series of spirals from the southwest. If we draw a circle about the North Pole, on a common terrestrial globe, we shall see that the wind enters all parts of this circle from the southwest, consequently a whirl is created thereby, in which the ascending column of air revolves from right to left, or against the hands of a watch.

At the South pole the winds come from the northwest, and consequently there they revolve about it with the hands of a watch.

That this should be so will be obvious to any one who will look at the arrows on the polar sides of the calms of Cancer and Capricorn, Plate II. These arrows are intended to represent the prevailing direction of the wind at the surface of the earth, on the polar side of these calms.

It is a singular coincidence between these two facts thus established, and other facts which have been observed, and which have been set forth by REDFIELD, REID, PIDDINGTON, and others, viz: that all rotary storms in the northern hemisphere revolve as do the whirlwinds about the North pole, viz: from right to left, and that all circular gales in the southern hemisphere revolve in the opposite direction, as does the whirl about the South pole.

How can there be any connection between the rotary motion of the wind about the pole and the rotary motion of it in a gale caused here by local agents?

So far, we see how the atmosphere moves; but the atmosphere, like every other department in the economy of nature, has its offices to perform; and they are many. I have already alluded to some of them. But I only propose at this time to consider some of the meteorological agencies which, in the grand design of creation, have been assigned to this wonderful machine.

To distribute moisture over the surface of the earth, and to temper the climate of different latitudes, are two of the great offices assigned by their Creator to the ocean and the air.

When the northeast and the southeast trades meet and produce the equatorial calms of the Atlantic, the air by this time is heavily laden with moisture—for, in each hemisphere it has travelled obliquely over a large space of ocean. The two winds meet here with opposing forces so nicely balanced that they neutralize each other, and a calm is the consequence; and, as one is pressing from the North and the other from the South, upon the atmosphere over this calm region, each with the whole amount of force that sets it in motion, we ought to have in this calm region an accumulation of atmosphere equal to the sum of those forces. Now, if we had barometrical determinations accurately made in the region of these calms, we should probably obtain an expression, in horse power, if you please, of the whole amount of force exerted by the sun in keeping up this system of atmospherical circulation—for it is the heat of the sun which causes the winds to blow and the waters to flow; at least, it is supposed to be the chief source of their motive power.

The air of the equatorial calms being charged with moisture, is thus compressed, and has no room for escape but in the upward direction. In this direction it reaches a cooler region; a portion of its vapor is condensed, and comes down in the shape of rain. Therefore it is, that under these calms we have a region of constant precipitation.

Old sailors tell us of such dead calms of long continuance here, of such heavy and constant rains, that they have scooped up fresh water from the surface of the sea.

The conditions to which this air is exposed here under the equator, are probably not such as to cause it to precipitate all the moisture that it has taken up in its long sweep across the waters.

Let us see what becomes of the rest—for nature, in her economy, permits nothing to be taken away from the earth which is not to be restored to it again in some form, and at some time or other.

Consider the great rivers—the Amazon and the Mississippi for example—we see them day after day, and year after year, discharging an immense volume of water into the ocean.

"All the rivers run into the sea, yet the sea is not full." Ecc. i, 7.

Where do the waters so discharged go, and where do they come from?

They come from their sources, you will say. But whence are their sources supplied?—for, unless what the fountain sends forth be returned to it again, it will fail and be dry.

We see simply, in the waters that are discharged by these rivers, the amount by which the precipitation exceeds the evaporation throughout the whole extent of valley drained by them—and by precipitation I mean the total amount of water that falls or is deposited, whether as dew, rain, hail or snow.

The springs of these rivers are supplied from the rains of heaven, and these rains are formed of vapors which are taken up from the sea, that "it be not full," and carried up to the mountains through the air.

"Note the place whence the rivers come, hither they return again," is a dictum of the wise man.

Behold now the waters of the Amazon, of the Mississippi, the St. Lawrence, and all the great rivers of America, Europe and Asia, lifted up by the atmosphere, and flowing in invisible streams through the air, back to their sources; and that through channels so regular, certain, and well defined, that the quantity taken up one year with the other is nearly the same; for that is the quantity which we see running down to the ocean through these rivers; and the quantity discharged annually by each is, as far as we can judge, nearly constant.

We now begin to see what a powerful machine is the atmosphere; and though it is apparently so capricious and wayward in its movements, here is evidence of order and arrangement which we must admit, and proof which we cannot deny, that it performs this mighty office with regularity and certainty, and is therefore as obedient to law as the steam engine to the will of its builder.

It too is an engine. The South seas themselves, in all their vast extent, are the boiler for it, and the northern hemisphere is its condenser.

The proportion between the land and the water in the northern hemisphere, is very different from the proportion between them in the southern. In the northern hemisphere, the land and water are nearly equally divided. In the southern, there is many times more water than land. All the great rivers of the world are in the northern hemisphere, where there is less ocean to supply them. Whence then are their sources replenished? Those of the Amazon are supplied with rains from the equatorial calms and trade winds of the Atlantic. That river runs E., its branches come from the North and South; it is always the rainy season on one side or the other of it; consequently it is a river without periodic stages of a very marked character. It is always near its high water mark. For one half of the year its northern tributaries are flooded, and its southern for the other half. It discharges under the line, and as its tributaries come from both hemispheres, it cannot be said o belong exclusively to either. It is supplied with water from the Atlantic ocean.

Taking the Amazon, therefore, out of the count, the Rio de la Plata is the only great river of the southern hemisphere.

There is no large river in New Holland. The South Sea Islands give rise to none, nor is there one worth naming in South Africa.

The great rivers of North America and North Africa, and all the rivers of Europe and Asia, lie wholly within the northern hemisphere. How is it then, considering that the evaporating surface lies mainly in the southern hemisphere; how is it, I say, that we should have the evaporation to take place in one hemisphere and the condensation in the other? The total amount of rain which falls in the northern hemisphere is much greater, meteorologists tell us, than that which falls in the southern. The annual amount of rain in the North Temperate Zone is half as much again as that of the South Temperate.

How is it then, that this vapor gets from the southern into the northern hemisphere, and comes with such regularity, that our rivers never go dry, and our springs fail not? It is because of the beautiful operations of this grand machine—the atmosphere. It is exquisitely and wonderfully counterpoised. Late in the fall, throughout the winter, and in early spring, the Sun is pouring his rays with the greatest intensity down upon the seas of the southern hemisphere; and this powerful engine which we are contemplating is pumping up the water there for our rivers with the greatest activity. At this time, the mean temperature of the entire southern hemisphere is about 10° higher than the northern.

The heat which this heavy evaporation absorbs, becomes latent, and with the moisture is carried through the upper regions of the atmosphere, until it reaches our climates. Here the vapor is formed into clouds, condensed and precipitated. The heat which held this water in the state of vapor is set free, it becomes sensible heat, and it is that which contributes so much to temper our winter climate. It clouds up in winter, turns warm, and we say we are going to have falling weather. That is because the process of condensation has already commenced, though no rain or snow may have fallen; thus we feel this southern heat that has been bottled away in the clouds, of southern summer, and set free in the process of condensation in our northern winter.

While evaporation is going on with most activity in the southern hemisphere, precipitation is taking place to the greatest extent here; the fall spell, the winter rains, and the "long season in May," are familiar terms of wet weather to us all. These are the seasons at which we look for high water, and expect our "inland seas" to be in good navigable order.

The vapor comes through the upper regions of the atmosphere, and is probably condensed here not many days after it is taken up there. Suppose it to travel with the velocity of the trade winds, at the rate of twenty miles the hour; it will only take it about twenty days to reach us from the middle of the southern hemisphere.

We cannot ascend into the upper regions of the atmosphere to see what is going on there; but we have such a train of well established facts derived from observations here below, that reason mounting on them, boldly soars aloft, and bids us confidently to assert knowledge of what is going on there.

When we see and feel, as in the trade wind region we do day after day, the year round, the wind blowing as steadily from the poles towards the equator, as the Mississippi runs down to the Gulf, we are forced to the conclusion that as much air, precisely as much, as we see coming from towards the poles, and going towards the equator, has to go from the equator back towards the poles. If this were not so, there would be an exhaustion, and this wonderful engine that we are considering would break down, for there would finally be a vacuum about the poles with a tremendous atmospherical accumulation about the equator.

Recurring to the illustration given just now, and considering both hemispheres, we shall see that the atmosphere, like the string of a musical instrument, has its nodes or points of rest. These nodes serve as escape valves to the winds. In the equatorial calms, both the N. E. and S. E. trades have run their course on the surface, they are going up to blow as upper currents, and therefore the motion of the air here in these calms, could it be seen and measured, would be upwards; and for the same reason, when the two upper currents meet in the region of the Tropics, the motion of the air is downward, for after passing this node, each upper current becomes a surface wind, and each is going whence the other came.*

Important operations are carried on, and purposes grand in the system of terrestrial economy are subserved by these atmospheric nodes.

This singular fact has been brought out by the investigations which we are conducting at the Observatory, with regard to the winds: Our investigations in the Atlantic, for we have not carried them much further, show us that the S. E. trade wind region is much larger than the N. E.—I speak of its extent over the Atlantic ocean only.

The S. E. trades are the fresher; they often push themselves up to 10° or 15° of North latitude; whereas, the N. E. trade winds seldom get South of the equator.

* If this interchange of atmosphere did not take place between the two hemispheres, how would a proper mixture of the air be preserved. In the North there is much more land, and many more plants and animals to corrupt the air, than in the South, and unless the interchange did take place, there would be reason to infer a difference as to atmospherical purity in the two hemispheres.

Seeing that there is so much more room for evaporation in the southern than in the northern hemisphere, and that there is so much more precipitation on this than on the other side of the equator, we are led to one of two conjectures; first, that aqueous vapor in its invisible state can permeate the atmosphere; in other words, it can flow through the air in separate or independent currents of its own, like some of the gases. In this case, we must further conjecture the seat of some power unknown, which would always drive this vapor from the southern over into the northern hemisphere. We know of no such force in nature, and in this age men would scarcely receive such a conjecture, as one having plausibility enough to command their respect.

Abandoning this, therefore, we are next led to the second conjecture, which is, that the motion of the air in the general system of circulation is not exactly such as I have already described; but that the N. E. trade winds, for instance, when they reach the equatorial calms, instead of turning back towards the north, as I have supposed, keep on towards the South, and the S. E. trade winds make the tour north. In this case, the course of the winds, as described by SOLOMON, would be, as represented by the arrows, along the outer lines, (Plate II,) A, B, C, D, to the South Pole, thence up with the arrow P and around with the hands of a watch, and back as indicated by the arrows along E, F, G, and H. Of course, as the surface winds, H, and D, approach the poles, there must be a sloughing off, if I may be allowed the expression, of air from the surface winds, in consequence of their approaching the poles. For as they near them, the parallels become smaller and smaller, and the surface current must extend much higher up, or below, with greater rapidity, as it approaches the poles, else a part of it must be sloughed off above, and so turn back before reaching the poles.

If this plate and description fairly represent the course of the winds, we shall see that the S. E. trade winds would enter the northern hemisphere, and bear into it all their moisture, except that which is precipitated in the region of equatorial calms.

The South sea, then, if this reasoning be good, supplies mainly the water for this engine, while the northern hemisphere condenses it; we should, therefore, have more rain in the northern hemisphere. The rivers tell us that we have—at least on the land: the great water courses of the globe, and half the fresh water in the world, are found on our side of the equator. This fact, alone, is strongly corroborative of this hypothesis.

The rain guage tells us also the same story. The yearly average of rain in the North Temperate Zone is, according to JOHNSTON, 37 inches. He gives but 26 in the South Temperate.

Moisture is never extracted from the air by subjecting it from a low to a higher temperature, but the reverse. Thus, all that air which comes loaded with moisture from the other hemisphere, and is borne into this, with the S. E. trade winds, travels in the upper regions of the atmosphere until it reaches the calms of Cancer—here it becomes the surface wind that prevails from the southward and westward. As it goes North it grows cooler, and the process of condensation commences.*

We may now liken it to the wet sponge, and the decrease of temperature to the hand that squeezes that

* The peculiar clouds of the trade winds are formed between the two currents of air. They are probably formed of vapor condensed from the upper current, and evaporated as it descends, by the lower and dry current forms from the poles. It is the same phenomenon up there, which is so often observed here below; when a cool and dry current of air meets a warm and wet one, an evolution of vapor or fog ensues.

sponge. Finally reaching the cold latitudes, all the moisture that a dew point of zero, and even far below, can extract, is wrung from it; and this air then commences "to return according to his circuits" as dry atmosphere. And here we can quote Solomon again: "The north wind driveth away rain." This is a meteorological fact of high authority and great importance in the study of the circulation of the atmosphere.

This air that is returning from the North in the general channels of circulation, does not ordinarily come in contact with the surface of the water, but remains in the upper regions isolated from all sources of vapor, until it descends in the calms of Cancer, and commences to blow the trades, as at B, (Plate, II.) Here, it is as the dry sponge, taking up and evaporating fresh water from the sea with great avidity, By the time these winds reach the equatorial calms they are saturated with moisture; thus loaded, they return to refresh the earth with rain, to cover the hills with snow, and to supply the fountains of our great rivers with water.

By reasoning in this manner, we are led to the conclusion that our rivers are supplied with their waters, principally from the trade wind regions—the northern rivers from the southern trades, and the southern rivers from the northern trade winds.

If this be so, then the saltest portion of the sea should be in the trade wind regions, where the water for all the rivers is evaporated—and there the saltest portions are found.

Dr. Ruschenberger, of the Navy, on his late voyage to India, was kind enough to conduct a series of observations on the specific gravity of sea water.

In about the parallel of 17° N. and S.—the middle of the trade wind regions—he found the heaviest water. Though so warm, the water here was heavier than the cold water to the south of the Cape of Good Hope.

In summing up the evidence in favor of this view of the general system of atmospherical circulation, it remains to be shown how it is, if the view be correct, there should be smaller rivers, or less rains in the southern hemisphere.

The N. E. trade winds returning from the polar regions where the moisture has been compressed out of them, remain, as we have seen, dry winds until they cross the calm zone of Cancer, and are felt on the surface as the N. E. trades. About two-thirds of them only can there blow over the ocean, the rest blow over the land, over Asia, Africa, and North America, where there is but comparatively a small portion of evaporating surface exposed to them.

The zone of the N. E. trades extends, on an average, from about 29° North to 7° North. Now if we examine the globe, to see how much of this zone is land, and how much water, we shall find, commencing with China and coming over Asia, the broad part of Africa, and so on, across this continent to the Pacific, land enough to fill up as nearly, or it may be, just one-third of it, equal to 120° of longitude.

Two-thirds then only of the N. E. trade winds are fully charged with moisture, and only two-thirds of the rain of the northern hemisphere falls in the southern.

This point of view is one which is not capable of any more than the rudest approximations, for the greater extent of S. E. trades on one side, and of high mountains on the other, must each of necessity have its effects.

These calm and trade wind regions or belts, move up and down the earth in latitude nearly a thousand miles. In July and August, the zone of equatorial calms is found between 7° N. and 12° N., in March and April, between latitude 5° S. and 2° N.

With this fact, and the Trade Wind Chart before us, it is easy to perceive, why it is that we have a rainy season in Oregon, a rainy and dry season in California, another at Panama, two at Bogota, none in Peru, and one in Chili.

In Oregon, it rains every month, but more in the winter months.

The winter there is the summer of the southern hemisphere, when this steam engine is working with the greatest pressure. The vapor that is taken up by the S. E. trades, is borne along over the region of N. E. trades to latitude 35° or 40°, where it descends and appears on the surface with the S. W. winds of those latitudes. Driving upon the highlands of the continent, this vapor is condensed and precipitated during this part of the year, almost in constant showers.

In the winter, the calm belt of Cancer approaches the equator. This whole system of zones, viz: trades, calms and westerly winds, follows the Sun; and they of our hemisphere are nearest the equator in the winter and spring months than at any other season.

The S. W. winds crowding down at this season to the South, reach as far down as the lower part of California. In winter and spring the land in California is cooler than the sea air, and is quite cold enough to extract moisture from it. But in summer and autumn the land is the warmer, and cannot condense the vapors of water held by the air. So the same cause which made it rain in Oregon, now makes it rain in California. As the Sun returns to the North, he brings the calm belt of Cancer and the N. E. trades along with him; and now at places where six months before, the S. W. winds were the prevailing winds, the N. E. trades are found to blow. This is the case in the latitude of California. The prevailing winds then, instead of going from a warmer to a cooler climate as before, are going the opposite way. Consequently, they cannot, if they have the moisture in them to make rains of, precipitate it under such circumstances.

Panama is in the region of equatorial calms. This belt of calms, as may be seen by the charts, travels during the year back and forth over about 17° of latitude, coming furthest North in the summer, where it tarries for several months, and then returns so as to reach its extreme southern latitude sometime in March or April. Where these calms are, it is always raining, and the chart shows that they hang over the latitude of Panama, from June to November; consequently, from June to November is the rainy season at Panama. The rest of the year, that place is in the region of the N. E. trades, which, before they arrive there, have to cross the mountains of the Isthmus, on the cool tops of which they deposite their moisture, and leave Panama rainless and pleasant, until the Sun returns North with the belt of equatorial calms after him. They then push the belt of N. E. trades farther to the North, occupy a part of the winter zone and refresh that part of the earth with summer rains.

This belt of calms moves over more than double of its breadth, and the entire motion from South to North is accomplished generally in two months, May and June.

Take the parallel of 4° N., as an illustration: during these two months, the entire belt of calms crosses this parallel, and then leaves it in the region of the S. E. trades. During these two months, it was pouring down rain on that parallel. After the calm belt passes it, the rains cease, and the people in that latitude have no more wet weather till the fall, when the belt of calms recrosses this parallel on its way to the South. By examining the "Trade Wind Chart," it may be seen what the latitudes are that have two rainy seasons, and that Bogota is within the bi-rainy latitudes.

The coast of Peru is within the region of perpetual S. E. trade winds. Though the Peruvian shores are on the verge of the great South sea boiler; yet it never rains there. The reason is plain, and the charts make it obvious.

The S. E. trade winds in the Atlantic ocean first strike the water on the coast of Africa. Travelling to the N. W., they blow obliquely across the ocean until they reach the coast of Brazil. By this time, they are heavily laden with vapor, which they continue to bear along across the continent, depositing it as they go, and supplying with it the sources of the Rio de la Plata and southern tributaries of the Amazon.

Finally, they reach the snow-capped Andes, and here is wrung from them, the last particle of moisture that that very low temperature can extract.

Reaching the summit of the range, they now tumble down as cool and dry winds on the slopes beyond. Meeting with no evaporating surface, and with no temperature *colder* than that to which they were subjected on the mountain tops, they reach the ocean before they become charged with fresh vapor, and before, therefore, they have any which the Peruvian climate can extract. Thus we see how the top of the Andes becomes the reservoir from which are supplied the rivers of Chili and Peru.

We see, moreover, that the Andes and all other mountains which run North and South have a dry and a rainy side, and that the prevailing winds of the latitude determine which is the rainy and which the dry side.

Thus the southern coast of Chili: in our summer time, when the Sun comes North, and drags after him his belts of perpetual winds and calms, that part of the coast is left within the regions of the N. W. winds—the winds that are counter to the S. E. trades—which, cooled by the winter temperature of the highlands of Chili, deposite their moisture copiously. During the rest of the year, the most of Chili is in the region of the S. E. trades, and the same causes which operate in California to prevent rain there, operate in Chili: only the dry season in one place is the rainy season of the other.

Hence we see that the weather side of all such mountains as the Andes is the wet side, and the lee side the dry.

We shall now be enabled to determine, if the views which I have been endeavoring to present be correct, what parts of the earth are subject to the greatest fall of rain. They should be on the slopes of those mountains which the trade winds first strike after having blown across the greatest tract of ocean. The more abrupt the elevation, the greater the amount of precipitation.

If, therefore, we commence at the parallel of about 30° N. in the Pacific, where the N. E. trade winds first strike that ocean, and trace them through their circuits till they first strike high mountains, we ought to find such a place of heavy rains.

Commencing at this parallel in the North Pacific, and tracing thence the course of the N. E. trade winds we shall find that they blow thence, and reach the region of equatorial calms, near the Caroline Islands. Here they rise up; but, instead of pursuing the same course in the upper stratum of winds through the southern hemisphere, they, in consequence of the rotation of the earth, are made to take a S. E. course. They keep in this upper stratum until they reach the calms of Capricorn, between the parallels of 30° and 40°; after which they become the prevailing N. W. winds of the southern hemisphere, which correspond to the S. W. of the northern. Continuing on to the S. E. they now are the surface winds; they are going from warmer to cooler latitudes; they become as the wet sponge, and are abruptly intercepted by the Andes of Patagonia, whose cold summit compresses them, and with its low dew-point squeezes the water out of them. Captain King found the astonishing fall of water here of nearly 13 feet (151 inches) in 41 days; and Mr. Darwin reports that the sea water along this part of the South American coast is sometimes quite fresh.

We ought to expect a corresponding rainy region to be found to the North of Oregon; but there the mountains are not so high, the obstruction to the S. W. winds is not so abrupt, the highlands are farther from the coast, and the air which these winds carry in their circulation to that part of the coast, though it be as heavily charged with moisture as at Patagonia, has a greater extent of country over which to deposite its rain, and consequently the fall to the square inch will not be as great.*

In like manner we should be enabled to say in what part of the world the most equitable climates are to be found. They are to be found in the equatorial calms, where the N. E. and S. E. trades meet fresh from the ocean, and keep the temperature uniform under a canopy of perpetual clouds.

The mean annual fall of rain on the entire surface of the earth is estimated at about 5 feet.

To evaporate water enough from the ocean to cover the earth 5 feet deep with rain; to transport it from one zone to another; and to precipitate it in the right places, at suitable times, and in the proportions due, is the office of the grand atmospherical machine. This water is evaporated principally from the Torrid Zone. Supposing it all to come thence, we shall have, encircling the earth, a belt of ocean 3,000 miles in breadth, from which this atmosphere evaporates a layer of water annually 16 feet in depth. And to hoist up as high as the clouds, and lower down again, all the water in a lake 16 feet deep, and 3,000 miles broad, and 24,000 long, is the yearly business of this invisible machinery. What a powerful engine is the atmosphere!†

*I have since through the kindness of A. Holbrook, Esq., U. S. Attorney for Oregon, received the Oregon Spectator of February 13, 1851, containing the Rev. G. H. Atkinson's Meteorological table, kept in Oregon City, during the month of January, 1851. The quantity of rain and snow for that month is 13.63 inches, or more than one-third the average quantity that falls here during the year.

† Since this paper was read, "Vol. IX Transactions Bombay Geographical Society, from May, 1849, to August, 1850," has been published. From it I derive valuable information in relation to this, as well as many other subjects. In his Annual Report to the Society, Dr. Buist, the Secretary, states on the authority of Mr. Laidly, the evaporation at Calcutta to be "about 15 feet annually; that between the Cape and Calcutta averages in October and November nearly ¾ inch daily;—betwixt 10° and 20° in the Bay of Bengal, it was found to exceed an inch daily—supposing this to be double the average throughout the year, we should," continues the Doctor, "have 18 feet of evaporation annually," p. c.v.

If, in considering the direct observations upon the daily rate of evaporation in India, it be remembered that the seasons there are divided into wet and dry;—that in the dry season evaporation in the Indian Ocean, because of its high temperature—and also of the high temperature and dry state of the wind—goes on more rapidly there than anywhere else in the world—if, moreover, we remember that the regular trade wind regions proper, are for the most part rainless regions at sea; that evaporation is going on from them all the year round, we shall have reason to consider the estimate of 16 feet annually for the trade wind surface of the ocean not too high. What a powerful engine, therefore, may not the atmosphere be considered!

We see light beginning to break upon us—for we now begin to perceive why it is that the proportions between the land and water were made as we find them in nature. If there had been more water and less land, we should have had more rain, and *vice versa;* and then climates would have been different from what they now are, and the inhabitants, neither animal nor vegetable, would have been as they are. And as they are, that wise Being, who, in his kind Providence, so watches over and regards the things of this world that he takes knowledge of the sparrow's fall, and numbers the very hairs of our head, doubtless designed them to be.

In some parts of the earth the precipitation is greater than the evaporation; thus, the amount of water borne down by every river that runs into the sea may be considered as the excess of the precipitation over the evaporation that takes place in the valley drained by that river.

In other parts of the earth the evaporation and precipitation are exactly equal, as in those inland basins such as that in which the city of Mexico, Lake Titicaca, the Caspian Sea, etc., etc., are situated; which basins have no ocean drainage.

If more rain fell in the valley of the Caspian than is evaporated from it, that sea would finally get full and overflow the whole of that great basin. If less fell than is evaporated, then that sea would dry up, and plants and animals would all perish there for the want of water.

In the sheets of water which we find distributed over that and every other inhabitable inland basin, we see reservoirs or evaporating surfaces just sufficient for the supply of that degree of moisture which is best adapted to the well-being of the plants and animals that people such basins.

In other parts of the earth still, we find places, as the Desert of Sahara, in which neither evaporation nor precipitation takes place, and in which we find neither plant nor animal.

In contemplating the system of terrestrial adaptations, these researches have taught me to regard the great deserts of the earth, as the Astronomer does the counterpoises to his telescope—though they be mere dead weights, they are, nevertheless, necessary to make the balance complete, the adjustments of this machine perfect. These counterpoises give ease to the motions, stability to the performance, and accuracy to the workings of the instrument.

Wherever I turn to contemplate the works of nature, I am struck with the admirable system of compensations, with the beauty and nicety with which every department is poised by the others; things and principles are meted out in directions the most opposite, but in proportions so exactly balanced and nicely adjusted, that results the most harmonious are produced.

It is by the action of opposite and compensating forces that the earth is kept in its orbit, and the stars are held suspended in the azure vault of Heaven; and these forces are so exquisitely adjusted, that at the end of a thousand years, the earth, the sun and moon, and every star is found to return to its proper place at the proper moment.

Nay, philosophers tell us, when the little snow-drop, which in our garden walks we may now see, raising its beautiful head to remind us that spring is at hand, was created, that the whole mass of the earth from pole to pole, and from circumference to centre, was taken into account and weighed, that the proper degree of strength might be given even to this little plant.

Botanists tell us that the constitution of this plant is such as to require that at a certain stage of its growth, the stalk should bend, and the flower should bow its head, that an operation may take place, which is necessary, in order that the herb should produce seed after its kind; and that after this its vegetable health requires that it should lift its head again and stand erect. Now, if the mass of the earth had been greater or less, the force of gravity would have been different; the strength of fibre in the snow-drop, as it is, would have been too much or too little; the plant could not bow or raise its head at the right time; fecundation could not take place, and its family would have become extinct with the first individual, because it could not have reproduced itself.

Now, if we see such perfect adaptation in the case of one of the smallest flowers of the field, how much more may we not expect it in the atmosphere, upon the right adjustment of which depends not only the life of that plant, but the well being of every individual that is found in the entire vegetable and animal kingdoms of the world.

When the East winds blow for a little while, they bring us air saturated with moisture from the Gulf Stream, and we complain of the sultry, oppressive, heavy atmosphere; the invalid grows worse, and the well man feels ill, because when he takes this atmosphere into his lungs, it is already so charged with moisture, that it cannot take up and carry off that which encumbers his lungs, and which nature has caused to be deposited there, that this atmosphere may take up and carry off. At other times the air is dry and hot; he feels that it is conveying off matter from the lungs too fast, he realizes the idea that it is consuming him, and he calls it parching.

Therefore, in considering the general laws of atmospherical circulation, in order to get at the clue to them, I have felt myself constrained to set out with the belief, that if the atmosphere had had a greater or less capacity for moisture, or if the proportion of land and water had been different—if the earth, air and water, had not been in exact counterpoise—the whole arrangement of the animal and vegetable kingdoms would have varied from its present state. But God chose to make those kingdoms what they are; for this purpose it was necessary to establish the proportions between the land and water, and the desert, just as they are, and to make the capacity of the air to circulate heat and moisture just what it is, and to have it to do all its work in obedience to law, and in subservience to order. Else why are we told that "He measured the waters in the hollow of his hand, and comprehended the dust in a measure, and weighed the mountains in scales, and the hills in the balance?" Why did he span the heavens, but that he might mete out the atmosphere in exact proportions to all the rest, and impart to it those properties and powers which it was necessary for it to have, in order that it might properly perform all those offices and duties for which he designed it? I have not the time, and if I had the time, I have not the heart so to abuse the patience of those who read, as I should do, by attempting to discuss the currents of the ocean, and to tell of the beautiful discoveries to which our system of investigation has led us with regard to those great agents in the terrestrial economy.

Harmonious in their action, the air and the sea are obedient to law, and subject to order in all their movements; when we consult them in their courses, they teach us lessons concerning the wonders of the deep, the mysteries of the sky, the greatness and the wisdom and the goodness of the Creator. The investigations into the broad-spreading circle of phenomena connected with the winds of heaven and the waves of the sea, are second to none for the good which they do, and the profit which they give.

The Astronomer sees the hand of God in the sky; but the right-minded mariner who looks aloft as he ponders over these things, hears His voice in every wave of the sea that "claps its hands," and feels His presence in every breeze that blows.

The cruise of the "Taney."

By an act of Congress, approved March 3d, 1849, the Secretary of the Navy was authorized to assist me in the undertaking to investigate the phenomena of the winds and the waves, to find short routes, and to discover matters of importance to Commerce and Navigation. The following is the joint resolution which expressed the wishes of Congress in the matter:—

"SECTION 2. *And be it further enacted,* That the Secretary of the Navy be directed to detail three 'suitable vessels of the navy in testing new routes and perfecting the discoveries made by Lieut. Maury in the 'course of his investigations of the winds and currents of the ocean; and to cause the vessels of the navy to 'co-operate in procuring materials for such investigations, in so far as said co-operation may not be incom'patible with the public interest: *Provided,* That the same can be accomplished without any additional 'expense."

But one vessel has been detailed for this service, and she unfortunately proving utterly unseaworthy, her cruise was broken up before it was half completed.

The U. S. Schooner "Taney," Lieut. J. C. Walsh commanding, was the vessel, and her unfitness for such service, is the more to be regretted, as her officers one and all, entered upon this field of research with so much spirit.

The "Taney," well equipped for the duties assigned her, sailed from New York in October, 1849, with the following instructions issued from the Navy Department:

"The object of the service upon which the "Taney" has been detailed, is to make observations upon the winds and currents of the sea, and to collect other facts in connection with the "wind and current charts" of Lieut. Maury, and which are of practical importance to the safe navigation of the seas, or to the study of the phenomena of the ocean. This is an important service. It is a service which requires patient and laborious observations from the officers entrusted with it.

A faithful record of every phenomenon observed, with a full statement of all the circumstances as to time, place, &c., connected with it, is of great importance.

It is expected, therefore, that you and the officers of the "Taney," will bestow upon the duty which has been assigned yourself and them, because of a peculiar fitness therefor, the utmost diligence and the most assiduous attention.

The subjects of observations which will command your particular attention, are:

1st, The force and direction of the wind, the hourly state of the weather, and all the meteorological conditions connected therewith, as thermal, dynamical, barometrical, and the like.

2d, The force and set of currents, their depth and width, their temperature, and the position of their edges or limits.

3d, Hourly observations upon the temperature of the surface water.

4th, Frequent observations upon the temperature of the ocean at various depths.

5th, Deep-sea soundings.

6th, Vigias, and all dangers about which there are doubts, either as to existence or position.

7th, Transparency and saltness, or the specific gravity of sea-water, in the diffeient parts of the ocean.

You will determine the specific gravity of the water, either by one of the hydrometers, or the specific gravity bottle furnished for the purpose.

You will keep an abstract of your log, as per form. It is believed that the form itself is sufficiently explicit as to what is wanted for the abstract, a copy of which you will send to Lieut. Maury, as often as you have an opportunity, returning the original to him when you arrive in the United States.

You will make it a rule, the better to ascertain rate of currents and fix their limits, to determine by observation the variation of the compass and your position in the forenoon, in the afternoon and at night, as well as at noon, whenever the weather will permit; and after allowing for lee-way, heave of the sea, variation of the compass and false steerage, you will call the difference between the place of the vessel as established by observation, and as established by *dead reckoning*, current, and so to enter it in the abstract.

You will also try in calms, and as often as convenient, both for surface and under currents, in the usual way, by lowering boats, letting down weights, &c.

For longitude by chronometer at night, the planets, or the largest of the fixed stars are the best objects to be observed when the horizon is good—The Mer. Alt. of the moon may be used for latitude at night, or in the fore or afternoon, according to its age.

Note in its proper column, not only the portion of cloudy sky, 10 being entirely overcast, and 0 clear; but state also the direction or directions in which the clouds are moving, with the kinds of clouds, as Nimb., Cum., Cirrus Stratus, &c.

In taking temperature of surface water, a fresh bucket should be drawn up each time, the thermometer plunged into it immediately, held there for several minutes, and *read while the bulb is in the water.*

For the purpose of ascertaining the existence of under currents, you will sound at intervals, at the least, of every 30 miles, with 100 fathoms line, if there be as much depth, attaching to the line two thermometers, one near the lead, and the other 50 fathoms from it. In case you have no thermometers suitable, or should lose them, then you will attach two hollow non-conducting cylinders with valves opening upward, in the place of the thermometers, haul the line up briskly, and try quickly the temperature of the water brought up in the cylinders.

In case you should find an under current, you will endeavor to ascertain its limits and set with all the accuracy possible. For rate and direction, a block of wood, or a barrega loaded just to sinking, and suspended at any required depth by a small float just sufficient to keep it from sinking further, will perhaps be the best means.

The determination of the rate and set of under currents is an operation which is so modified by the weather and other circumstances, that it must of necessity be left, in a great measure, to the judgment and mental resources of the operators. The officers of the "Taney" will perhaps have abundant opportunity to display their ingenuity with regard to the subject. The lead used in sounding for temperatures should be painted white, and the distance at which it disappears going down and reappears coming up should be entered in fathoms in the transparency column.

The "Taney" will be provided with the means of sounding at great depths. It is desirable to reach the bottom at every attempt, for the depth of the ocean is an important element towards a perfect understanding of the tides, their laws of motion, the course and form of the tidal wave and the like.

At the distance of every two hundred miles across the ocean, soundings must be made all the way, both going and returning, with the view to reach the bottom and determine the depth of the sea. The "Taney" has been provided with the necessary apparatus therefor. In each case the lead must be armed, the specimens of the bottom which it may bring up must be preserved in a bottle, with a lable attached showing the date, place and the depth. The time selected for these soundings should be calm weather, when the sea is smooth, and when there is a likelihood of its so continuing for several hours at least. In hauling up the sounding line from great depths, care should be taken to prevent the lead from having too great an upward motion, lest by turning around it should twist the line in two. Therefore in hauling it up, frequent pauses should be made to allow the line to untwist. It is desirable, also, to have specimens of water from the greatest depths.

In going across the Atlantic, and in looking after the vigias and doubtful dangers to which your attention will also be called, it will be most convenient for you to take up your position for deep sea-soundings in the calm regions known as the "horse latitudes," which in the month of October will be found between the parallels of 24° and 35° N., according to longitude; you will see the limits of this calm belt sufficiently marked and developed on series B, of Maury's wind and current chart, with copies of which the "Taney" will be supplied.

A series of accurate barometrical observations in this belt of calms will be of exceeding interest and value. It is one of the nodes in the general system of the atmospherical circulation of the earth. Here the winds from the polar, meet in the upper regions, those from the equatorial calms, and they so nearly balance each other as to produce almost a perpetual calm. We may then look under this meeting of opposing winds for an accumulation of atmosphere, and consequently for an increased barometrical pressure, and from this increase of pressure accurately determined, may be derived an expression to show the total amount or value of those physical forces which are exerted to put and keep the trade winds in motion. You will therefore be diligent with the barometer in those regions, and in all others, taking care when it is mounted on board, to note in the abstract log its distance from the level of the sea.

The "vigias," and dangers of doubtful existence or position which you will look after, are Ashton's Rock, about latitude 35° 50′ N., longitude 71° 48′ W., said to be 8 feet above the water, and to have been seen in 1824. False Bermudas about latitude 32° 37′ N., longitude 58° 37′ W. They are rocks, said to be frequently mistaken for the Bermudas, they are laid down in a part of the ocean but little frequented.

Nye's Rock, - - - - -	31°	15′	N. Lat.	Long.	55°	41′	W.
Van Kuelen's Vigia, - - -	31	40	"	"	38	10	"
Josyna Rock, - - - -	31	45	"	"	23	20	"
Steen's Ground, - - - -	32	30	"	"	21	15	"

You will touch at one of the Canaries for water. Without unnecessary delay, you will proceed thence towards the Cape Verds, examining as you go the position of Maw's Rock, Bon Felix Shoal, the Bonetta Rocks, and the reef to the west of them, marked on Maury's chart as doubtful with regard to position.

The route, so far as it has been indicated to you, will take you through the Sargasso sea. You will be careful to try the depth, and the temperature of the water of that sea, and to note the latitude and longitude of its edges where you cross it.

Besides the regular series of deep-sea soundings, you are requested to make frequent use of the lead (deep sea) in the vicinity of all "vigias" and "rocks" that are supposed to lie in your way; for if they exist, you will probably find shoaler water in their vicinity.

After completing this service, you will put into Port Praya for water and provisions. Filling up with these, and allowing your crew and officers a few days to refresh, you will again put to sea; standing to the southward, and examining as you go Warley's Shoal and French Shoal of 1796; the supposed place of both of which are marked on the charts of Lieut. Maury.

From the last-named shoal you will proceed to a supposed submarine volcanic region of considerable extent, between the equator and 3° south latitude, and between 15° and 25° west longitude. Through all parts of the ocean you will continue as you go, the regular series of observations as to winds, currents, temperatures, soundings, &c., as per form of Abstract Log.

In passing the region of equatorial calms, you will again cross one of those atmospherical nodes under which nice barometrical observations become of exceeding interest.

After having satisfied yourself as to the characteristics with regard to depth and bottom in that part of the ocean just alluded to as probably volcanic, you will proceed to make Cape St. Roque, bestowing unremitted attention to the soundings and temperatures as you go.

There seem to be reasons to suppose that an under-current of warm water has its genesis in this part of the ocean; soundings and deep-sea temperatures across the Southern Atlantic may throw some light upon this important question.

Arriving off Cape St. Roque, and having put into some convenient port of Brazil for water, if necessary, you will proceed to make a zig-zag course along the coast to the northward, for the purpose of investigating the currents thence to the mouth of the Amazon. You will make stretches off from the coast of one hundred miles, or as far as it may be necessary, in order to cross and define the system of currents and counter-currents that are supposed to prevail there, and a correct knowledge of which is so essential to the speedy and safe navigation of that part of the ocean.

Having satisfied yourself as to those currents, you will proceed homeward by the following route:—from the equator in long. 37° W., draw a straight line to Cape Charles. This line will lay nearly in the middle of a strip of the ocean about 300 miles broad, and which is remarkable for the temperature of its water. You will sail a zig-zag course through this strip, crossing it at least four times on your way home, and passing the line which you are directed to draw, at least two hundred miles on either side, and taking deep-sea soundings before you put about to recross it again. Should you discover anything remarkable as to the depth of the sea within this region, you will push the discovery to a conclusion.

It is expected that you will return to the United States some time in the month of April next.

As the service on which you are engaged has for its object the making of observations and the collecting of facts *at sea*, you will keep the sea during your absence as long as practicable.

It is not expected that you will at all times be able to carry on without interruption the series of observations as here laid down for you. It is supposed that they will be interrupted from time to time by the weather and other circumstances. Much, therefore, must be left to your discretion; you understand the nature of the service which is required, and are in possession of the views of the Department on the subject. The Department therefore commits the service to you, feeling assured that you will in all cases exercise a sound discretion, and so meet its just expectations."

Lieut. Walsh, and the officers associated with him, acquitted themselves of the duty thus assigned them, in a manner creditable in the highest degree to them as well as to the profession to which they belong.

The greatest length of sounding line that ever penetrated the depths of the ocean, gives eclât to this cruise of the "Taney," for to her officers belong the honor of having obtained the greatest sounding ever known.

To them credit is also due for clearing off from the charts of the ocean, the names of various rocks, shoals, and dangers which for years had been causing mariners to turn out of their way; been hindering navigation, interfering with commerce, vexing navigators and discouraging merchants, shippers and owners.

Before his vessel was condemned as unseaworthy, Lieut. Walsh had an opportunity of examining the localities assigned to no less than seven of these great commercial hindrances. He performed this duty in so thorough a manner, as completely to establish their non-existence. Upon the faith of his work, I have been duly authorized to erase the whole seven from the charts. See the list reported by him; page 62.

The discovery, also, by Lieut. Walsh of a submarine current, of great velocity; of water in the depths of the ocean which when brought to the surface, relieved of pressure and reduced to the surface temperature, was found to be lighter than the surface water;—and that the depth of the North Atlantic ocean probably exceeds six miles and a half in the deepest parts, also adorns the list of interesting results of this highly serviceable cruise.

On November 15th, 1849, in latitude 31° 59′ N., longitude 58° 43′ W., Lieut. Walsh with his sounding wire obtained a cast of 5700 fathoms = 34,200 feet, or 6.48 miles, without reaching bottom. This is the greatest depth ever attained, and would show that the greatest depths of the ocean exceed the greatest elevations of the land by more than one mile at the least. It is very desirable to have this sounding verified.

On the return of the "Taney," Lieut. Walsh did me the honor to communicate to me in writing, the results of his labors during this cruise. Though that letter has been extensively copied in nautical and scientific works, and though it has already had a wide circulation, yet in as much as it is a part of the history of this undertaking, I quote it in place.

Lieutenant J. C. Walsh to Lieutenant Maury.

BORDENTOWN, NEW JERSEY, *August* 15*th*, 1850.

SIR,—I have to add to the "Abstract Log" of the U. S. Schooner Taney, which has been sent you, some remarks upon the results of parts of our work there recorded: the explorations in the Atlantic, for some of the many rocks and vigias of doubtful existence,—deep soundings with the wire,—investigations of currents, particularly the under currents, &c.

The *rocks and vigias* searched for, with the positions assigned to them upon the Charts, are as follows:

Ashton Rock	Lat. 33°50′ N.	Long. 71°40′ W.
False Bermudas	" 32 30	" 21 15
Nye's Rock	" 31 15	" 55 50
Vankeulen's Vigia	" 31 40	" 38 20
Josyna Rock	" 31 40	" 23 45
Steen Ground	" 32 30	" 21 15
Mary's Rock	" 19 42	" 20 45

Not one of them was found, nor any indication of their existence; on the contrary, every evidence to disprove it. Our various tracts over and about their reported positions, covering the extent of 1½ degrees of longitude and 40 miles of latitude, with the many and deep soundings, from 100 to 800 fathoms, without getting bottom, will be found sufficient, I trust, to satisfy navigators that they have no existence,—or at least, that those parts of the ocean in which they have been reported to exist, are free from all dangers. To the first three mentioned, we gave the most thorough search: to Ashton Rock, six days time; to the False Bermudas, eight days; to Nye's Rock, likewise eight days. All our tracks were by daylight, as the schooner was always hove to at night, while engaged in these explorations. A slight discoloration of water was noticed in the region assigned to Mary's Rock, but no soundings could be got with 500 fathoms. This rock had been previously searched for with like results, by the U. S. Exploring Expedition, Captain Wilkes; and by H. M. S. Levin, Captain Bartholomew. Ashton Rock is placed in a most frequented part of the ocean; there is not a day that some vessel does not pass in the vicinity, and nothing has been seen of it since the first and only report of it in the year 1824. This fact alone should disprove it, independent of our search. I find Mr. Blunt has erased it from his Chart of the North Atlantic, as also the False Bermudas, Vankeulen's Vigia, Steen Ground and Mary's Rock. There are sufficient real dangers in the Atlantic; these imaginary ones should not disfigure the charts; they only serve to harrass navigators, turn vessels from their routes, and thus injure commerce. The reports of them by merchant vessels, which seldom take time to examine the appearances of such dangers, can be readily explained. Floating wrecks, large trees, carcasses of whales, &c., presenting all the appearance of reefs, have deceived experienced seamen.

Though we did so much less in *deep soundings* in the Atlantic, than expected, owing to the rough weather, bad state of the vessel and loss of so much wire, in the first experiment, nevertheless, the proving the ocean to have a depth or more than 5,700 fathoms, (34,200 feet, or more than six statute miles,) as was satisfactorily done in this first trial, is alone of much interest and importance. This vast depth, greater than the elevation of any mountain above the surface, and the greatest depth of the ocean ever yet measured, was reached without finding bottom, in latitude 31° 59′ N., longitude 58° 43′ W., on November 15th, 1849. The wire broke at this length, 5,700 fathoms, at the reel, and this large proportion of our supply was thus so early lost. It preserved the exact plumb line throughout the sounding; there was a steady, uniform increase of weight and tension; no check whatever in any instant of its descent,—which prove that it could not have touched bottom before the break.* It had been very carefully measured and marked, so that the *ocean here is deeper than 5,700 fathoms,* can be relied upon as accurate. This great sounding is within 32 miles of the assigned position of the rocks, called the False Bermudas, for which we were then in search, which fact alone should go far to

*The lead used was but 10 lbs. weight, with a Stellwagen cone fitted to it. Nothing else was attached to the wire but a small instrument (weighing about 6 lbs.) invented by yourself, for indicating the depth reached: I had tested this several times to considerable depths, and found its indications correct. Our arrangements for these deep soundings were altogether very complete. It may be well to add an account of them. We had on board 14,300 fathoms wire, weighing 3,025 lbs., all of the best English steel, of five different sizes, Nos. 5, 7, 8, 10, and 13 (Birmingham guages.) Every part was tested to bear at least one-third more than the weight which it was calculated to sustain.

An extent of 7,000 fathoms of this, weighing 1,800 lbs. (the remaining 7,300 fathoms, composed of the smaller sizes, Nos. 10 and 13, being stowed away as spare wire,) carefully measured and marked with small copper labels, was linked into one piece, and wound upon an iron cylinder, 3 feet in length and 20 inches in diameter,—the largest-sized wire being wound first, so as to be uppermost in sounding. Two swivels were placed near the lead, and one at each thousand fathoms, to meet the danger of twisting off by the probable rotary motion in reeling up. The cylinder with the wire was fitted to a strong wooden frame, and machinery attached—fly-wheel and pinions, to give power in reeling up. Four men at the cranks could reel up with ease, with the whole weight of wire out. Iron friction bands, which proved of indispensable importance, were connected to regulate the rate of the wire in running off the reel. One man with his hand upon the lever of one of these friction bands could preserve a uniform, safe velocity, checking or stopping the wire as required. The whole apparatus could be taken apart, and stowed away in pieces (being so large and massive, this was indispensable in so small a vessel as the Taney.) When wanted for use, the frame was put together, and secured to the deck by iron clamps and bolts, near amidships, the reel hoisted up from below, and shipped in its place; a *fairleader* was secured to the taffrail, being a thick oak plank, rigged out five feet over the stern, having an iron pully, 18 inches diameter, fitted in its outer end, and two sheet iron fenders 3½ feet long, of semi-circular shape, fitted under it, to guard the iron wire from getting a short nip in the drifting of the vessel. The wire was led aft, from the reel, over the pulley which traversed freely in the fairleader, and passed between these fenders into the water.

The time occupied in the descent of *the* 5,700 *fathoms*, at the moderate rate it was allowed to go off the reel, using the friction bands, was exactly 1½ hours. I found in the subsequent soundings, that two or three men could reel up 1,000 fathoms in 2¼ hours, taking time to rub dry and oil it in passing to the reel, to guard against rust.

disprove them. We had three choice chronometers, two of which performed with rare excellence throughout the cruise, and being a beautiful, clear day, a number of sets of observations were taken in the morning, noon, and afternoon, so that the position was determined with the nicest accuracy. It proved the finest possible day for this work, the sea so smooth, and hardly a breath of wind. Though we found by trial in the morning a slight surface drift, setting to W. S. W., there was no change of position during the sounding, as proved by the observations; the great weight and extent of the wire, penetrating to such profound depths, seemed to serve as an anchor to keep the little schooner steady.

In all our subsequent work under this head, I found the heave of the sea, however slight, was the great difficulty—the lifting of the stern in the pitching motion causing such an immense increase of strain upon the wire, breaking it upon almost every occasion on reaching about 2,000 fathoms. It is under the most favorable circumstances, when the sea is very unusually smooth, that this mode of measuring its vast central depths can succeed.

The next subject to which I would refer, is our investigations of the *under-currents* of the ocean. I regret we had so few opportunities for these very interesting experiments; but enough has been done to seem to warrant the conclusion, that these under-currents are *generally* stronger, setting in various different directions, than those of the surface. I am well aware that there is no mode of testing their *exact* velocity; but that practised by myself, which I will describe, was certainly all-sufficient to show their relative velocity. There may be none so rapid as that mighty oceanic river, the *Gulf Stream:* unfortunately, the weather prevented our making these investigations in that interesting region; but in the various parts of the Atlantic in which we succeeded in these experiments, on only two occasions did we find the under-current of less velocity than that running in a different direction above it. The following is the mode practised in testing them:

The surface-current was first tried by the usual mode (a heavy iron kettle being lowered from a boat to the depth of 80 fathoms); then, for the trial of the under-current, a large *chip-log*, of the usual quadrantal form, the arc of it measuring full four feet, and heavily loaded with lead to make it sink and keep upright, was lowered by a light but strong cod-line to the depth of 126 fathoms, (the length of the line;) a barrega was attached as a float, a log-line fastened to this barrega, and the rate of motion of this float, as measured by this log-line and the glass, as well as the direction as shown by a compass, were assumed as the velocity and set of the under-current. No allowance was made for the drag of the barrega, which was always in a different direction from the surface current. It was wonderful, indeed, to see this barrega move off against wind and sea, and surface current, at the rate of over one knot an hour, as was generally the case, and on one occasion as much as 1¾ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had hold of the weight below and was walking off with it. I will cite from the Log several instances of these experiments:

On May 11th, in lat. 24° 43′ N., long. 65° 25′ W., we found a surface current of one-third knot per hour setting to the West, and an under current, at the depth of 126 fathoms, of one knot, setting W. S. W.—

temperature of water at surface 77.3°, at 50 fathoms 77.5°, at 100 fathoms 73.5°. The current felt by the vessel on that day (as deduced from the comparison of the true positions obtained by astronomical observations and chronometers, with those by the dead-reckoning) agreed with this trial of the surface current, being the same within a fraction, viz: 0.3 knot, westerly. On this day, as noted in the "Column of Remarks," the sea was covered by a species of *medusæ*, of a dark-red color, spherical in shape, from one-eighth to three-eighths inch in diameter.

On May 12, at 4 P. M., in lat. 25° 55′ N., long. 64° 43′ W., the surface current was found to be ⅓ knot, setting N. N. E., and the under current (at 126 fathoms) 1¾ knots, setting S. E., being the strong under-current I have alluded to: this was well ascertained by several trials—temperature of water at surface 75°, at 50 fathoms 76°, at 100 fathoms 69°. From this time, 4 P. M. to 8 A. M., the following morning, we experienced a strong current of 1.3 knots per hour, setting N. 14° E., as determined by the observations. While trying the currents in the boat, all hands remaining on board the schooner were employed sounding with 500 fathoms line, but failed to get the temperature at that depth, there being at the time too much swell.

On May 13th, at 5*h*. 30*m*. P. M., in lat. 26° 42′ N., long. 64° 4′ W., the surface current was found to be ⅓ knot setting E. by S., the under current (at 126 fathoms) 1¼ knots setting W. S. W.; at same time obtained the following temperatures: at surface 77.5°, at 50 fathoms 76.5°, at 100 fathoms 74.5°, at 500 fathoms 53°. The current felt by the schooner in the interval from 8 A. M. to 4 P. M., was easterly 0.4 knot per hour, agreeing with the trial in the boat.

On May 14th, in lat. 26° 46′ N., long. 63° 53′ W., found a slight surface drift, too small to be measured, setting to the westward, and an under current (at 126 fathoms) of 1¼ knots, setting N. by E. No current had acted on the vessel for the preceding 16 hours, and dead-reckoning agreeing with the observations.

On this day, the sea, being pretty smooth, we tried soundings with the wire, and got 1,050 fathoms without bottom, and we succeeded in getting, by one of the Syx's self-registering thermometers, (which came up uninjured by the immense pressure,) the temperature at that great depth, which was 49°, while at the surface it was 77°.

On 18th May, at 9 A. M., in latitude 36° 6′ North, longitude 67° 56′ West, found a surface current of one-third knot, setting N. W. by N., and a very slight under-current (at 126 fathoms) not more than one-sixth knot settihg N. E. No current was felt by the vessel during that day, but during the preceding night one-fourth knot per hour, setting N. W. Being calm and pretty smooth, we sounded during this day to the depth of 2,050 fathoms, when the wire broke without reaching bottom. The temperature at surface 70°, at 100 fathoms 65°. The trial of currents on this day was one of the two occasions which I have alluded to, on which we found a less under-current than that above it.

On 29th May, at 11 A. M., in latitude 33° 58′ N., longitude 72° W., found the surface current one-third knot, setting S. E., and an under-current (at 126 fathoms) of one knot setting W. N. W.; temperature at surface 71°, at 50 fathoms 70.5, at 100 fathoms 67°. We were set during this day, as determined by the afternoon observations, to the eastward, at the rate of one-half knot per hour. On this, which happened to be the last occasion of these experiments, I tried the current at the depth to which the kettle was lowered (80 fathoms) which it would have been better to have always done; I found it tended in the same direction as that at 126 fathoms, (counter to the surface current,) but at so small a rate that it could hardly be measured, not more than $\frac{1}{10}$ knot per hour, the float moving at only this small rate, being but one-tenth of the velocity at which it had moved just before when trying at 126 fathoms. This indicates that the kettle had just penetrated the under current; and thus, by this means, it would appear practicable to measure the depth of the surface current, or its point of contact with the counter under current. Such experiments in the *Gulf Stream* would be particularly interesting.

In connection with this subject of under-currents, or *submarine streams*, I may hope that you will find our record of the temperature of the ocean, taken, according to instructions, at every 30 miles, to the depths of 100 and of 50 fathoms, and the surface temperatures taken every hour, may serve to throw more light in this new world of research, of such great interest and importance in terrestrial physics.

The column of currents, in the abstract log, gives the currents of practical importance to navigation, those of the *surface* for every eight hours, or as often as ascertained by the observations; the difference between the true position, as determined by them, and that deduced from the log or dead-reckoning, being held as the effect of current. Our dead-reckoning was with this view kept with unusual care and nicety. I found the night observations could not be depended upon sufficiently to determine currents, but the early morning or evening twilight often afforded beautiful opportunities—the horizon so well defined, and the larger planets and stars so clear and brilliant. You will notice we met with the usual variable currents in crossing the North Atlantic in about latitude 31°, region of variable winds: between the longitudes, however, of 48° and 57° we met with a steady current of about one knot an hour, setting to northward and westward. Recrossing, in about latitude 17°, we experienced daily the great *Equatorial stream* setting to the westward, at the average of half a knot per hour. This is within the region of the *Trade Winds*—and here we often noticed the upper light clouds, the *cirri*, moving from the westward, while the lower strata moved with the prevailing winds from the eastward, thus indicating the existence of an upper current of winds counter to the *Trades*.

We first crossed the *Gulf Stream* on the 31st October; we struck into it in latitude 37° 22′ N., longitude 71° 26′ W., as indicated by the temperatures of the water, which were as follows:

8 A. M.	water	at surface	66°,	air	54°
9	"	"	" 73°,	"	53°
10	"	"	" 76°,	"	55°
11	"	"	" 77°,	"	56°

Making a S. S. E. course good at the rate of six knots an hour. 77° was the highest temperature found in the stream in crossing it this time. We were set by it to the eastward, at the rate of 3.6 knots per hour. We got out of it, judging from the water getting back to 70°, in latitude 36° 16′ N., longitude 70° 56′ W., bearing from the point of entrance S. 20° E., distant 71 miles. This 71 miles would, therefore, appear the breadth between those points of latitude and longitude; no doubt, however, the surface breadth varies considerably, as also the *velocity*, affected by the winds and other causes unknown. We encountered the usual bad weather, and suffered much in our little craft from a very heavy, irregular, and topling sea, which kept the decks flooded. I extract from the column of "Remarks" on that day: "Oct. 31st—*On western edge of Gulf Stream*—from 4 A. M. to 8 A. M., fresh, with heavy squalls, accompanied by thunder, lightning, *hail*, *snow*, rain, and appearances of waterspouts; columns of dense vapor rising from the sea to the clouds," &c. "The same bad weather continued throughout the day. From 8 to midnight, hail with rain, accompanied by squalls and a tremendous sea."

Recrossing this *stream* on our return, on May 30th, we entered it in latitude 35° 30′ N., longitude 72° 35′ W., having a slight touch of the same weather, "squalls with rain, thunder and lightning." The temperatures stood as follows:

	Water at surface.	Water at 50 fathoms.	Water at 100 fathoms.	Air.
8 A. M.	71.8°	71.8°	67°	70°
9 "	73			
10 "	75.5			
11 "	78.5			
12 "	78.5	77.5	72.5	76

79° was the highest temperature found, when at the same time it was 77° at 50 fathoms, and 74° at 100 fathoms. Its velocity, as felt by us in crossing this time, was 2.5 knots per hour, setting N. 77° E. We got out of it in latitude 36° 42′ N., longitude 72° 10′ W., bearing from the point of entrance N. 16° E., distant 78 miles: 78 miles, therefore, appears the breadth between these points of latitude and longitude.

The temperatures, on leaving it, stood as follows, the air being 66°:

3 A. M., water at surface 78°.

4 A. M., water at surface 74°, at 50 fathoms 70°, at 100 fathoms 64°.

5 A. M., water at surface 72°.

6 A. M., water at surface 71°.

Heading during these three hours N. W. by N. at the rate of three and a half knots an hour. At 9 A. M. the water stood at surface 69.5°, at 50 fathoms 65.5°, at 100 fathoms 65.5°. By 1 P. M., the temperature at surface had fallen to 63.5°, at 50 fathoms to 58.5°, at 100 fathoms 58°, the temperature of the air being 68°.

When on soundings next day, June 1st, in latitude 39° N., longitude 70° 30′ W., the water showed as low as 51° at surface, and maintained an average temperature of 53° until we reached New York. This is a difference of 28° from the adjacent Gulf Stream. Shoals of porpoises and black fish were seen by us in the hot waters of the stream. We saw very little Gulf or sea-weed (fucus natans) in it, but much at its outer edge. While mentioning this weed I may here remark, that we looked in vain, in the region assigned to the *Sargasso Sea*, for the great fields of it which have been reported. Small patches of five or six feet, generally arranged in long parallel lines in the direction of the wind, were seen daily in crossing the Atlantic till we reached the longitude of 28°, when it disappeared altogether. My frequent examinations of this weed satisfy me that, wherever it may originally come from, it feeds and grows upon the waters of the sea, which is certainly not more strange than the plant which feeds upon the air.

We discovered the *hot waters of the Gulf Stream* extending as far east as 73° 10′, in a latitude so far South as 33° 30′. The column of water temperatures in the "Abstract" from May 23d to 29th, while engaged in the search for Ashton Rock, will satisfy you of this interesting and important fact; for you will notice that whenever we reached that longitude, in our various tracks between the latitudes 33° 30′ and 34° North, we experienced a sudden change of as much as 5° and 6° in the surface temperature—70° to 76°. This must be a branch or offset from the Gulf Stream, being so far to the eastward of the limits hitherto given to it *in those latitudes*. We first noticed this extraordinary change of temperature on the 23d—the temperature of surface water rising on that day from 71.5° to 79°. I cite from the Abstract:

Midnight, commencing 23d May, latitude 32° 35′ North, longitude 73° 24′; surface water 71.5°, at 50 fathoms 71.5°, 100 fathoms 67°.

8 A. M., latitude 32° 58′ North, longitude 73° 36′, surface water 73°.

9 A. M., latitude 32° 50′ North, longitude 73° 38′, surface water 75°, at 50 fathoms 73.5°, 100 fathoms 70°.

3 P. M., latitude 33° 03′ North, longitude 73° 52′, surface water 79°.

The current at 8 A. M. was found by trial to be one knot per hour, setting W. N. W., and the under-current (at 126 fathoms) one knot, setting to the E.; the current felt by the vessel (as determined by comparison of results of observations and dead reckoning) was 1.5 knot per hour, setting westerly; this was between 8 A. M. and 4 P. M. The variations of temperature of the water, recorded on the next day, (24th of May,) in latitude 33° 25′, longitude 72° 40′, are worthy of notice—the sudden fall of 3½ degrees in one hour, from 6 to 7 P. M., 75.5° to 72°, while standing to the northward and eastward, and the rise again the next hour to 75°, made me suspect the possibility of a *shoal*, so that I put back, found the place again, and sounded with 300 fathoms line, but got no bottom. It being thick squally weather, I could not attempt deeper soundings.

The column of *specific gravity* of sea-water calls for some remarks. Our measurements by the hydrometer show that in some parts, if not in most parts of the ocean, the water is specifically *lighter* at depths than at surface, when reduced to like temperature—the correction for this difference being applied. I found on one occasion the following large difference: On December 8th, at surface 1028.6, (distilled water as standard held at 1000,) at 200 fathoms 1028.4; at 500 fathoms 1027.2, all at 60° temperature: this was in latitude 31° 42′ North, longitude 38° 12′ W. The specific gravity generally found at surface, appears about 1028.4 at 60° temperature; and this specific gravity at surface appears, according to our record, more variable than at depths.

The greatest *transparency* of the water observed, as found in its column, was seventeen fathoms, being able to see a large lead, painted white, at that depth. This was in latitude 21° 4′ N., longitude 66° 36′ W.

The column of *barometer* contains the records of the improved marine mercurial barometer, got from Tagliabue, in New York, which proved to be an excellent instrument, and most valuable to me, never failing to warn of an approaching gale. The Aneroid, though not noticed in the "Abstract," was regularly recorded in the Log, with the Mercurial, every four hours during the cruise. This may serve as a good test of its performance. It was set with the *mercurial* on leaving New York in October. It commenced at once to differ, indicating higher; and, though its daily fluctuations agreed well, this difference steadily increased until, by the time we got back to New York, seven months after, it had reached as high as six-tenths of an inch above it; thus acquiring an error of very nearly one-tenth of an inch a month. This leads me to doubt whether this ingenious instrument can ever be sufficiently trusted to take the place of the mercurial, though it is so much to be desired.

The observations for the *variation of the compass* could be taken but seldom with exactness, and therefore appear but seldom in the "Abstract," the needle being generally kept by our jumping little schooner in too unsteady a state for correct azimuths.

In conclusion, I must express my regrets that the most important part of the "Instructions" was prevented being carried out by the bad condition of the schooner, proving, on overhauling at Porto Praya, quite unseaworthy. I allude to the investigations of the currents about Cape St. Roque, and of the volcanic region of the South Atlantic near the equator. But I sincerely trust that the work will not be allowed to stop here—that it will be continued under your instructions, in connection with your "*Wind and Current Chart*," as has been authorized by Congress. The employment of three suitable vessels was recommended by the bill; but one has yet been employed, and that quite unsuitable in size and condition. A vessel of but one hundred tons, as is the "Taney," independent of being too unstable for the observations and the soundings, cannot carry officers and men enough for the incessant and laborious work required, nor provisions and water enough to keep the sea for long periods of time, as is essential on this service."

What the greatest depth of the ocean may be, has ever been a matter of speculation among philosophers, an object of longing desire and curious inquiry among mariners.

Many questions of deep interest touching the physical condition of our planet are connected with the depths of the sea.

The basin of the Atlantic ocean separates the Old World from the New; it is a long channel, with some conformity of outline along its opposite shores. The basin or trough in which those waters are held, extends from the Antarctic to the Arctic seas, perhaps from pole to pole. What is the depth of this trough?

The tides attain their greatest rise and fall as their waves roll, or rather undulate from South to North through this deep and narrow channel.

Do the tides rise higher upon the borders of this sea than elsewhere, because its channel is deeper, or its depths freer than the depths of other seas are from obstructions to the tidal wave?

This great marine trough lies between the Andes of South America on one hand, and the Mountains of Africa on the other—each range shooting forth its peaks far beyond the limits of perpetual snow.

Is the bed of the Atlantic depressed in proportion to those elevations—and is that proportion in an increased or diminished ratio? Nothing that relates to the physical condition of our planet can be without interest, and knowledge with regard to every such thing is profitable.

It is wise to seek for it, for the ways of nature are the paths of wisdom, and whoever seeks to tread in those paths is profited, both he and his generation, by the mere attempt.

The bottom of the Atlantic ocean, indeed, I might say, the bottom of what the sailor calls "blue water" is, with here and there an exception, all over the world as unknown to us as in the interior of the other planets of our system.

Astronomers have measured the volume, and weighed the masses of those distant spheres. But neither the curiosity nor the explorations, nor the researches of man have ever succeeded in penetrating farther than a few feet into the crust of our planet.

From the top of the Himalaya to the depth of Lieutenant Walsh's great sounding in the Taney would measure in a vertical line, about 12 miles. Before this sounding was taken, the vertical reach of the greatest sounding at sea, added to the perpendicular elevation of the highest mountain on the land, measured only about 10 miles.

What the capacity of those reservoirs which contain the waters that perform such an important part in the economy of the terrestrial arrangement may be, is certainly a matter of inquiry as profitable, as instructive, and as useful as is the delineation on our maps of mountain ranges and other configurations of the earth's surface.

Therefore, in this undertaking to collect physical data that we might from them gain knowledge as to the phenomena displayed by the air and the ocean, the subject of deep sea soundings did not escape attention.

Congress had given the Secretary of the Navy authority to have deep-sea soundings made by our men-of-war wherever they go; and to employ them in collecting materials for the great work I have in hand. The first attempt encouraged further exertions: Lieutenant Walsh's deep-sea soundings invested the subject with renewed interest, and when it was officially brought to the notice of Commodore Warrington, the chief of Bureau of Ordnance and Hydrography, under whose orders I am, he at once gave it his hearty approval and official sanction.

The following circular order to the commanders of all vessels of the Navy was thereupon issued:

Directions for taking Deep Sea Soundings, prepared by the Bureau of Ordnance and Hydrography, under authority from the Secretary of the Navy, dated May 31st, 1850.

"Provide hanks, balls or skeins of wrapping twine. Let some contain 5,000 and some 10,000 fathoms each. This twine should be strong enough to bear a weight of 20 or 30 pounds. It should be as small as consistent with this degree of strength. It should be smooth, having nearly the specific gravity of salt water, so that in sounding at great depths it will not be likely to buoy up the shot or to part with the weight, or from its own friction through the water.

In order to prevent friction, the twine should be waxed or oiled. If oiled, the oil should be put on not more than three days before the twine is to be used.

It should be marked at every 100 fathoms, not by a knot, but by a silk thread tied tightly around.

Let the first 1,000 fathoms on each parcel be marked with a green silk thread wrapped twice about the twine and tied; then the 100 fathoms (from 100 to 900 inclusive) marks may be designated by a silk thread drawn between the strands of the twine as many times as there are hundreds to be marked.

In like manner mark 2,000 fathoms and its intermediate hundreds with a white silk thread. The 3,000 and intermediates with a blue. The 4,000, &c. with red. The 5,000, &c. with a black. The 6,000, &c. with yellow, and so on up to the 10,000 fathoms with other colors, or with striped threads.

The object is to attach these threads to the twine in such a manner as not to make knots, or rough, or uneven places by which the sounding line may catch.

Provide several large and light spools or reels on which the twine is to be reeled before proceeding to sound. These spools should be large enough and light enough to give line to the shot, as fast as the shot will take it, without danger of breaking.

Sling the shot to serve as the sounding weight by passing two straps of canvass, ½ inch broad, about it in such a manner as to hold, and as to have the straps to lay smooth and without knots and wrinkles about the shot. Let the sailmaker with his needle secure the sounding line to these straps, or leave a loop of strong twine to them to which the line may be tied.

Use one or more 32 lb. shot at a time according to the depth of the sounding, and the suggestion of experience. Sound at least once a day and give the latitude and longitude of the sounding with as much accuracy as possible, together with the depth, stating the allowance that is to be made for slack or stray line.

When the shot touches bottom, as will be known by the turning of the reel, break the twine and enter on the log—state the length of the part lost; this length should be determined accurately by measuring from the broken end to the next 100 fathom mark.

Unless at very great depths the most convenient sounding line will be a strong fishing line, say three of 5,000 fathoms each, marked at every 50 fathoms, wound on reels by which they may be reeled up rapidly.

The line should be smooth, with strength enough to bear a weight of 50 or 60 pounds; attach a bit of cork (the stopper of a champagne bottle will be large enough) to the lower end; toggle or tie the line on to the shot by a thread that will part on attempting to pull the shot up. When the shot touches bottom, haul on the line, detach it from the shot and the cork will bring the end to the top, and thus make the reeling up more easy.

With this line should be used a sounding nipper, which gives the exact depth up and down."

The "Albany's" deep-sea Soundings.

The U. S. Ship "Albany," Commander Chas. T. Platt, was among the first vessels equipped under this order. Her cruising ground was the West India station. Her commander entered heartily into the spirit of deep sea soundings, and has been unceasing in his attention to them.

Here, therefore, was a fine opportunity for solving one of the most interesting physical problems of the day, by ascertaining the depth and shape of the basin which holds the waters of the Gulf of Mexico, and of the Caribbean sea.

This problem is in a fair way of being solved by this ship. She has already obtained many beautiful results.

In searching for one thing in the domains of physics, we are often rewarded by finding others of great value, which were not included in the original design. And so it has been here.

The "Albany," besides ascertaining the depth out in the blue water of the Gulf, will probably ascertain also in what parts of it, under-currents exist, and in what parts they do not; and this system of research has already afforded grounds for the hope that it may lead also to the discovery of those secret channels through which the general system of oceanic circulation is kept up.

The twine furnished the "Albany" for this service, unfortunately proved too weak. The best size and the proper strength for the twine to be used were points which experiment alone could determine. That furnished the Albany measured about 150 fathoms to the lb. weight, and she had 40,000 fathoms of it. It was intended to be strong enough to bear a weight of 50 or 60 lbs.

And though the sailor resources and ingenuity of Capt. Platt and Lt. Wm. Rodgers Taylor, the executive officer of the ship, finally overcame, in a great measure, as will appear from the reports, these difficulties, yet this could not be accomplished until a large portion of the twine had been lost in the experiment.

The twine when used for sounding was wound on a delicately constructed reel, which would turn with as little friction and to the least force, possible. The usual sounding weight was a 32 lb. shot. When the shot was cast overboard, it was allowed to take the line as fast as it would—as in heaving the log, the chip is allowed to take the line;—and the time occupied by the shot in taking out the line was from the first, carefully noted.

Now it is evident, the line being always of one size, and the weight a 32 lb. shot of the same form, that these soundings and observations would soon afford us the means of determining, with some degree of approximation at least, the law of descent which would govern a 32 lb. shot sinking in sea water, and drawing after it this particular line.

Having determined from the mean of a number of unexceptionable observations the law of the descent for still water, it would then be practicable to determine in each instance, whether the sounding had been made through an under-current of water or not; and whether the shot had reached the bottom or not.

Suppose the sounding to be made through an under-current—what would be the effect? After the shot had passed through it, it would be operating upon the *bight* of the line. In towing vessels when the bight of the tow line gets in the water, every sailor knows how great is the power which requires to get the line straight again.

In the case of the sounding line, the force exerted by the under-current is a *swigging* force, and supposing the shot to be stationary on the bottom, and the ship at rest on the top of the sea, the current will take the twine off from the reel at double its own velocity nearly.

Now if the time occupied by each 100 fathoms in running out were to be noted at every sounding, we should be furnished not only with the means of determining with some degree of probability, at what depth this under-current is encountered, but we should have the means of determining its velocity also; and except in those cases where the velocity of the current happens to be that of half the rate at which the shot was sinking just before reaching the bottom, we shall likewise have data for determining what rates are due the shot and what the current, and consequently whether bottom be reached or no.

Lieut. Taylor has kindly promised when the new line, of which a fresh supply of 40,000 has been ordered, reaches the "Albany," to have it marked at every 100 fathoms, and to note at every sounding, the time it requires the shot to take out successively as it goes down, every 100 fathoms.

I am permitted by Commodore Warrington to quote Capt. Platt's reports to him upon the subject of these interesting experiments.

Captain Platt to Commodore Warrington.

U. S. Sloop of War "Albany," Harbor of St. Thomas, Island of St. Thomas,

December 18*th*, 1850.

Commodore Lewis Warrington,

Chief of Bureau of Ordnance and Hydrography,

"Sir:—In conformity with your instructions, I have the honor to report the results of our attempts at deep sea soundings.

Our *first* sounding, made with the line provided by the Department for that purpose and a thirty-two pound shot attached, was attempted on the 6th of December, in lat. 38° 38′ North, and long. 66° 31′ West, both by dead reckoning. At this time, bottom* was found with 1,625 fathoms of line which ran out in 27 minutes.

On the 7th and 8th of December, the weather was too rough to admit of sounding.

On the 9th of December, being by dead reckoning in lat. 33° 34′ North, and long. 61° 38′ West, we found bottom* with 1,950 fathoms of line, running out in one hour and three minutes, with a drift of one mile. On this day, six shots were lost in unsuccessful efforts, the line parting with the heaving of the ship. A bar of iron, weighing 12 pounds, was also tried without success. The result was at last obtained by means of a bar of lead, weighing 13 pounds.

On the 10th of December, no sounding was attempted in consequence of the rough weather.

On the 11th of December, our *third* and *fourth* soundings were effected. The *former* was taken in latitude, by observation, 30° 05′ North, and longitude, by chronometer, 58° 12′ West, with 1,000 fathoms* of line, running out in eleven minutes. The *latter* sounding was made in observed latitude 29° 58′ North, and longitude 58° 48′ West, with 1,500* fathoms of line running out in twenty-eight minutes. The former sounding was effected under a light breeze, and the latter in a dead calm, during which the ship had no perceptible drift. Eleven shots were expended before the soundings of this day were secured.

On the 12th of December, after lying to for two hours, nothing was accomplished. Five experiments

* Further experiments satisfied Captain Platt that he did not get bottom on any one of these occasions.—M. F. M.

were made with an oiled line, running out respectively 600, 20, 300, 550, and 200 fathoms. Two experiments were also made dispensing with the oil, the sixth shot for the day being lost at a depth of 200 fathoms. The seventh and last sounding for the day was made with three bars of iron lashed together, and having an aggregate weight of twelve pounds. The line parted near the reel, after 1,000 fathoms had been run out.

Our time until the 16th was spent in waxing the twine preparatory to other experiments. On this day, in observed latitude 21° 34′ North, and longitude, by chronometer, 63° 23′ West, the line ran out in 28 minutes, and parted at 1,600 fathoms.

This is the extent of our experiments, and the best results we have been able to attain. I am convinced, from the frequent parting of our line under such various circumstances, with reduced tension, at such different lengths, with equal strain, and with repeated marks of fracture in the strands, that the twine furnished was not suitable for our use. If the knots had been well fastened, and the strength of the line equal in all its parts, results more satisfactory to ourselves and more valuable to others might have been obtained.

I have reason to commend the perseverance and scientific skill with which these experiments have been prosecuted by Lieut. Taylor. I am confident that every effort within our power was made by him to render these soundings as complete and accurate as the materials furnished us would warrant.

Since discovering the defectiveness of the line, and observing its liability to fracture, especially at great lengths, I have been suspicious that in no case we had reached the bottom, although the cessation of the strain upon the line had been regarded as indicating a legitimate sounding.

About 14,000 fathoms of the sounding line supplied us yet remain, with which I shall continue experiments at the first opportunity.

"*Havana, Island of Cuba, January 20th,* 1851.—I beg leave [further] to report the progress of our experiments in deep sea soundings. Subsequently to the attempts reported on the 18th of December, 1850, our next sounding was made on the 29th of the same month, in latitude 17° 54′ North, and longitude by chronometer 67° 28′ West,—being below the Mona Passage, midway between the west end of Porto Rico and Mona Island. The line used on this occasion was waxed, and the sounding was made without once severing it; 1200 fathoms of line were run out in 17 minutes, with a drift of about one-half a mile. The temperature of the air 81°, and of the water 84°.

On the 4th of January, 1851, being becalmed in going out of St. Domingo, soundings were found with a vertical line of 370 fathoms, the ship lying about nine miles from land,—latitude 18° 30′ North, longitude 69° 41′ West. Temperature of the air 80°, and of the water 82°. The line ran out in five minutes. It was waxed, and did not part except in the effort to recover the shot.

With a similar line, on the next day, January 5th, at 4 P. M., we found bottom in nineteen minutes, at 1275 fathoms, with about one-half a mile drift. We lay in latitude 17° 16′ North, and longitude 71° 26½′ West, with Altavela in sight. Temperature of the air 82°, and of the water the same.

On the 13th of January, at noon, three unsuccessful attempts at soundings were made with a waxed line, which parted the first time in two minutes at 250 fathoms, the second time in three minutes at 300 fathoms, and the third time in eighteen minutes at 1200 fathoms. These failures occurred in observed latitude 19° 12′ North, and longitude by chronometer 76° 05′ West, with the temperature of the air 83° and of the water 82°.

On the 16th of January, two successful soundings were made,—the former in latitude 22° 29′ North, and longitude 84° 35′ West, at 3.30 P. M., and the latter in latitude 22° 32′ North, and longitude by chronometer 84° 32′ West, at 5 P. M. In the former case, the line ran 420 fathoms in five minutes,—in the latter, 720 fathoms in eight minutes, with the temperature of the air 82°, and of the water 80°. Between these soundings in which bottom was found, two unsuccessful experiments had been made to verify the first, but in one case, the line parted at 280 fathoms, and in the other case, a squall drove us so rapidly as to render the cast unreliable. All these experiments were made with a waxed line.

From the effect upon the line when bottom was assuredly reached in these experiments, a suspicion has been thrown upon the soundings made before arriving at St. Thomas.

Further experiments I shall endeavor to prosecute, and to report as soon as practicable.

"*Santiago de Cuba, February 8th*, 1851.—I beg leave [to continue] to report the results of soundings made since my communication of the 20th ult.

The first deep sea sounding was made at noon on the 28th of January, in North latitude 24° 05′ and West longitude 82° 05′. Bottom was found with 470 fathoms of line, running out in about six minutes. The temperature of the air 78°, and of the water 80°.

The next day, January 29th, two shots were lost in unsuccessful attempts, the line parting in both instances, once at 280 fathoms, and once at 360 fathoms. At a third trial, bottom was found with 500 fathoms of line running out in about six minutes and a half. This sounding was taken in North latitude 24° 37′, and West longitude 79° 48′. I was the more gratified with succeeding in this third attempt, because it had been questioned whether the gradually decreasing velocity of the shot's descent, would not become equal to the velocity of the current in the Gulf Stream, and the line be taken out indefinitely at a consequent speed. It cannot now be questioned that bottom was found, as stated. From the time of these experiments until our arrival on the 2d of February at Cape Haytien, a strong wind and heavy sea rendered soundings impracticable.

On the 6th February, at noon, we sounded during a calm off Cape Haytien. The line ran perpendicularly 640 fathoms in 8 minutes and 45 seconds. Our position by bearings was in latitude 19° 57′ North, and longitude 72° 11′ West. Temperature of the air 82°, and of the water the same.

On the 7th of February, being in the Windward Passage, midway between Cuba and St. Domingo, bottom was reached with 840 fathoms of line, running out in ten minutes and two seconds. I cannot determine, however, what allowance to make for drift on this occasion, nor infer with any certainty the actual depth found at this position. Although in heaving to for these experiments, sail is always reduced to topsails; yet the unavoidable drift during a strong breeze materially effects our result, and prevents our giving at the best more than an approximate estimate. Lieut. Taylor, who conducts these experiments quite enthusiastically, will take pleasure in using the first opportunity to make an attempt at sounding from a boat, and ascertain the comparative result.

I should add, that since ascertaining the greater tenacity of the waxed line, we use it altogether in these deep soundings.

I shall continue these experiments on all practical occasions so long as our materials last.

I have the honor to be, respectfully,

Your obedient servant,

CHARLES T. PLATT,

Commanding the Albany."

Captain Platt mentions that these soundings were performed generally under the immediate superintendence of his accomplished first Lieut. Wm. Rogers Taylor, U. S. N.

Lieut. Taylor kept minute records of the operations connected with each sounding, and had the kind ness to furnish me with copies of them, simply for my own satisfaction. It is obvious that he never designed his sounding journals for publication. But they are not the less valuable for that reason; and he will I hope pardon me the liberty I am taking, for the sake of the motive I have in view, which is to let other officers have the benefit of his experience. The freedom with which the difficulties in his own case are stated;—his account of the manner of overcoming them, the statement of his success and failures, will all afford most valuable assistance to other officers engaged with the same thing, and encountering similar difficulties. It is, therefore, that I take the liberty of publishing unofficial papers that were never intended for the public eye.

Deep-sea Sounding Journal kept by Lieutenant Wm. Rogers Taylor, on board the U. S. ship Albany, Commander Platt.

Date.	Lat. Obs. N.	Lat. D. R. N.	Long. Obs. W.	Long. D. R. W.	Fathoms.	Time running out.	Temp're. Air.	Temp're. Water.	Remarks.
1850.	° ′	° ′	° ′	° ′			°	°	
Dec. 6.	—	38 38	—	66 31	1625	27 minutes	61	68	No bottom.
7.	37 09	—	64 59	Too rough to sound					
8.	35 14	—	63 01						
9.	—	33 34	—	61 38	1950	1 hour 3 m.	68	72	Drift 1 mile.

"Mem.—9th.—We lost six shot in attempting to sound to-day, owing to the heavy swell, which caused the line to snap when the ship rose abaft. We then tried a bar of iron which weighed about twelve pounds, which descended more rapidly than the shot; but the line failed and snapped. At length we resorted to a thirteen pound lead, and got bottom as above. The light weight of the lead caused the line to go out very slowly towards the last, but I have no doubt of the sounding. I set the drift at about one mile, from which you can easily calculate the perpendicular depth. The first day we lost one shot only by the parting of the line; the second attempt was entirely successful.

"10th. Lat. obs. N. 31° 54′. Long. D. R. W. 61° 15′. Too rough for sounding.

"11th. The experiments of to-day have cast a doubt over the former soundings, and I am now uncertain whether we have ever obtained bottom. This forenoon we got, as I supposed, an excellent cast, and the line stopped running out at 1,000 fathoms; the strain was very great upon the line, when it was pulled upon, but as the breeze was light, it was some minutes before it parted. I felt confident that we got bottom at the time. But this afternoon there was as perfect a calm as I ever saw; we thought it would be well to verify the cast of the forenoon, and renewed the soundings; the line stopped running out at 1,500 fathoms, and the ship had not drifted apparently ten yards; the line was up and down. But upon pulling upon it, the line came in gradually, though very heavily; indeed, sufficiently so as to cause me to believe that if the ship had had headway it would have parted. And yet we hauled in some three hundred fathoms, the weight diminishing as it rose, but with no sudden relief of strain, as if the line had snapped. It at once occurred to me that if the shot had broken the line at that depth, the effect upon the reel would have been the same, and it became doubtful whether we had got bottom in this, or in any other sounding. We have lost eleven shot to-day; once the line snapped at 300 fathoms, and once at 600 fathoms. I ought to say, rather, that the knots made by the rope-makers slipped. The twine seems to be of unequal strength, and sometimes parts without the slightest apparent cause; it may be that the knots have slipped on such occasions. I know that some knots have slipped, from hauling in the end, and finding it cut square off, whereas a fracture always leaves the strands of different lengths at the broken end. We have, at last, learned how to start the shot fairly, which is a point of great importance. Take three parts of the twine, for about fifteen fathoms, and lower the shot into the water carefully; hold back the reel (which is fitted with a crank, and stands upon a support,) until it takes the whole weight of the shot upon the three parts, eight or ten fathoms of which remain upon the reel; when all ready, let go the crank, and the shot descends without jerking; it is necessary to have a compressor upon the edge of the reel, to keep it from revolving too rapidly, as the line is apt to run off and get foul in such cases; a piece of old canvass in a man's hand, is probably the best thing of the sort that can be used. I am well satisfied with our reel, (which was made by Captain Platt's direction at the Boston Navy Yard,) and am also satisfied of the entire practicability of this mode of sounding, if you can get us *good* line; by good, I mean of *equal* strength. I send you a specimen of our twine, which easily bears the shot, but in some cases has parted with it when there has been no jerk, and no unusual duration of the strain. I should think that you might have good twine made of this size, of fine flax, and carefully knotted, or spun in one length, which would answer every requirement.

"Lat. obs. 30°05′ N., long. chro. 58°52′ W. Line run out 1,000 faths. Time running out 11 minutes. Temp. air 78°. Temp. water 74°. Lat. obs. 29°58′ N., Long. 58°48′ W. Line run out 1,500 fathoms. Time running out 28 minutes. Temp. air 72°. Temp. water 74°.

"December 12th. The experiments in sounding to-day have been signally unfortunate, and I much fear that no satisfactory result will ever be obtained with the line we have. In fact, it is only throwing away the shot, and is moreover a complete loss of time. We lay to two hours to-day, and achieved nothing.

"The 1st shot parted after running 7 minutes, at a depth of 600 fathoms; the fracture took place near the surface, and I send you the end that we hauled up. You will see how it untwisted, although it did not break there. The twisted end, with a single knot upon it, is where it broke, I think there was a knot there which slipped.

"The 2d shot parted at about 20 fathoms below the surface; no jerk, and the reel running freely. I send you the end that we hauled up, it has two knots near it. You will see that both this and the former are clean, sharp, cut ends. I think that this also was knotted and slipped.

"The 3d shot parted the line between the reel and my hand, when it had ascended 300 fathoms, and had been running about 2½ minutes. I send you the end, which has three knots near it. It is a decided break; though there was no reason why it should have broken: the reel was running freely, and no strain upon the line. It is though evidently a weak spot.

"The 4th shot parted the line at a great depth, when it had run out 550 fathoms, and had been running 5 minutes.

"The 5th shot parted in the same way, after 200 fathoms had run out.

"In these five experiments the line was *oiled*.

"The 6th shot parted the line after 200 fathoms had run out; the oiling was dispensed with in this case.

"The seventh and last sounding was made with an unoiled line, with three bars of iron lashed together, about 18 inches long, and weighing about 12 lbs. The line parted after running out 1,000 fathoms between the reel and my hand, when the weight was descending very slowly indeed; there was scarcely strain enough to turn the reel; it is evidently a *slip*, as you may see from the end, which I send you; it has seven knots near it. It had been running 22 minutes.

"I also send you two specimens, cut from our twine, to show you what sort of stuff has been sent to us. As a matter of strict fact, we are somewhat to blame for the slipping of knots, although we had no reason to suspect that they would slip before yesterday. Still, the makers should be rowed-up for being so faithless. By the way, we did not get the line until a day or two before we sailed, and had no chance to examine it carefully, and were even obliged to mark it in the greatest hurry. Capt. Platt was informed that it would be sent to him marked at every thousand fathoms, but it did not have a mark upon it. Send us good line, and we will give you as many soundings as you wish. The captain is much interested in the experiments, as you may see from the expenditure of shots; we have lost 25 in these few experiments, enough to show that the line is not trustworthy. A light weight gives very uncertain soundings, by reason of the great length of time it takes to run out, and the great drift in consequence.

"December 16th.—For several days past we have been overhauling the line, re-knotting it, and *waxing* it; to-day we made another experiment; the line run well, and parted at 1,600 fathoms. I have no doubt that the wax was of service to it, but the line is not suitable, and we did not deem it expedient to try it again to-day.

"Lat. obs. 21°34′ N.; Long. chro. 63°24′ W. Temp. air 84°. Temp. water 81°. Time the line was running out, 28 minutes."

"*December* 29*th*, 1850.—Since our last soundings, we have visited St. Thomas, Santa Cruz, and Ponce. We arrived at St. Thomas on the next day after taking the last sounding; the run from St. Thomas to Santa Cruz occupied about four hours, only, and the passage from Santa Cruz to Ponce was made in the night. We are now on our way from Ponce to St. Domingo. This afternoon we hove to opposite that portion of the Mona Passage between the west end of Porto Rico and Mona Island. We were successful in getting bottom, beyond a doubt, and the fact settles the question of our former experiments, and *proves that we have never before got bottom.* I judge entirely from the strain upon the line, after the shot stopped; the drift of the ship was sufficient to part it, and the strain was unlike any we have had before. Lat. 17° 54′ N., Long. chro. 67° 28′ W. 1200 fathoms of waxed line run out; drift about half a mile; time of running out, 17 minutes. Temp. air 81°; temp. water 84°. *One* shot expended.

"*January* 4*th*, 1851.—This morning we left San Domingo, and at noon being becalmed about nine miles from the land, we took advantage of the opportunity to get soundings. We got bottom with 370 fathoms up and down; time of running, 5 minutes. Lat. 18° 20′ N., Long., 69° 49′ W. Temp. air 80°; temp. water 82°. Line waxed. *One* shot expended.

"*January* 5*th*, 1851.—At 4 P. M., got another sounding. The line was waxed; it ran 19 minutes, and stopped at 1275 fathoms; got bottom, without doubt. Altavela in sight, Lat. 17° 16′ N., Long. 71° 26½′ W. Temp. air 82°; temp. water 82°. *One* shot; drift about half a mile.

"*January* 13*th*, 1851.—Yesterday we sailed from Aux Cayes. Hove to at noon this day, and made three unsuccessful attempts to get soundings.

The 1st shot ran about two mintues, and the line parted at 250 fathoms.

The 2d shot ran about three minutes, and the line parted at 300 fathoms.

The 3d shot ran 18 minutes, and the line parted at 1200 fathoms, *waxed line.*

Lat. obs. 19° 12′ N., Long. chro. 76° 05′ W. Temp. air 83°; temp. water 82°.

"*January* 14*th*, 1851.—Very fresh wind and the sea running too high for sounding.

"*January* 15*th*, 1851.—Same as yesterday.

"*January* 16*th*, 1851.—At 3.30 P. M. sent a boat to board a wreck lying upon the Colorados Reef; took advantage of the opportunity to sound, and got bottom with 420 fathoms line. Time of running 5 minutes; emp. air 82°; temp. water 80°; Lat. 22° 29′ N., Long. 84° 35′ W.

Attempted to verify the above cast, and in so doing the line parted at 280 fathoms.

On the next attempt a smart squall came up, causing us to drift very rapidly, and rendering the operation so uncertain that the result is not worth sending.

At 5 P. M. being about 3 miles from the first position we got bottom with 720 fathoms, the line being eight minutes in running out. Lat. 22° 32′ N., Long. chro. 84° 32′ W. Waxed line.

"*January* 28*th*, 1851.—Sailed from Havana yesterday. Hove to at noon to-day, and got bottom with 470 fathoms; waxed line; time of running about six minutes; Lat. 24° 05′ N., Long. 82° 05′ W.; temp. air 78°; temp. water 80°.

"*January* 29*th*, 1851.—Got bottom with 500 fathoms; waxed line; time of running about six minutes and a half; Lat. 24° 37′ N., Long. 79° 48′ W.; temp. air 79°; temp. water 79°.

We lost two shots in unsuccessful attempts, the line having parted in both instances; once at 280 fathoms and once at 360 fathoms.

"*Mem.*—Deep soundings will, I think, always be attended with great uncertainty if there should be a current. For as the shot descends its velocity decreases, and when its rate of running becomes equal to the velocity of the current, it is obvious that you cannot tell whether it is on the bottom or not, as the line will continue to go out at the same speed, indefinitely. Would it not? This idea suggested itself to me to-day; being in the Florida stream; I expected to have got much deeper sounding, and was reflecting upon the uncertainty attaching to them when my shot brought up and settled the question, as regards this case, beyond all doubt.

"*January* 30*th and* 31*st*.—Blowing very fresh and a heavy sea running; sounding impracticable. We regret very much that we could not have got a cast in the Florida Stream, abreast of the Bahama Bank, near its northern extremity. It would have been interesting to have compared it with the soundings of the 29th.

We are making a glorious run. During the 24 hours ending at noon to-day we ran 260 miles, and since noon (it is now 8 P. M.) we have averaged 12 knots. You will receive our abstract in due time. The Captain is deeply interested in your various investigations.

"*February* 1*st*, 1851.—Blowing a fresh gale from N. E. which prevented us from sounding. During the 24 hours ending at noon to-day, we ran 277 knots, and the observations put us still further on.

"*February* 2*d*, 1851.—Arrived at Cape Haytien in a fresh norther.

"*February* 6*th*, 1851.—Sailed from Cape Haytien at 7 A. M. this day. At noon got soundings in a calm; depth 640 fathoms; time of running 8 minutes 45 seconds. Position by bearing, Lat. 19° 57′ N., Long. 72° 11′ W.; temp. air 82°; temp. water 82°.

"*February* 7*th*, 1851.—Got a cast in the windward passage, midway between Cuba and San Domingo; the result is very uncertain owing to the drift of the ship. We got out 840 fathoms line, but could not tell with any degree of accuracy the depth of the water, although the shot was, doubtless, upon the bottom. The best results are obtained in calm weather, for then the soundings are perpendicular. But when the breeze is at all fresh, it is impossible to keep the ship from drifting rapidly, and from falling off so as to gather headway before she comes to again. In this way, if the shot should happen to strike the bottom as she begins to shoot ahead, many fathoms (perhaps a couple of hundred) might be paid out before she stops. Perhaps I make too large an estimate. I suppose that something of the sort occurred to-day, for there was so much slack line to haul in as to induce me to believe that it had parted, until we filled away, when it soon became apparent that the shot was fast. We shall seize the first convenient moment to try the experiment from a boat. It is almost throwing away the materials to sound from a sailing ship in anything like a fresh breeze, and yet we always reduce sail to topsails.

"*February* 18*th*, 1851.—Sailed from St. Jago de Cuba at 9 P. M. of the 16th inst. At 1 P. M. this day, in Lat. 15° 40′ N., Long. 77° 07′ W., got bottom with 1,300 fathoms, waxed line. Time of running about 17 minutes; temp. air 83°; temp. water 81°. Drift about one quarter of a mile.

This sounding is particularly satisfactory, as the ship was entirely still upon the water, at the moment the line stopped.

"*February* 19*th*, 1851.—At 5.30 P. M. got bottom with 600 fathoms, waxed line, in Lat. 11° 07′ N., Long. 79° 13′ W. Time of running 7 minutes; temp. air 82°; temp. water 82°. Drift at the rate of about a mile an hour.

"*March* 2*d*, 1851.—On the 20th ult. anchored at Chagres, from whence we sailed on the 22d. From that date to the 28th we were beating to the northward and eastward, in comparatively shoal water, and the greater part of the time, the wind was blowing a gale. On the 28th we kept away to the northward and westward, with a smashing breeze and a large sea on, which rendered sounding impracticable. The evening of the 1st afforded the only opportunity, but unluckily we were about passing between two dangerous shoals, (Baxo Nuevo and Saranilla,) and it was important to keep our reckoning correct by running; as it was, we did not get through the difficulty until 9 P. M. This has been a favorable day for the operation, and accordingly at 1.30 P. M. we got a cast which resulted in giving us bottom with 895 fathoms. Time of running 12 minutes; Lat. 17° 54′ N., Long. 80° 25′ W.; temp. of air 84°; temp. of water 82°. Drift about 200 yards.

At 5h. 15m. P. M. we got a second cast, which was taken in Lat. 18° 06′ N., Long. 80° 34′ W. We found bottom with 680 fathoms line; time of running 7m. 45s.; temp. air 83°; temp. water 81°.

The line was waxed in both experiments. We never lose a shot now in starting the line, and our experience has taught us to overhaul the knots carefully, while waxing the twine, so that it parts less frequently than formerly. Here are two points gained, at least.

"*March* 3*d*, 1851.—The day has been passed in the vicinity of the Grand Cayman, where we have procured a supply of turtle, &c. for the crew. At 5.30 P. M., when about 20 miles West of that Island, we made three unsuccessful experiments in sounding. The 1st shot ran 6 minutes and parted with 660 fathoms out. The 2d shot ran 5 minutes and parted with 585 fathoms out. The 3d shot ran 3½ minutes and parted with 377 fathoms out. I can assign no cause for the repeated parting of the line, unless it be that it is of unequal strength, and we have fallen upon a weaker portion than we have had of late. The next experiment may throw some light upon the subject.

"*March* 4*th*, 1851.—At 5 P. M. got bottom with 990 fathoms line; time of running 14 minutes 45 seconds; Lat. 21° 25′ N., Long. 84° 45′ W.; temp. air 82°; temp. water 80°.

"*Mem.*—In overhauling the line to-day some parts were found which were very deficient in strength, being easily broken by a light strain with the hand. It appeared as well as any other portion, and it is highly probable that the results of yesterday are attributable to a similar cause.

"*March* 5*th*, 1851.—We are now running towards the banks off Cape Catoche, (Yucatan,) and are not far from them. The captain thought a cast here would be important, and directed me to get one at 9 A. M. We found bottom with 445 fathoms line; time of running 4 minutes 40 seconds; temp. air 82°; temp. water 80°; Lat. 22° 05′ N., Long. 86° 22′ W.

"*March* 15*th*, 1851.—Having visited Sisal, Campeche, and Laguna, since my last date, running over the Campeche banks in from 8 to 10 fathoms, as we went from port to port. We sailed from the last named place this morning. At 5.30 P. M. being several miles outside of the deepest soundings laid down upon our charts, we got a cast which gave us bottom at 170 fathoms; the shot ran one minute and twenty-eight seconds; Lat. 19° 12′ N., Long. 92° 56′ W.; temp. air 82°; temp. water 78°.

"*March* 18*th*, 1851.—At 9 A. M. got bottom with 530 fathoms line; time of running seven minutes and fifteen seconds; Lat. 19° 30′ N., Long. 94° 30′ W.; temp. air 81°; temp. water 76°.

At 5 P. M. we got another cast, and found bottom with 967 fathoms line; time of runing eleven minutes and thirty seconds; Lat. 19° 37′ N., Long. 94° 49′ W.; temp. air 80°; temp. water 78°. We also lost two additional shots by the parting of the line; one in the forenoon, and the other in the afternoon. In each case we lost about a hundred fathoms of line or more.

These two soundings are as exact, in my opinion, as any that can be taken; the ship was perfectly still, and the line was nearly up and down.

"*April* 2*d*, 1851.—On the 17th March, we anchored at the Island of Sacrificios, near Vera Cruz, where we lay until the 28th, when we sailed for Tampico; the passage afforded no opportunity for sounding, as we ran down quite near to the coast. Yesterday, the 1st April, we sailed from Tampico for Havana; although very desirous to run a line of soundings across the Gulf, the weather to-day has been too rough for the operation, blowing fresh from E. N. E., and a heavy sea running.

"*April* 3*d*, 1851.—At 9 A. M. got bottom with 490 fathoms line, (waxed;) time of running six minutes and five seconds; Lat. 25° 56′ N., Long. 95° 51′ W.; temp. air 80°; temp. water 76°.

At 5 P. M. made *three* unsuccessful attempts to sound, the line parting, each time, at 385, 400, and 405 fathoms; the time of running was 4 minutes, three minutes 40 seconds, and 5 minutes 45 seconds, respectively. Owing to this discrepancy, I am forced to conclude that some mistake was made in marking the line. These old quartermasters are very liable to err, as you well know, though Peter Alverdron (our signal quartermaster,) repels such a supposition with disdain, and says the *line didn't run* so fast the last time as it did the first!

"*April* 1*st*, 1851.—At 9 A. M. got bottom with 725 fathoms, *waxed* line; time of running eleven minutes; Lat. 26° 58′ N., Long. 92° 58′ W.; temp. air 78°; temp. water 74°.

How can we account for the great difference in the quantity of line that runs out in equal intervals of time?

For example, on the 16th ult. we got 967 fathoms in thirty seconds more time only than we had to-day in getting 725 fathoms. I am sure of the time, and pretty sure of the correctness of the line. Can the density of the water vary, and produce this result?

"*April* 5*th*, 1851.—Got bottom with 982 fathoms line, (waxed;) time of running, 13 minutes 50 seconds; Lat. 26° 36′ N.; Long. 88° 56′ W.; temp. air 83°; temp. water 78° Drift about one-fifth of a mile.

"*April 6th*, 1851.—Got bottom with 810 fathoms waxed line; time of running, 9 minutes 50 seconds; Lat. 26°43′ N.; Long. 85°27′ W.; temp. air 81°; temp. water 78°. Drift about one mile an hour.

"*April 7th*, 1851.—Got bottom with 700 fathoms waxed line; time of running, 8 minutes 17 seconds; Lat. 25°23′ N.; Long. 85°19′ W.; temp. air 82°; temp. water 78°. Drift about one mile an hour.

We lost three shot, with about 200 fathoms line to each shot, by parting.

"*April 8th*, 1851.—Got bottom with 916 fathoms waxed line; time of running, 11 minutes 20 seconds; Lat. 24°39′ N.; Long. 85°12′ W.; temp. air 84°; temp. water 79°. *Calm.*

"*April 10th*, 1851.—Got bottom with 600 fathoms waxed line; time of running, 7 minutes 30 seconds; (up N. E. off N. by W., wind E. S. E., drift about a mile an hour.) I give you the above data, so that you may estimate what is due to the currents, in this position.

Lat. 23°47′ N.; Long. 83°32′ W.; temp. air 80°; temp. water 80°."

Lieutenant Taylor to Lieutenant Maury.

April 10th, 1851.

"My dear Sir: I improve the opportunity of a steamer to send you my fourth report of our sounding operations; you will perceive that we have got a line across the Gulf of Mexico, and that in no portion of the Gulf have we found quite 1000 fathoms. As we enter the Gulf of Florida, the depth diminishes to 600 fathoms. You will recollect that we found only about 500 fathoms between Havana and the Great Bahama Bank. I am just preparing a small reel of sewing silk, which I intend to have waxed, and marked (by knots,) to one thousand fathoms. I wish to try the experiment of sounding with it; having a small weight attached, to be determined by experience. We are now upon our last reel of twine, and I do not think we have more than 7000 fathoms remaining; so unless you have a new supply for us at Pensacola, we must stop the work. You will never find another captain, I really believe, who will go into the thing so heartily as Captain Platt does."

From these results we are entitled to infer, that this method of sounding, if not corrected for the effect of under currents upon the line, will make the ocean appear rather deeper than it really is. A cast is made; the shot reaches the bottom; and the twine during the descent is swept off in a bight by an under current, the precise quantity of line taken out by it, cannot be determined, and by the length of the line so taken out, we are left in fault as to the true depth. I regard this method, therefore, as an approximation. But as a general rule, the approximation falls within comparatively narrow limits, and usually on the same side, viz: in excess; so as to make the ocean appear deeper, rarely shallower than it really is. These deep-sea soundings, therefore, may be regarded as a step in the work of measuring the depth of the ocean, by assuring us that its depth is not beyond a certain extent.

Report of Deep-sea Soundings as far as the same have been received at this office, May 1, 1851.

Date.	Latitude. N.	Longitude. W.	Temp're.	Time.	Fathoms.	Drift.	Up & Down.	Rate.
	° ′	° ′	°	*m. s.*		*faths.*	*fathoms.*	*fathoms.*
December 6	38 38	66 31	68	27	1625 } No bottom. (brace spans these eight entries, down to 300)	00		60.2
" 9	33 34	61 38	72	63	*a* 1950	800		30.9
" 11	30 05	58 52	74	11	1000	00		90.9
" 11	29 58	58 48	74	28	1500	00		53.5
" 12				7	600	00		85.7
" 12				5	550	00		110
" 12				22	*c* 1000	00		45.4
" 12				2 30	300	00		120
" 16	21 34	63 24	81	28	1600 *w.*	00	1600*	57.1
" 29	17 54	67 28	84	17	1200 *w.*	440	1113	70.6
January 4	18 20	69 49	82	5	370 *w.*	00	370*	74
" 5	17 16	71 26	82	19	1275 *w.*	440	1203	67.1
" 13	19 12	76 05	82	18	1200 *w.*	00	1200	66.6
" 16	22 29	84 35	80	5	420	00	420*	84
" 16	22 32	84 32	80	8	720	00	720	90
" 28	24 05	82 05	80	6	470 *w.*	00	470*	78.3
" 29	24 37	79 48	79	6 30	500 *w.*	00	500*	76.9
February 6	19 57	72 11	82	8 45	640	00	640*	73.1
" 18	15 40	77 07	81	17	1300 *w.*	220	1280	76.4
" 19	11 07	79 13	82	7	600 *w.*	50	598	85.7
" 28	17 54	80 25	82	12	895 *w.*	100	885	74.5
" 28	16 06	80 34	81	7 45	680 *w.*	00	680	87.7
March 3	19 20	81 50		6	660	00		110
" 3	"	"		5	585	00		117
" 3	"	"		3 30	377	00		107.7
" 4	21 25	84 45	80	14 45	990	00	990*	67.1
" 5	22 05	86 22	80	4 40	445	00	445	96.7
" 16	19 30	94 30	76	7 15	530	00	530*	73.1
" 16	19 37	94 49	78	11 30	967	00	967	84
April 3	25 56	95 51	76	6 5	490 *w.*	00	490	80.5
" 4	26 58	92 58	74	11	725 *w.*	00	725*	65.9
" 5	26 36	88 56	78	13 50	982 *w.*	180	962	71.1
" 6	26 43	85 27	78	9 50	810 *w.*	150	795	82.6
" 7	25 23	85 19	78	8 17	700 *w.*	100	693	84.3
" 8	24 39	85 12	79	11	916 *w.*	00	916	83.2
" 10	23 47	83 32	80	7 30	600 *w.*	90	593*	80
Taney's sound'g	31 39	58 43	73	90	5700 *d.*	00	5700	63.3
Saratoga	28 21S	29 17		69	3100 *e.*	00	3100	44.9

* Is the supposition admissable that in these cases, the shot reached bottom, and that the effect of current upon the line, and of the drift upon the ship, was such as to make the sea appear somewhat deeper than it really is? The whole table authorizes the conclusion, that the rate of 74 fathoms per minute, for 5′—January 4th—is too slow. Subsequent observations will probably throw more light upon this point.

a. A 10 lb. lead, instead of a 32 lb. shot, and line oiled.

c. Weight 18 lbs:—three iron bars.

w. Line waxed.

d. Wire used with 10 lb. lead as weight.

e. Line of twine, three times size of Albany's, laid up; weight 32 lb. shot.

To this account, I have appended Lieut. Walsh's deep-sea sounding in the "Taney," with wire; and the "Saratoga's" deep-sea sounding in the South Atlantic. She had 100,000 fathoms of sounding line on board, of triple the size of that with which the "Albany" was furnished. She, much to my regret, went all the way from the United States to Rio, without getting a single cast. The "St. Mary's" was supplied with twine like that of the "Albany;" she went around Cape Horn, and reported from Rio on her way, that she could do nothing in the way of deep-sea sounding with such twine.

There is a general agreement in the "Albany's" soundings of December 6th and 16th, and the second one of the 11th. They were made with the line dry and unwaxed. And though it was thought at the time, that soundings were obtained, yet subsequent experiment satisfied both Capt. Platt and Lieut. Taylor, that the results were not to be relied on. I am also well satisfied that bottom was not reached.

Those soundings, each of about the same duration—27 or 28 minutes—give nearly the same depths and the same rate. See the column Rate, for the rate in fathoms per minute, at which the shot descended. These would seem to repudiate the soundings of December 9th, in which with a 10 pound lead for the weight, 325 fathoms more of line only ran out in one hour and three minutes, than ran out on the 6th, in 27 minutes.

At first these soundings suggested the inquiry; did not the shot reach the bottom on all four of the occasions; and was it not the sweep of the current below, probably the cold current from the North, which theory suggests to be running counter to the Gulf Stream, which continued to take the line from the reel after the shot was landed?

The soundings of December 29th, January 15th, and February 18th, were made with waxed line. Time, depth and rate, all show considerable agreement, notwithstanding there is not a perfect accordance as to circumstances. At the casts of 17 minutes, there was drift—more at the first than at the last.—At the 18 minute sounding, there was no drift, still the rate of descent during the 18 minutes, is less per minute, than during either of the two others; which, as the rate is in a decreasing ratio, in consequence of the increased resistance afforded by an increasing length of line, which the shot has to drag after it, shows reasonable conformity.

It is worthy of note, that these three casts were made in that part of the ocean in which Lieut. Walsh discovered that remarkable under-current, which ran off with his barrega, and excited to such a pitch the astonishment of the sailors.

The strain of an under-current would be very great on a great length of line. Persons, who are not familiar with the force which a current exerts upon the bight of a rope, as for instance, when the two ends are made fast on opposite banks of a river, and the middle suffered to get into the current—may form some idea of that force by calling to mind the action of the wind upon the string of a kite.

If we imagine still water to be above and below a submarine current intercepted in one of these soundings, it will readily be perceived, how, after the shot has passed through this current, and is still descending, it will have to draw the line after it in the shape of a loop. In this case, the resistance afforded by the line would be greatly increased, and it would go out with whatever rate the shot might have, *plus* twice the rate of the current *nearly*.

Again, when there is both an upper and an under-current, but in opposite directions, the shot instead of having to draw the line down as a curved or crooked line, would, if the two currents were equal, have to draw it down as a straight line, but along an inclined plane. In this case, the shot would sink slower, but the line would run faster off the reel than it would were the shot going through still water, and drawing the line off normally. In this case, the effect of the two currents upon the descent of the shot and the rate of the line, would be very nearly as though there were only a surface current, with the joint velocity of the hypothetical upper and lower currents.

If we add to the effect of this supposed surface current, the drift of the vessel also, we shall be ready to appreciate the effect of this motion upon the reel, and the rate at which the twine runs off from it.

Now if we imagine the shot to have reached the bottom, then the effect would be what those who have attempted these experiments have all witnessed, viz: a continually paying out of line, and finally a break.

Imagine the effects of an under-current, running no faster even than half a mile an hour, but operating upon the bight of a line some 3000 fathoms long. The leverage in such a case is immense; it is that so well known to sailors as "swigging off;" and the strain in such a case would be sufficient to part very strong lines.

Hence the value of the check, derived from carefully timing the rate of descent through various depths at every cast;—and of all vessels using the same sized shot for weights, and twine of the same texture, manufacture and kind for the sounding line.

A faithful record of this sort from our men-of-war as they cruize in various parts of the world, will enable us to determine with a degree of probability, to be not easily weakened, as to the relative velocity of the under-currents in different seas, and in various parts of the same sea.

Returning now to a little further consideration of the table of soundings, p. 84, we perceive by running the eye up and down the columns—"Time," "Fathoms," and "Rate,"—that in those soundings with waxed lines, (*w*,) of near 7 minutes each, the rate of descent is 80, 86, 88 fathoms, respectively. The 80 fathoms rate being in the Gulf Stream, and being the only one exposed to so rapid a current.

The sea here is, therefore, probably not quite as deep as this sounding would represent it.

The April soundings are from West to East, nearly across the Gulf of Mexico. They appear to be sufficiently accurate to authorize the opinion which has been already expressed, viz: that the basin of the Gulf in the deepest parts is a little over one mile, (880 fathoms) in depth. The very deepest part has not yet been probably reached.

The western half of the Caribbean basin is probably not so deep, but its eastern half may be deeper.

Could we obtain with every sounding in these two basins, specimens of the bottom, we might expect to gain light from them and this plan of sounding together, which would enable us to comprehend much more clearly than we now do the system of aqueous circulation of these two basins; we should discover where they are silting up; and with the aid of the microscope, we should probably recognize in one place, deposits brought from the grand South American, and in another, deposits brought from the great North American, system of river basins.

The mariner might then hail the Geologist and say, "come and see. Here the Amazon and the Orinoco are secretly at work in the recesses of the sea; here, the turbulent Mississippi—and here, sub-marine currents, are busy in laying the foundations, on a grand scale, of sedimentary formations, which at the next chime of the geological clock are to rise up from the ocean, to bewilder and amaze Geologists with the variety, the extent, and the richness of their organic remains: fossil palms and infusoria from the Amazon; reptiles from the Orinoco; birds from the Rio Grande; plants and creepers from the Upper Missouri; pine, beach and ash, from the Mississippi; —heaped up with wrecks of steamers and skeletons of man and beast, will all in the remote future be found imbedded together in the same deposit."

The deep-sea soundings of the Albany are already casting glimmers of light upon our investigations as to the currents of the Gulf of Mexico. The sounding of April the 7th, is significant in this connection.

I had already traced the current that flows through the Yucatan Pass on its way to feed the Gulf Stream, and remarked the sharp turn made by it in the middle of the Gulf near the place of this sounding. This remarkable elevation in the bottom, would seem in this connection, to indicate that the Mississippi is pushing out its silty barricades to keep back these salt water waves, and to protect its own formations from the violence of this mighty current of the sea.

To say the least, and to speculate no further than may be necessary to show how rich and inviting is this field, that I may tempt more laborers into it, I may be permitted to remark that no attempt to investigate the currents of the sea, or to comprehend the system of aqueous circulation that is maintained in the ocean, can be crowned with success, unless it include in it also the depth and shape of the oceanic basins.

A few ships in the different oceans, with such a corps of observers as the officers of the "Albany" have proven themselves to be, would in a short time enrich our knowledge in this respect, to a vast extent.

Deep-sea Soundings across the Atlantic.

In the delays for proof reading, I have an opportunity of enriching the account of these researches into the depths of the ocean, by communicating the results of a line run nearly across the Atlantic, by the United States ship "John Adams," Captain Barron.

I am permitted by Commodore Warrington to copy Capt. Barron's official report to him upon the subject, and I throw myself upon the indulgence of the Captain for taking the liberty of publishing his very interesting private letter, touching his work.

Captain Barron to Commodore Warrington.

U. S. Ship John Adams, Madeira, *May 29th*, 1851.

"Sir: I have the honor to report the following "Deep-sea Soundings," viz:

May 3d—Lat. 33° 50′ N., Long. 52° 34′ W. Temp. air 64°; water 65°. Had a fair "up and down" sound with (2600) twenty-six hundred fathoms of line. Time of running out, 1 hour 23 minutes and 10 seconds. One 32 pound shot on the line.

May 9th.—Lat. 32° 06′ N., Long. 44° 47′ W.; Temp. air 66°; water 68°. Got bottom with (5,500) five thousand five hundred fathoms of line out. Time of running out, 2 hours 44 minutes 28 seconds. Drift of ship 3 miles. Lost two 32 pound shot, and 5,500 fathoms of line.

May 10th.—Lat. 31° 01′ N., Long. 44° 31′ W. Temp. air 68°, water 68°. Got bottom with (2300) twenty-three hundred fathoms of line out. Time of running out, 1 hour 4 minutes 35 seconds.

May 17th.—Peak of Pico bearing N. 18° E., distant 24 miles. Found bottom with (670) six hundred and seventy fathoms line. Time of running out, 12 minutes 4 seconds.

May 21st.—Lat. 35° 07′ N., Long. 25° 43′ W. Temp. air 65°, water 64°. (1,040) one thousand forty fathoms line—found bottom. Time of running out, 19 minutes 58 seconds.

We have made frequent other casts, but in consequence of the severe motion, and large drift of the ship, without any satisfactory results."

Captain Barron to Lieut. Maury.

JOHN ADAMS, at sea, *May 3d*, 1851.

"MY DEAR MAURY—Yesterday for the first time, I had a fair chance at a *deep-sea* sounding, the results of which were in every respect satisfactory. The line and reel are quite perfect, having met with no accident or impediment whatever, for which success we are indebted to—after the makers of the line, (Plume & Co.,) and the admirable reel—the hints given us by the experience of Lieut. Taylor in the "Albany;" all of his precautions having been adopted by us. Mr. I. Higgins, our master, is a young man of fine qualifications in his profession, and seems anxious to get at satisfactory results in these experiments. In Lat. 33° 55′ N,, Long. 52° 34′ W.; Temp. air 64°, water 65; we got a fair up and down sound of (2600) twenty-six hundred fathoms of line—(2700) twenty-seven hundred fathoms out. Time of running out, 1 hour 23 minutes 10 seconds, *and bottom without a doubt.* It was very nearly a calm, and after hauling in about 100 fathoms of line, it "grew up and down;" the line did not part till we had reeled 400 fathoms, losing 2,300 fathoms of line. The quartermasters and officers are of opinion, that if the ship had been perfectly steady, we might have brought the shot up, but there being considerable swell on, when her stern lifted, and rolled to leeward, she brought such a sudden strain on the line that it snapped. While the shot remained on the bottom, I could draw it along with my naked hand, but so soon as it lifted, I could not move it with a glove on, the weight was so great, and the pain to my hand so severe. One of our quartermasters, as strong a man as we have aboard, could not raise the shot *an inch*, at 2,000 fathoms depth.

I made an effort to get you a cast in the middle of the Gulf Stream, but it was blowing so strong a gale that I found it quite impossible to do anything. In "luffing to" to take the third reef in our topsails, we ran out a thousand fathoms, but finding her drift so much, and the motion so sudden and severe, that we snapped the line. On the 28th April, in Lat. 34° 35′ N., Long. 67° 41′ W., we brought the ship to, and ran out three thousand fathoms of line in one hour, without getting bottom. The line parted, after running all off the reel but about forty fathoms. We have now 5,000 fathoms on the reel, and after getting a few hundred miles deeper into the Atlantic, I shall put on 7,000 fathoms, in order to go beyond the greatest depth ever yet attained. Our apparatus is so complete, that I see nothing to prevent it.

May 4th.—Sounded to-day in a calm—line got foul of the rudder, when 2,000 fathoms were out, and parted—put two shot on to the remaining 3,000 fathoms, which ran out rapidly—no bottom—5,000 fathoms line lost to-day.

May 7th.—Weather too rough for sounding till to-day. From the first fair sound, which was "up and down," the officers have become very much interested. To-day we sounded, and got bottom with five thousand and five hundred (5,500) fathoms of line. Time of running out, 2 hours 44 minutes 28 seconds. Lat. obs. 32° 06′ N., Long. 44° 47′ W. Drift 3 miles. Temp. air 66°, water 68°. Used two 32 pound shot. Lost 5,500 fathoms of line. It is difficult for us to say what our up and down sound was. The other sound that I have given you, was in almost a calm, and the sound was "up and down," and no mistake. After the shot took the bottom to-day, the quartermaster held the line in his hand *three minutes* without any difficulty. We all had a feel of it, and it was determined that no line would run off the reel, but that taken off by the ship's drift, and that she would take off by her drift the line as long as we would let it run; but of course *much slower when on the bottom;* this might not be the case, particularly when *checked* for *three minutes,* with the weight of two 32 pound shot attached, and 5,000 fathoms of line out, if it was not on the bottom.

	h.	m.	s.
Cast at	9	22	32
2,000 fath.	10	02	20
3,000	10	30	18
4,000	10	59	30
5,000	11	44	30
5,500	12	07	00

May 10th.—Breeze so light as to be almost a calm; occasional "catspaws" prevented our getting an up and down sound. Got bottom with 2,300 fathoms of line—Lat. 31° 01′ N., Long. 44° 31′ W. Air 68°; water 68°. Time of running out, 1 hour 4 minutes 35 seconds. Drift.—

When we commenced to haul in the last time, I hauled in some four or five fathoms with my naked hands; after getting in some forty or fifty fathoms, the line became as stiff as a bar of iron, and it required the *full strength* of a very stout man to *turn* the *crank* of the reel—of course, the line soon parted. We lost 2,200 fathoms.

The last sound which we attempted in a moderate top-gallant breeze, the motion of the ship was so severe, and the drift so considerable, that I found we might easily have lost the whole 7,000 fathoms without a result. This has determined me to husband the 10,000 fathoms of line now remaining for casts, when the prospect for something satisfactory is more promising.

May 17th.—Peak of Pico N. 18° E., distant 24 miles. Sounded in 670 fathoms water; lost the whole quantity of line out.

May 21st.—Lat. 35° 07′ N., Long. 25° 43′ W. Temp. air 65°, water 64°. Found bottom with 1,040 fathoms line. Time of running out, 19 minutes 58 seconds.

May 29th.—Madeira—arrived here day before yesterday—shall sail in one week for Porto Praya, where we shall find Commodore or orders. Expect to return here in October. I have 7,000 fathoms of good line left, and shall give you some soundings along the Coast, and perhaps across to St. Helena." * * *

The soundings of the "John Adams" confirm the conjecture of Captain Platt of the "Albany," that he did not get bottom on the 6th and 9th December, for not far from his position on those days, Captain Barron, with the experience of the "Albany" to guide him, reports a sounding of 3,000 fathoms—18,000 feet without bottom.

The great sounding of 5,500 fathoms of May the 9th, corrected for drift, gives 28,950 feet, as the greatest depth at which the bottom of the ocean has ever been reached. Lieut. Walsh in the "Taney," went deeper, but he got no bottom.

This sounding of the "John Adams," carries internal evidence of its correctness. The rate of descent given for the depths of 2, 3, 4, and 5 thousand fathoms, is a decreasing rate, and it conforms with the rate of the other soundings generally.

The average rate of descent for the first 2,000 fathoms of this sounding was 50.4 fathoms a minute, whereas the rate of descent for the sounding (2,300) fathoms of May 10th, was only 32 fathoms per minute.

Hence, I infer that the shot—May 10th—had reached the bottom sooner than was expected, for this cast was only 67 miles from that of 5,500 fathoms the day before, and the officers, doubtless, did not expect the shot to reach the bottom so soon. The drift of the ship, probably, continued to take the line out after the shot had reached the bottom, for that it was on the bottom, the great strain felt upon the line leaves no doubt.

My inference is, therefore, that the sea here is *not* 2,300 fathoms deep, while it is more than twice that depth 60 miles further to the North.

Here is a new feature brought out as to the depths of the ocean, and one which we were not prepared to anticipate; at least I had always supposed that the bottom of the sea generally, was somewhat regular in outline, passing gradually from deep to shallow, and from shallow to deep; that the exceptions are such as we find near the land, being confined mostly to its immediate vicinity, and that the precipices to be found in the depths of the ocean seldom exceeded a few hundred feet in descent.

But judging from these two soundings of May 9th and 10th, we perceive that we should not now be surprised if this system of observations should shew that the shape of the earth's crust at the bottom of the sea is quite as irregular in its outlines, in elevations and depressions, in its mountains and its valleys, as is the face of our continents.

Indeed after plotting the soundings of the "John Adams," and comparing them with the "Taney's" and the "Albany's," we find we have just enough to whet curiosity and create an eager impatient desire for more. And I am happy to add, that Lieut. S. P. Lee, has been just ordered to the command of the U. S.

Brig "Dolphin," for service specially relating to this subject, and other matters connected with my researches. Lieutenant Lee is a highly accomplished and intelligent officer. His being selected for this service, may be considered as a mark of the high estimate placed upon his fitness for it, by the Navy Department. Much interesting information may be anticipated from his cruise in the "Dolphin."

The Storm and Rain Chart.

Letter E of the series,—the Storm and Rain Chart,—was commenced for the North Atlantic by Lieutenant Wm. Rogers Taylor, U. S. N., and in his absence at sea in the "Albany," has been continued by Lieutenant Wm. H. Ball.

The object of these charts is to show the total number of observations that have been discussed for each month, in every space of 5° square in the ocean; and then to show for every square and month, the number of days each in which there was a rain, a calm, a fog, thunder and lightning, or a storm and the quarter whence it blew.

This series is not yet ready for the press, though a vast amount of labor has been bestowed upon it as well as upon the others.

The manner in which these observations are collected from the quarry of Log-books,—brought together and discussed, and the officers at work upon them, reminds one of the sculptor: any single stroke of the chisel, however well directed, does but little towards developing the figure which in due time is to stand out from the rude mass upon which he is engaged; so with these observations: any single one, however accurate, is in itself worth but little. It is only by oft-repeated observations multiplied and brought together in sufficient numbers to express their own meaning, that satisfactory and significant results can be obtained. Then, like the piece of statuary to the repeated touch of the chisel, the charts speak for themselves, and all at once stand out before the compiler, eloquent with facts which the philosopher never dreamed were lurking so near.

Among the various phenomena presented in the course of these investigations, some have pointed to the moon and suggested the inquiry: Has the declination of the moon any influence upon the bands of trade winds and calms, by moving the edges of their zones up and down the ocean, or by accumulating an excess of atmosphere, first in one hemisphere, then in the other, according as the declination be North or South.

The abstract logs will in the course of time afford observations enough probably to enable me to answer this question, for it is one of those questions to which a satisfactory reply, either in the affirmative or negative, is equally desirable.

The investigation of this problem was assigned to Passed Midshipman Mathews. His researches related entirely to the Atlantic. Before he had completed it, he was ordered away to sea; and I have not had force since to continue them. But I am apprehensive that the true answer to the question will be so masked by the effects of other causes in moving these trade wind bands up and down the ocean, that its purport will not be perceived.

Perhaps the Pacific ocean, when there shall be observations enough made in it, will enable me to put this question to rest.

Plate III is a sample of the Storm and Rain Chart.

As in the other cases, so in this: the ocean is divided out into districts of 5° of Lat. by 5° of Long. for these investigations, and whatever phenomenon is reported as occurring in one part of a district, is assumed to occur in all parts of that district.

Between each pair of meridians having a space of 5° between them, are 12 lines, for the twelve months, always beginning with December, the first winter month; and horizontally between each pair of parallels for each 5° there are 13 lines, eight of which are for gales from the eight semi-quadrants—one for the calms—one for rain—one for thunder and lightning—one for fogs, and the other for the number of observations, called days, which have been observed for each month and district. These last are expressed in figures, (See Plate III,) and the others according to the method of "fives and tallies," already explained for other charts.

Three observations make a day; so, in order to see how many days of observation have been discussed for any month, it is necessary to divide by three the number which stands in the column for the month and on the line marked "days."

The object of this chart was to show the exceptions to what may generally be considered the prevailing condition of the weather at sea, and to determine from what quarter storms are most liable to occur for each month in every district.

It may be that mariners do not *always* record in their logs rain, fog, thunder or lightning. They do always mention gales and calms, and the quadrant whence the wind blows: It may, therefore, be probable that both rains and lightning occur at sea more frequently than it would appear by the chart they do; if so, I have at present no means of knowing. But it may be presumed that mariners generally are not more apt to neglect to mention rains, thunder and fogs, in one part of the ocean than the other, and that therefore, the relative frequency with which they occur may be supposed to be fairly indicated on the chart.

But as the chart is a fair exponent according to the data from which it is constructed, as to the frequency of the phenomena to which it relates, we are bound to give it as much faith and credit in one respect as in another, and therefore, to assume until we have reason to suppose it otherwise, that the occurrence of rain, fogs and lightning, is fairly represented in point of frequency.

The scores designate not the times that it thunders or rains, or blows a gale, but simply the number of days on which such phenomena have been reported to occur; as an example, a gale may be accompanied with fog and rain, thunder and lightning, in which case a score would be made in the appropriate places for each.

The districts represented in Plate III by A, B and C, extend from 30° N. to 45° and from 55° W. to 60° W. Those represented by D, E and F, extend from the equator to 15° N., between the meridians of 25° and 30° W.

This plate also affords matter that is interesting to sailor philosophers.

Examining district F, it appears that rains and calms, and N. W. gales abound from Dec. to May, inclusive. That lightning is never seen, nor thunder heard there from April to September inclusive;—that in October there is an occasional gale from the eastward; and that from June to September may be called a rainless season, during which period there is rarely a calm and never a gale, nor a thunder cloud to disturb the air.

This is because the equatorial calms and their train of atmospherical disturbances have gone up, as shown per trade wind charts, into district E. The rainy season in E is the dry one of F: It may be said that E has two rainy seasons, one for about 2½ months before August, the other for three months after.

It appears from D that the rains commence before the calms and continue after them. That from December to March is a rainless period, and that an electric display from the clouds is a rare occurrence at any time of the year in this district.

Now going to A, the first thing that strikes us is the prevalence of fogs, the regularity of precipitation, the almost total absence of gales in June and July, the scanty rains in the former month, and the abundance of the materials from which these facts are drawn.

Contrasting this with B we find that July and August are the months which are most exempt from storm and rain, fogs and thunder; that calms rarely occur in January, February, March and April, July and August, October and November.

In district C, storm and rain seldom occur in April, May, June and July. But it is needless to repeat what the chart *tells* so plainly at a glance.

The September Gale of 1850.

My attention was first called to the great September gale of 1850, by Lieut. B. J. Totten, U. S. N., and afterwards by Mr. W. C. Redfield of New York.

As I afterwards received a number of Log-books from ships that were in various parts of the North Atlantic during the gale, I have thought it would be a matter of some interest to quote extracts from them.

At my request, Passed Midshipman Fillebrown has represented, on Plate IV, the force and direction of the wind, as reported by various ships in different parts of the ocean about the time of the gale. The direction in which the wind hauled is represented by curved arrows, pointing to that direction. The tracks marked a, b, c, and so on, on the plate, are the tracks of the ships lettered in like manner in the following extracts from the Log-books. All the tracks were not projected in the chart, on account of appearance. With this explanation, Plate IV, and these extracts from the Log-books, are left to speak for themselves.

Extracts from Log-books.

(a.*) *Sir Edward Barry, New Margaret, of*

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
1850. September	4	° ′ ″ 17 10 48 N.	° ′ 26 17 W.			29.60 to 29.40 to 29.10			E. N. E.
(b.) *Ship Horatio,*									
1850. September	4	° ′ 12 14 N.	° ′ 45 25 W.				80	83	N. W.
	5	13 40	48 00				80	83½	N. E.
	6	15 17	50 40				81	83	N. E.
	7	17 05	53 35				83	83	N. E.
	8	18 56	56 20				81	83½	N. E.
	9	20 56	59 15				81	83½	N. E.
	10	23 00	62 15				82	83	N. E.
	11	25 15	64 25				82	83⅓	N. E.
	12	26 45	65 55				82	84	N. by E.
	13	27 07	66 25				82	83½	E.
	14	28 15	67 10				82	84	S. W.
	15	30 26	68 20				80	82	W.
	16	32 04	69 32						S. W.
	17	33 24	69 10				76	79	N. E.
	18	36 00	70 56				74	78	S.W.,S.S.W.,S.
	19	36 22	71 12				74	77	N. N. E., N.
	20	38 31	71 24	Gulf.			●		N. W.
(c.) *Barque Mason Barney,*									
September	4	19 22 N.	53 35 W.	None.		29.90	85	80	E. N. E.
	5	20 39	55 08	None.		29.90	85	80	E. N. E.
	6	21 32	56 15	South 10′		29.95	84	81	E. N. E.
	7	22 33	57 31	None.		29.98	84	81	N. E. by E.
	8	23 25	58 30	None.		30.00	84	81	N. by E.
	9	24 58	59 51	None.		30.00	84	81	S. E.
	10	26 30	61 30	None.		30.00	84	81	E. N. E.
	11	28 14	63 12	N. 51° W. 16 m.		30.08	85	80	E.
	12	29 45	64 39	None.		29.98	85	79	E.
	13	31 15	65 33			29.87	79	79	S. W. by W.
	14	31 50	66 00			29.86	75	78	Baffling westerly.
	15	33 08	67 22			29.64	79	77	S. E.

*Those that are lettered, have their tracks projected on Plate IV.

Squires, Master.

Liverpool.

Extracts from Log-books.

WINDS. Middle Part.	WINDS. Latter Part.	REMARKS.
		Particulars of a hurricane encountered in September last, near the Cape de Verd Islands.
E. N. E.	E. N. E.	"The Sir Edward Barry, Squires, Master, and the New Margaret, of Liverpool—San Antonio bearing E. S. E., dist. about 60 miles—Sept. 4th, were both dismasted about 30 miles from each other. The following particulars are from the Master of the Sir Edward Barry." "The day commenced with fresh trades and unfavorable appearances—rough sea—Bar. 29° 60′—wind E. N. E. At 3 P. M. wind increasing—Bar. falling 29.40. At 5 P. M. Bar. still falling—appearances more unfavorable—brought to under bare poles on port tack—wind blowing at the time with great violence—Bar. 29.10. Before midnight the mizenmast was broken off at the futtock band—mainmast do.—foremast sprung—topmast gone—no material injury done to the hull—She was nearly new, A 1, and in first-rate order, when she left port—Both bound for China—put into port for repairs."—*Lt. B. J. Totten, U. S. N., to Lt. Maury.*

Jos. W. Crocker, Master.

W.	N. E.	Moderate breezes with heavy squalls and hard rain—Ends fair.
N. E. by E.	N. E.	Light trades with fine weather—Smooth sea.
N. E.	N. E.	Brisk trades with passing clouds—Smooth sea, no rain.
N. E.	N. E. by E.	Brisk trades—fine weather—passing squalls.
N. E.	N. E.	Brisk trades and fine weather—Saw gulf-weed.
N. E.	N. E.	Brisk breezes with a rough sea—Some rain.
N. E.	N. E.	Strong trades with fine weather—Light squalls.
N. E.	N. E.	Brisk trades with fine weather—Light squalls.
N. N. E.	N.	Light and baffling airs—Calm.
Calm.	E.	Light airs.
Calm.	S. W.	Moderate breezes—Hazy in N. W.—Thunder and lightning in N. W.
S. W.	S. W.	Hard squalls from West—Ends with brisk breezes, and hazy.
Calm.	N.	Heavy squalls—Ends brisk breezes—Swell from S. W.
S. W.	W. S. W.	Middle calm—Thunder and lightning.
SS.E., SE., E.S.E. 4 hours each.	E. N. E. N. W. 16 hours.	Moderate breezes—heavy squalls.—Much thunder and lightning, remaining at each point of the compass for three hours—Strong gale with heavy squalls—Thunder and lightning.—Strong gale—little sea—heavy squalls with rain.
S. W.	W. S. W.	Strong and squally—thunder and lightning—heavy rain. Following day moderate from N. W. to N. N. E.

F. B. Langston, Master.

N. E. by E.	E. N. E.	Throughout, light winds and fine weather. Symp. 29.00.
E. N. E.	N. E.	Throughout, light winds and fine weather. Symp. 29.00.
E. N. E.	N. E.	Throughout, a light breeze and fine weather. Symp. 29.08.
N. E. by E.	Baffling to N.	Throughout, light winds and passing clouds. Symp. 29.12.
Variable.	S. E.	Commences with moderate breezes and light passing clouds.—At 9 P. M., wind veered to S. with dark and heavy clouds hanging to N. W.—with vivid lightning. Thunder to N. W. —Ends clear.
E.	N. E.	Throughout, moderate winds and clear weather. Symp. 29.10.
Variable.	S. E.	Moderate breezes and fine weather. Symp. 29.12.
"	S. E.	Moderate breezes and passing clouds. Symp. 29.12.
S. E.	S. W.	Light winds and fine weather. Symp. 29.18.
W.	W. and variable.	Commences with clear weather. At 2 A. M., squally appearances—Ends with light baffling airs and thick rain.
Baffling.	Baffling.	Throughout, light baffling winds and cloudy with rain.
Baffling from W. to S. W.		First part, a light breeze and dark rainy weather—Midnight wind baffling—Ends with a fresh gale from S. W. and violent squalls.

Extracts from Log-books. (d.) *Ship White Squall,*

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
1850.		° '	° '				°		
September	4								
	5								
	6	40 6 N.	70 50 W.			30.20	76	Thermometer left behind.	South.
	7	39 41	68 23			30	74		S. S. E.
	8	No obs.				29.50	75		S. S. E.
	9	39 24				30.10	76		Southerly.
	10	38 24				30.15	78		
	11	38	62 57			30.20	78		
	12	36 53	58 1			30.20	77		S. W.
	13	35 24	53 45			30.20	78		S. S. W.
	14	33 50	50 30			30.25	79		South.
	15	32 59	47			30.25	79		

(e.) *Ship Fanchon,*

September	4	39 39 3 N.	60 4 15 W.	1 k. N. E.		30.	72	77	S. W.
	5	39 14 29	57 4 30	1 k. N. E.		30.	75	75	S. W.
	6	38 37 46	55 14 15		14° W.	30.	73	75	W. by N.
	7	37 48 54	53 42 5		12 14	30¼	73	76	N. E. by N.
	8	36 48 22	52 27 45		13 30	30¼	74	75	N. E. by N.
	9	36 38 21	51 40 15			30.	74	75	S. S. E.
	10	35 38 45	46 35 45			30.	74	75	S. W. by S.
	11	34 54 7	43 13 30		15 33	30.	74	73	W. S. W.
	12	34 21 20	42 2 30			30.	72	74	N. W. by W.
	13	33 53 56	40 19 45			30.	73	74	Variable.
	14	33 23 32	39 5 15		16 55	30.	73	74	S. W.
	15	33 18 31	38 23 15		20 04	30.1	79	76	S. W. by S.

(f.) *Packet Ship Independence,*

September	4	39 56 N.	56 25 W.	1 knot, E.	2	30.20	80	76	North, light.
	5	40 48	56 48		2	30.12	80	75	W. N. W., light.
	6	41 00	58 15	Very little.	2	30.10	76	75	North, *very light.*
	7	41 11	59 30		1¾	30.25	72	74	Calm.
	8	40 52	63 40		1½	30.05	72	74	South, fresh.
	9	40 20	64 00		1½	29.70	69	69	W. N. W., *gale.*
	10	39 34	64 45			30.12	69	69	Calm.
	11	39 34	66 37			30.15	67	69	E. S. E., light.
	12	39 51	68 42			29.90	74	74	N. W., fresh.
	13	39 26	69 36			29.90	60	63	N. W. moderate.
	14	39 25	70 25			29.90	64	65	Calm.
	15	39 43	71 38			29.95	66	65	N. N. E., light.
	16		Passed Sandy Hook at noon.						East.

(g.) *Royal Mail Steamship Asia,*

September	4	51 02 N.	32 50 15 W.	S. 39° W. 8 miles.	35 W.	29.50	61	59	S. by E.
	5	49 40	40 16 15	S. 33 E. 4 miles.	36	29.40	60	61	S. S. E.
	6	47 44	47 16	East 19 4 miles.	35	29.70	55	51	N. N. E.
	7	46 10	54 20	S. 29 W. 4 miles.	30	30.	55	56	North.
	8	44 53	61 01	S. 24 W. 35 m.	22	29.90	62	64	West.
	9	At 0.45 p.m. Sambro bore N. N. E. ¾ mile distant.				29.70	60	61	West.
	10	41 03	68 3	S. 30° E. 5 miles.	19 to 10°	30.	57	55	West.
	11	At 10.45 off the wharf, Jersey City.				30.	58	56	S. W.

B. Lockwood, Master. *Extracts from Log-books.*

WINDS.		REMARKS.
Middle Part.	Latter part.	
	S. S. E.	At 2 P. M. passed Sandy Hook—Moderate southerly winds.
		Moderate weather.
	West.	Strong heavy gales—Lost maintopmast.
	Variable.	Squally, rainy weather.
		Rainy weather.
		Rainy weather.
S. W.	S. W.	Strong breeze through twenty-four hours.
S. S. W.	S. S. W.	Strong breeze through twenty-four hours.
	South.	Moderate weather throughout.
		Moderate weather throughout.

George Lunt, Jr., Master.

S.	S. W.	Moderate breezes, and pleasant—Saw gulf-weed.
W.	W. by N.	Fine breezes, and pleasant—Saw gulf-weed.
Baffling.	N. E. by N.	First part pleasant—Middle part squally, with thunder and lightning—Ends pleasant.
N. E. by N.	N. E. by N.	Moderate breezes, and pleasant.
E. S. E.	S. E.	Wind moderate—Gradually hauled to S. E.
S. E. ¼ E.	S. W. by S.	Fine breezes and pleasant—An abundance of weed in sight.
S. W. by W.	W. S. W.	Strong winds and pleasant—Saw gulf-weed.
S. W.	West.	First part stormy—Mid. part moderate—Latter light—From 2 A. M. to 8 rain.
N. E.	North.	Winds light and variable—Heavy swell from N.
Variable.	S. W.	Light airs, and variable—Heavy swell from N.
S. W. by S.	S. W. by S.	Light airs, and pleasant—swell not so heavy.
Calm.	Baffling.	Light airs, and baffling throughout—Plenty of weed in sight.

H. Knight, Master.

N. W. by N.	S. W., very light.	Fine weather—Sea-weed in sight.
N. N. W., light.	N. by E., light.	Light squalls.
N. N. E.	Calm.	Fine weather.
South, light.	South.	Warm pleasant weather—Passed through several strong "tide rips."
South.	West, very heavy gale	From 4 P. M. to midnight almost a hurricane from W. S. W. to W., with heavy rain at times—Bar. 29° 12′.
W. N. W.	S. W.	Blew heavily till 4 P. M., when weather moderated—Forenoon fresh—Ends moderate.
Calm.	N. W.	Light breezes—Latter part fine weather.
S. W., fresh.	S. E., light.	Thick, foggy weather during the night—Barometer at midnight 29° 67′.
W. N. W.	W. N. W., fresh.	Clear weather from 6 to midnight—Wind heavy from N. W.—Clear.
N. W.	N. W., very fresh.	Fine weather.
N. W.	N. W., light.	Very fine weather—Light breeze.
N. E.	N. N. E. light.	Very fine weather—Light breeze.
E. S. E.	N. E., light.	Fair weather—Light breeze from Eastward.

C. H. E. Judkins, Commander.

S. S. W.	S. S. W.	Strong wind and cloudy, with high sea until 10 P. M., when wind fell light.
N. E.	N. N. E.	From 2 A. M. strong wind, with frequent showers, and high sea on.
N. by E.	North.	Strong wind, and cloudy until noon—Passed an ice-berg—P. M. moderate.
N. W.	W. N. W.	Moderate breeze, with hazy weather.
W. S. W.	S. W.	Thick, foggy weather, with heavy gale and constant rain.
N. W.	N. W.	Thick, foggy weather.
W. S. W.	S. W. by W.	Light wind and cloudy weather.
S. W.		Light breeze, with fine clear weather.

Extracts from Log-books.

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	Water.	WINDS. First Part.
									(h.) *Barque Racehorse,*
1850.		° ′	° ′				°	°	
September	4	9 03 S.	33 25 W.				78	77	S. E. by S.
	5	12 17	35 22				78	76	S. E.
	6	15 47	36 36				76	76	S. E. by E.
	7	18 8	37 24				78	74	N. E.
	8	20 56	38 24				74	74	N. E. by N.
	9	23 34	39 0				69	72	N. N. W.
	10	25 36	41 22				67	70	S. S. E.
	11	28 38	43 37				63	66	S E.
	12	31 47	46 14				64	67	E. S. E.
	13	34 56	48 18				64	62	N. E.
	14	38 12	51 15				61	58	N. to N. N. W.
	15	40 57	53 53				52	62	N. by W.
									(i.) *Ship Frederick Deming,*
September	4	31 23 N.	55 20 W.			30.2	78	79	E. N. E.
	5	30 1	54 20			30.2	78	79	E.
	6	30 26	53 40			30.2	78	79	E. by S.
	7	29 9	52 34			30.2	78	79	E. by S.
	8	28 18	51 18			30.5	79	81	E. by N.
	9	27 31	50 2	S. W. 1 mile.		30.3	79	80	E. by N.
	10	26 10	48 17			30.2	79	81	E. by N.
	11	26 47	47 33			30.2	79	81	E. S. E.
	12	29 1	46 37			30.2	78	80	E.
	13	25 48	46 8			30.2	80	80	E.
	14	26 23	45 23			30.2	80	81	S. S. E.
	15	27 46	44 24			30.2	84	81	S. E.
									(l.) *United States Ship Relief,*
September	6								
	7	39 54 N.	73 25 W.			30.30 / 29.60	75	75	Calm. E. S. E.
	8	39 32	72 40			29.60 / 29.19 / 29.68	70	67	E.N.E. to N.N.E.
	9	39 34	72 37			29.78 / 30.00	71	68	N'd and W'd.
	10	39 47 30	73 6			30. / 29.90	71	68	Variable.
	11					29.83	66	71	Westward.
	12								
	13								
	14								
	15								
									(m.) *Barque Rover,*
September	4	27 42 N.	56 15 W.				79	80½	East.
	5	25 50	55 32	½ South.			80½	82	East.
	6	25 26	55 8				80½	82	S. E. ½ S.
	7	24 26	54 16	½ West by N.			81	80	E. to S. S. E.
	8	24 37	53 42	1 W. N. W.			79	80	East.
	9	22 57	53 8	1 West.			80	81	E. N. E.
	10	21 19	51 30	¾ W. by N.			80	81½	E. by N. ½ N.
	11	19 22	50 27	½ do.			80½	81½	E. by N.
	12	18 2	49 45	1 West.			81½	81½	E. by N. ½ N.
	13	17 8	49 12	¼ do.			82	81	E. S. E.
	14	16 27	48 25	½ do.			82	81	E. N. E.
	15	15 09	46 30				81	81	N. E. ½ N.

Extracts from Log-books.

W. S. Babcock, Master.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
S. E.	S. E.	First part light breezes and pleasant—latter, heavy squalls and thick rainy weather.
S. E. by E.	S. E. by E.	Moderate trades and pleasant weather.
E. S. E.	E. N. E.	Moderate trades and pleasant weather—latter part wind light.
N. E.	N. E. by N.	Light breezes and very pleasant.
N. N. E.	N.	Light breezes and very pleasant—latter part breeze freshening.
W. S. W.	S. S. W. to S. S. E.	First part strong breezes and squally—8 P. M. wind hauled to westward—latter part fresh.
S. E. by S.	S. E.	Fresh gales with very large sea—latter part moderating, Bar. 30.2.
S. E.	E. S. E.	Fresh breezes and fair weather—saw Cape Pigeons.
E.	N. E.	Moderate winds and cloudy—Bar. 30.3.
N. N. E.	N.	Moderate winds—latter part large swell from N. W.
N.	N.	First part moderate winds and hazy—Bar. 6 P. M. 30.1—latter part freshening—Bar. 29.8.
N. N. W.	W. to W. S. W.	First part strong breezes and hazy—Bar. 4 A. M. 29.35—latter part heavy gales.

Wm. H. Churchill, Master.

E.	E.	Moderate breezes and clear throughout.
E. by S.	E.	Light winds, clear and pleasant.
E. by S.	E. by S.	Light unsteady breezes, with occasional rain squalls.
E.	E. N. E.	Light airs, clear and pleasant.
E. N. E.	E. N. E.	Light winds, clear and pleasant.
E. N. E.	E. by N.	Light airs and clear—latter part light winds and clear.
E. N. E.	E. N. E.	First part moderate breezes and clear—latter part squally.
E.	E.	First part light and pleasant—latter clear.
E. N. E.	E. N. E.	Light winds and clear in first and middle parts—latter part moderate and cloudy.
E. S. E.	S. E.	Light airs and clear weather.
S. E.	S. E.	First part calms—middle part squally with sharp lightning.
E. S. E.	E. S. E.	Light winds throughout—weather clear and pleasant.

Lieut. B. J. Totten, commanding.

		At meridian left the Navy Yard, Brooklyn, in tow of a steamer—At 5.30 discharged pilot—At 5.40 Sandy Hook bore N. W. by W. 8′—At 11 wind freshening.
S'd and E'd.	E S. E. E. N. E.	Commences light airs and cloudy—At sunset threatening appearances—Barometer falling.
N. W. to N. E.	N'd and W'd.	Commences strong winds—At midnight wind blowing a hurricane—To 5 A. M. wind constantly increasing, with a rapid fall of barometer—At 5 it commenced to rise, with a shift of wind to N. W.
To N. by E.	Variable and calm.	Pleasant—Sea falling rapidly—Overcast.
N'd and E'd.	N'd and E'd.	Cloudy, with rain at intervals—At 10 made Navesink Light, bearing N. N. W.
N.		At 3 took steamer and stood up for New York.

Horatio Nelson, master.

E. S. E.	E. by N.	Moderate gales and squally, with rain.
S. E.	S.	Light variable winds, and squally.
E. N. E.	E. N. E.	At 3 A. M. heavy gale, with lightning and rain.
S. S. E.	E.	Strong gales, and very strong current.
E. N. E.	E. N. E.	Strong gales, and very squally.
E. N. E.	E. by N.	Pleasant gales, and squally, with rain.
E.	E. ¼ N.	Fine Trade Winds.
E. N. E.	E. N. E.	Moderate weather.
E. N. E.	E. S. E.	
E. S. E.	East.	
N. E.	N. E. by N.	Fresh, with heavy sea.
N. E. by N.	North.	Fresh breezes, and squally, with lightning.

Extracts from Log-books.

(n.) *Ship Hendrick Hudson,*

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation. *observed.*	Bar.	THER. 9 A. M. Air.	Water.	WINDS. First Part.
1850.		° ′	° ′				°	°	
September	5	49 50 N.	9 0 W.	¼ N. N. E.		30.28	50	52	E. S. E.
	6	49 53	13 30			30.20	52	52	S. E.
	7	49 54	18 00			29.95	54	52	S. by E.
	8	49 42	22 54			29.70	57	56	S.
	9	50 55	26 56	¼ S. W.		29.28	54	53	W. by S.
	10	50 10	27 13			29.40	55	53	W. N. W.
	11	49 57	30 35	S. ½		29.10	56	55	S. S. W.
	12	48 51	34 48	½ S. W.		29.25	55	60	N. N. E.
	13	47 20	37 52	¼ S.		29.70	58	55	N. by E.
	14	46 41	40 45			29.76	54	56	S. S. W.
	15	46 46	42 12			29.80	57	60	W. S. W.

(o.) *Ship Baltimore,*

Date.		Latitude, at noon.	Longitude, at noon.	Currents.	Variation.	Bar.	Air.	Water.	Winds.
September	4	48 10 N.	32 50 W.				64	60	Variable.
	5	48 18	32 55				62	60	Calm.
	6	47 40	36 20				64	62	S. E.
	7	46 10	39 12				64	62	N. N. E.
	8	43 58	41 30				62	63	N.
	9	42 19	43 1				68	72	N. W.
	10	44 0	43 37				68	72	S. W.
	11	44 42	43 0				68	72	W.
	12	43 37	44 54				68	72	N.
	13	44 31	46 57				68	68	S. E.
	14	43 15	47 43				66	62	Calm.
	15	43 45	49 7				62	60	W. S. W.

(p.) *Ship Yorkshire,*

Date.		Latitude, at noon.	Longitude, at noon.	Currents.	Variation.	Bar.	Air.	Water.	Winds.
September	4	53 28 N.		Weighed and stood	out.				
	5	53	5 11 W.		2½				E. S. E.
	6	51 52	Waterford	light bearing N.					E. by S.
	7	50 51	12 1						E. S. E.
	8	50 15 D.R.	18 47						S.
	9	49 58	21 56						S. S. W.
	10	49 10	25 24						Calm.
	11	48 53	28 6						Calm.
	12	48	32 42						S. W.
	13	47 27	37 6						N. N. E.
	14	46 31	38 24						Calm.
	15	46 4	39 57						Calm.

(q.) *Ship Malabar,*

Date.		Latitude, at noon.	Longitude, at noon.	Currents.	Variation.	Bar.	Air.	Water.	Winds.
September	3	36 21 N.	26 50 W.			29.8	78		S.
	4	36 58	27 55			29.7	78		W. N. W.
	5	37 8	28 47			29.7	78		S. W.
	6	38 38	29 50			29.8	78		W. S. W.
	7	40 5	31 7			29.7	75		W. S. W.
	8	41 22	31 47			29.8	75		W. by S.
	9	41 10	33 0			29.8	75		W.
	10	40 10	34 7			29.9	72		W. N. W.
	11	41 02	34 30			29.4	72		S. W.
	12	40 58	34 25			29.6	75		W.
	13	39 57	35 20			29.9	75		N. W.
	14	41 5½	36 45			29.9	75		W.
	15	42 7	37 25			30	78		W. S. W.

Extracts from Log-books.

S. Warner, Master.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
S. E.	S. E.	First part fresh breezes and cloudy—latter part light breezes and cloudy.
S. E. by S.	S. S. E.	First part fresh breezes—latter part strong breezes with showers of rain.
S. S. W.	S. S. E.	First part fresh breezes and cloudy—ends with strong wind and heavy rain.
S. W. by S.	W. S. W.	Commences with strong winds, and increasing fast—at meridian fresh breezes and clear.
W. N. W.	N. N. W.	First part fresh breezes and clear—middle part heavy westerly swell—latter part light baffling airs.
W. by N.	S. S. W.	First part light airs and and variable—latter part strong winds, thick and rainy.
S.	S. E.	First part strong breeze and heavy sea—at meridian less wind and hauling.
N. by E.	N. by E.	Commences with light easterly breeze—latter part strong breezes and squally.
Calm.	S. S. W.	First part strong breeze—at 4 A. M. moderating fast—at noon fresh breeze and clear.
N. W.	W. S. W.	Commences with fresh breeze—thick and rainy—wind shifted to N. N. W.—ends with fresh breeze from S. W.
W. N. W.	N. W. by W.	First part light breeze and variable—at 5 A. M. wind shifted from S. W. to N., and back to S. S. W.—latter part light airs and thick foggy weather.

R. D. Conn, Master.

Variable.	Variable.	Light breezes and variable winds.
S. E.	S. E.	Light airs and squally, with rain.
E. S. E.	N. E.	Light breezes and pleasant weather.
Variable.	Variable.	Moderate breezes and cloudy.
N.	N.	Fresh breezes and squally weather.
N. W.	N. W.	Moderate breezes and pleasant.
W. S. W.	W. N. W.	Heavy gales with heavy sea.
W.	W.	Heavy gales.
N. N. W.	N. N. W.	Fresh gales and squally weather.
N. N. W.	N. N. W.	Light breezes and squally.
S. E.	S. E.	Calms and light breezes, and variable.
W. S. W.	W. S. W.	Moderate breezes and variable.

Shearman, Master.

		Pleasant weather.
Calm.	Variable.	First part, pleasant—Latter part, hazy.
E. by S.	E. by S.	Light and pleasant throughout.
S.E.	S. S. E.	First part, light breezes—Latter part, brisk breezes—hazy.
S. by W.	S. S. W.	Strong breezes—hazy and rain.
S. S. W.	S. W.	Light breezes—First part, rainy—Latter part, pleasant.
N. E.	N. N. W.	Pleasant throughout.
S. W.	S. W.	First part, pleasant—Latter part, brisk breezes and pleasant.
S. E.	N.	First part, moderate—Latter part, strong breezes and squally.
N. N. E.	N. N. W.	Strong breezes and squally.
S.	Calm.	Brisk breezes and pleasant.
N. W	W. S. W.	Moderate and pleasant throughout.

S. Freeman, Master.

S. S. W.	N. N. W.	Unsteady winds and squally—Ends light airs and clear.
W. S. W.	W. S. W.	First part, light airs—Latter part, fresh breezes and squally.
S. W.	W.	Fresh gales and rough sea—very squally—Latter part, clear.
W. S. W.	W. S. W.	Fresh breezes and squally.
S. W.	W. by S.	Fresh breezes and squally—At midnight, Corvo Island S. S. W. 20′.
W.	W.	Moderate breezes and rain squalls.
N. W.	N. W.	Light breezes—baffling and rain squalls.
N. W.	W. S. W.	Variable winds and rain squalls.
W. S. W.	W.	Very heavy gales and heavy sea.
W. N. W.	N. W.	First part, heavy gales—Latter part, more moderate.
N. W.	W. S. W.	Gradually moderating—Latter part, light airs.
S. S. W.	W.	Moderate and foggy.
W.	Calm.	Moderate and pleasant.

Extracts from Log-books.

(r.) *Brig S. D. Horton,*

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation observed.	Bar.	THER. Air.	THER. Water.	WINDS. First Part.
1850.		° ′	° ′				°	°	
September	4	4 10 N.	20 0 W.				78		S.
	5	3 23	20 34				75		S.
	6	3 5	19 11				78		S.
	7	2 13	19 27				78		S.
	8	0 33	21 0				79		S. S. E.
	9	1 59 S.	22 24				82		S. E. by S.
	10	4 1 S.	23 57				82		S. E. by S.
	11	6 20	25 41				80		S. E.
	12	8 29	27 22				80		S. E.
	13	10 19	29 10				80		S. E.
	14	12 40	31 18				80		S. E.
	15	14 55	33 2				80		S. E.

(s.) *Royal Mail Steamship Niagara,*

September	4	49 32 N.	33 38 W.			29.19	58	61	N. W.
	5	50 30	27 35			29.35	59	61	Variable.
	6	50 51	22 18			29.50	60	61	Southeastwardly
	7	51 19	16 14			29.87	59	58	Southeastwardly
	8	51 15	16 40			30.10	57	58	Southeastwardly
	9								
	14								S. S. E.
	15					30.10			E. S. E.

(t.) *Barque Panchita,*

September	4	20 20 N.	38 13 W.						E. S. E.
	5	21 53	39 10						E. N. E.
	6	21 41	40 10						N. N. E.
	7	26 10	41 27						N. N. E.
	8	27 46	42 55						S. E.
	9	28 33	44 13						E. S. E.
	10	30 28	46 2						E. S. E.
	11	33 3	47 10						N. E. by N
	12	34 31	50 50						N. N. E.
	13	35 29	54 21	N. E. 2¼					N. N. E.

Ship Elizabeth,

September	4	54 55	33 15	½ N. W.	3½ points.	39.3½	60	58	S. E.
	5	53 23	33 14		3¼	29.4	60	58	S. E.
	6	52 1	31 40		3	29.4	60	58	S. E. by S.
	5	52 40	30 50		3	29.4	64	59	E. South.
	8	52 55	30 16		3½	29.4	64	60	S. E. to
	9	53 8	27 21		3¼	29.3½	64	59	North.
	10	53 21	25 0			29.3	63	59	W. S. W.
	11	53 48	24 20	½ N.	3¼	29.3	64	58	Calm.
	12	55 31	20 40	½ N.	3¼	29.4	63	58	S. E.
	13	56 25	17 20	½ N.	3¼	29.6½	63	58	South.
	14	57 46	13 47			29.7½	63	58	South.
	15	57 45	10 5			29.9	62	57	South.

Extracts from Log-books.

A. O. Blackinston, Master.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
S.	S.	Moderate breezes, and pleasant.
S.	S.	Moderate breezes, and pleasant.
S.	S.	Moderate breezes, and pleasant.
S.	S.	Moderate breezes, and pleasant.
S. S. E.	S. S. E.	Fresh breezes, and squally—At 8 P. M. crossed the Line.
S. E. by S.	S. E. by S.	Pleasant gales, and squally.
S. E. by S.	S. E. by S.	Pleasant gales, and squally—Last watch more moderate.
S. E.	E. S. E.	Pleasant breezes, and fine weather.
S. E.	S. E.	Pleasant breezes, and fine weather.
S. S. E.	S. E.	Fresh gales, and squally.
S. E.	S. E.	Fresh gales, and squally—Heavy sea running.
S. E.	S. E.	Fresh gales, and pleasant—Heavy sea running.

J. Stone, Master.

W. S. W.	South.	Variable winds, and squally, with heavy rain throughout.
S. S. E.	South.	Strong breezes, with rain at intervals.
through twenty-	four hours.	Strong gales, and squally, and rain.
through twenty-	four hours.	First part, strong breezes—Middle and latter moderate.
through twenty-	four hours.	Strong breezes.
Variable througho	ut.	Moderate, and fine weather—At 6 P. M. anchored at Liverpool.
S. E.	E. S. E.	Sailed from Liverpool—Wind moderate.
S. E.	S.	At noon light winds.

Peterson, Master.

East	S. E. by E.	Moderate—Sounded—39 fathoms, rocky bottom.
N. N. E.	N. E. by E.	Moderate and clear.
N. E. by E.	N. E. by E.	Strong breeze.
S. S. E.	S. by W.	Strong breeze, and heavy.
E. S. E.	East.	Fresh, and rain squalls.
S. E.	East.	Strong breezes and drizzling rain.
S. E.	East.	Moderate and squally.
S. E.	East.	Fresh and clear.
S. E.	East.	Fresh and clear.
S. E.	East.	Fresh breeze—Strong current—At 4 P. M. made Island Lobos, bearing N. N. W. dist. 4 miles.

R. T. Hartshorn, Master.

S. E.	E S. E.	Moderate and hazy—Light rain; sea from S. S. E.
S. E.	S. E.	Moderate—Light rain; swell from S. S. E.
E. by S.	E. by N.	Moderate, and light rain—foggy weather.
S. E.	S. E. by E.	Begins light from east; at 1 P. M. violent squall from S.—Middle moderate.
South.	S. E. by E. to E. N E.	Moderate: light rain—Calm—Baffling—Light from north.
N. W.	to W. S. W.	Begins light from north, veering to W. S. W.
W. S. W.	Calm.	Light, and ends calm.
Calm.	S. E.	Calm—middle clear—ends from S. E.
S. E.	S. E. South.	Southeast and steady—Pleasant—Many birds.
South.	South.	Southeast from south—Pleasant—Many "shumotes."
South.	South by E.	Southeast from south—Pleasant—At noon "Rockall" S. S. E. 12 miles.
S. S. W.	S. S. W.	Very pleasant—Many whales and black fish.

Extracts from Log-books.

U. S. Frigate Raritan,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
1850.		° ′	° ′				°	°	
September	4	37 36 N.	60 38 W.	N. W. by N. 1.3		30.22	74	78	S'd.
	5	37 10	59 27	S. E. ¼ E. 0.9 knots.	11 16 W.	30.20	75	78	S. by W.
	6	36 40	57 52	S. E. by E. ½ E. 2 kts.		30.27	75	78	N. W.
	7	36 16	55 46	E. S. E. ¼ E. 0.5 kts.		30.30	80	79	N. E.
	8	35 51	55 9	N. by E. ½ E. 0.6 kts.		30.27	77	79	Calm and E.
	9	35 48	51 50	N. E. 1.5 knots.		30.20	75	78	S. W.
	10	35 20	47 37	N. N. E. ¼ E. 0.3 kts.		30.16	76	77	S. W.
	11	35 3	44 51			30.15	75	78	W. S. W.
	12	34 50	43 23	E. S. E. ¼ E. 0.4 kts.		30.13	73	77	N.
	13	34 46	40 24	N. E. ½ E. 0.8 kts.		30.17	79	77	N. W.
	14	34 40	37 43	N. N. W. ¾ W. 0.3 k.		30.23	76	77	S. W.
	15	34 21	35 36			30.24	76	76	N. W.

Barque Montauk,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
September	4	23 16 N.	83 40 W.	S. by E. ½ knot.		29.70	89	85	E. N. E.
	5	23 16	82 30	E. ½ knot.		29.60	89	85	N. E.
	6	23 56	80 38			29.55	92	86	N.
	7	25 43	79 32	N. by E. 2½ knots.		29.64	91	86	N. W.
	8	27 20	79 49	N. 3 knots.		29.80	96	86	W. S. W.
	9	29 15	79 40	N. 3 knots.		29.70	96	86	N. E.
	10	31 42	79 00	N. N. E. 3 knots.		29.80	86	83	N. E.
	11	32 30	76 20	E. by N. 2¾ knots.		29.75	78	84	E.
	12	33 6	74 17			29.84	80	82	N. by E.
	13	33 49	75 15	S. ¾ knot.		28.80	83	83	Calm, N.
	14	35 21	75 5	N. by E. 2 knots.		28.65	82	76	N. E.
	15	36 43	74 47	S. ¾ knot.		28.70	64	72	E. N. E. and E.

Ship Ashland,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
September	4	42 40	49 33			29.83	60	62	W. N. W.
	5	41 56	51 2			29.90	60	64	N. N. W.
	6	42 12	52 11			29.96	62	64	N. N. W.
	7	44 44	53 52			30.09	62	68	N. to N. E.
	8	42 41	54 34			30.03	64	65	Baffling.
	9	42 49	56 20			29.03	70	72	S. W. by S.
	10	43 19	56 18			29.75	62	60	N. W. by N.
	11	42 56	56 54			29.75	62	62	N. W.
	12	43 27	58 0			39.38	62	60	South.
	13	43 51	59 0			29.40	52	54	W. by S.
	14	43 45	59 6			29.56	56	53	West.
	15	43 5	59 18			29.70	54	55	West.

Extracts from Log-books.

Chas. Gauntt, Commander, from Norfolk, Va.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
Calm.	S. W. and calm.	Pleasant weather—first part light airs—middle part calm—latter part light airs and calm.
S. by W.	S. by W.	During this day light winds—ends calm—weather pleasant—large quantities of gulf-weed floating past.
N.	N.	First part calm and light winds—*middle and latter part* light breezes and pleasant—this day ends with passing clouds and squalls.
N. E.	Baffling.	*First part* light breezes and pleasant—*middle part* do.—latter part light winds and calms.
E. S. E.	S.	First part calm and light airs—pleasant weather—middle part light breezes and pleasant—latter, moderate breezes and passing clouds.
S. W.	S. W.	Moderately fresh breezes and pleasant.
S. W.	S. W.	Moderate breezes and pleasant—ends squally with rain—Bar. 30.13.
N. E.	N. E.	*First part* light airs and cloudy—*middle part* moderate breezes and pleasant—latter, light breezes and squally with rain.
Calm & baffling.	S. W.	Clear pleasant weather—a heavy swell from N'd—light winds.
S. W.	S. W.	Moderate breezes and pleasant—a heavy swell from the N'd.
W.	N. W.	First part light breezes and cloudy, hazy weather—middle and latter part light breezes and pleasant.
Calm.	Calm.	First part light breezes and passing clouds—middle part squally appearances with rain—latter part cloudy.

Brown, Master.

N. E.	E. S. E.	First part fresh breezes and pleasant—middle, squally—mercury steady.
E. N. E.	E.	First part fresh breezes, middle also—latter, moderate clear weather.
N. N. W.	N. W.	First part fresh breezes—middle and latter moderate and light—I was abreast "Havana"—to Matanzas there was 2½ knots current, but from there to the Double-headed Shot Keys, there was little or none.
W. N. W.	W. N. W.	First part light airs—middle, gentle breeze—latter, very light.
Calm.	Calm.	First part fresh breeze and squally with thunder and lightning.
E. N. E.	N. E.	Very light throughout.
E. S. E.	N.	First part gentle breezes—middle and latter part fresh and squally.
N. E.	N. by E.	First part fresh gales—middle light—latter fresh gales.
N.	N. E. by N.	First part and middle fresh gales—latter part very light—the mercury rising steadily during the 24 hours.
N. E.	N. E. by N.	First part light airs—middle fresh gales—latter part moderate.
E. N. E.	E. S. E.	First part very light—middle and latter gentle breeze—went out of the Gulf Stream at 11 A. M., in the Gulf the water was 83°; in green water (slightly tinged) 77°; on soundings 71°.
N. E. by E.	N. E. ½ N.	First part strong gales with rain—mercury falling—middle, also strong gales and cloudy—latter part clear, mercury fell till 4 A. M. to 28.60, when it rose to 28.70, and there stood.

J. D. Rice, Master.

N. N. W.	N. N. W.	First part, strong breezes—Middle and last, moderate and fine.
N. W. by N.	West.	Throughout fine weather and light breezes.
N. N E.	N. N. E.	Throughout fine weather and light breezes.
North.	N. E.	Throughout fine, light and baffling wind—(Much gulf-weed.)
Calm.	S. W.	First part baffling—Ends light wind from S. W.
S. S. W.	N. N. W.	First part light—Middle and last, heavy gale and rain—(Much gulf-weed.)
N. W. by W.	N. W. by W.	First part strong gale—Middle and last part moderate.
Calm.	South.	First part light and baffling—Middle calm—Ends fine and moderate.
S. E. by E.	West.	First part light—Middle, rainy and fresh breezes—Ends foggy, and strong breeze.
W. S. W.	W. N. W.	First part, hard gale—Middle, same—Ends moderate.
W. S. W.	W. N. W.	First part, strong breeze—Ends fine.
W. by N.	Calm.	First part and middle, light breezes and calm.

Extracts from Log-books.

Ship Bavaria, C. Anthony, Jr., Master,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
1850.		° '	° '			-	°	°	
September	4	49 6	16 22			30.2	64	63	E. S. E.
	5	48 35	21 44			30.1	64	64	S. E.
	6	48 20	26 54			29.8	66	66	South.
	7	48 23	30 24			29.7	64	62	S. W. by W.
	8	47 53	32 13			29.8	64	66	S. W.
	9	45 52	33 27			29.9	65	66	N. W.
	10	45 44	36			29.7	70	69	N. W.
	11	46 48	36 40			29.	64	66	W. S. W.
	12	45 47	38 48			29.7	64	65	North.
	13	45 11	41 6			30.	63	60	N. N. E.
	14	44 33	43 45			30.	66	67	South.
	15	45 35	44 59			30.	63	65	South.

Royal Mail Steamship Europa, E. G. Lott, Master,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
September	4					30.05	60	66	Calm.
	5	43 5 N.	65 25 W.			30.07	64	64	E ½ N.
	6	44 35	62 32			30.30	62	63	South.
	7	45 35	56 5		1½	30.19	64	59	S. S. W.
	8	47 18	50 7		2½	29.92	56	50	West.
	9	48 36	43 25		3	29.65	62	66	Variable.
	10	49 57	36 34			29.36	62	61	South.
	11	50 54	29 31		3¼	29.30	63	60	(South S. W.)
	12	51 10	23 21		3¼	29.63	62	62	S. S. E.
	13								
	14	51 6	17 49		3¼	29.88	62	60	S. S. E.
	15	51 13	12 6		3	30.19	58	56	S. E. by S.
							60	58	E. by S.

Packet Ship Isaac Hebb,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	THER. 9 A. M. Water.	WINDS. First Part.
September	4	48 22	32 20			28.93	63	64	West.
	5	48 25	34 4			29.54	67	64	Calm.
	6	47 57	34 57			29.50	63	65	Calm.
	7	46 44	36 44			29.50	62	63	North.
	8	45 10	39 40			29.93	64	67	N. W.
	9	43 48	40 56			29.95	69	70	N. N. W.
	10	44 48 D.R	41 53 D.R.			29.40	66	69	S. W.
	11	44 48	41 22			29.50	62	69	N. W.
	12	43 22	42 4			29.90	63	69	N. N. W.
	13	43 54	46 56			29.72	66	70	Calm.
	14	44 12	46 6			29.82	66	59	W. N. W.
	15	45 22	47 50			29.90	56	49	West.

Extracts from Log-books.

from Havre de Grace to New York.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
S. E. by S.	S. E.	Fresh winds and cloudy through the twenty four hours.
S. S. E.	South.	Strong winds and cloudy weather throughout.
South.	S. S. W.	Strong winds and cloudy through twenty-four hours—Ends rainy.
S. W.	S. W.	First and middle parts fresh winds and rain—Latter part moderate and cloudy.
West.	N. W.	First part light winds—Middle and latter part fresh, with rain.
N. W.	N. N. W.	First part fresh and rainy—Middle, fresh and cloudy—Latter, moderate and cloudy.
W.	S. W. by W.	First and middle parts moderate winds—Latter part, fresh winds.
W.	West.	Strong gales throughout—Middle part rainy.
N. N. E.	N. N. E.	Fresh gales and squally, with rain, throughout.
S. E.	S. S. E.	First part fresh gales—Middle and latter parts, moderate and cloudy.
S. E.	S. S. E.	First part fresh winds—Middle and latter parts, light winds.
W. N. W.	S. W.	Light winds all these twenty-four hours, and cloudy.

from Boston to Halifax and Liverpool.

Calm.	Variable.	
N. W.	E. S. E.	Light breezes and cloudy—3. Dense fog—Midnight, thick and foggy.
S. by E.	S. by E.	Dense fog—Noon, light breezes and cloudy—Midnight, steady breezes and clear.
S. S. E.	North.	Light breezes and fine weather—Noon, ditto—Midnight, light airs and hazy.
Calm.	Calm.	Light airs and hazy—Noon, calm and cloudy—Midnight, dense fog.
South.	South.	Light variable airs and dense fog—Noon, light airs and cloudy—Midnight, strong gales and thick weather.
S. S. W.	S. by W.	Strong breezes and rain, heavy squalls—4. Fresh gales—Noon, ditto, with heavy rain—Midnight, steady breezes and hazy.
S. S. E.	S. S. E.	Moderate breezes and hazy—Noon, strong breezes and cloudy—Latter part, ditto.
S. S. E.	S. S. E.	Moderate and fine—Noon, strong breezes and cloudy—Midnight strong gales and squally; heavy rain and head sea.
S. S. E.	E. S. E.	Strong gale and heavy squalls—Noon, ditto, weather—Midnight, ditto.
S. S. E.	E. by S.	Strong breezes and head sea—Latter part, fresh breezes and fine.
East.	E. N. E.	Fresh breezes and clear—9.30 passed Kennybeg light vessel—10.15 Tackar; 5.50 Holyhead; 11.45 Rock light—Midnight, off George's pier head.

from Liverpool to New York.

W. N. W.	West.	First and middle part, strong breezes, with rain—Latter, light; a very heavy swell from N.W.
Calm.	East.	First part, light winds—Middle calm—Latter part light—East—Fine weather.
S. E.	E. S. E.	First part calm—Middle and latter part light winds and rain squalls.
West.	N. W.	First part, light winds—Middle, rainy and squally—Latter part, strong breezes. For the last two days there has been a number of water-spouts in sight.
North.	North.	Strong breezes and fine weather.
N. N. W.	W. N. W.	First part, strong breezes—Middle and latter parts, light and calm. Great quantity of gulf-weed in a fresh state.
W. N. W.	N. W.	Heavy gales from W. N. W. to N. W.—Sea very high.
N. N. W.	N. N. W.	Heavy gales and very high sea.
N. N. W.	N. N. W.	First part, strong gales—Middle and last, light—Much gulf-weed.
S. E.	W. N. W.	Middle and last parts, fine breezes—Misty and rainy—No sea-weed.
Calm.	West.	First part, strong breezes—Middle, calm—Latter part, light, fine weather.
West.	W. N. W.	First and middle, light winds—Latter part, light and calm—No sea-weed.

Extracts from Log-books.

Ship Roscius, A. Eldridge, Master,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M.		WINDS.
							Air.	Water.	First Part.
1850.		° ′	° ′				°	°	
September	4	39 38 N.	56 10 W.			30.00	77	78	Calm.
	5	40 3	58 0			30.00	78	79	W. by N.
	6	40 6	58 37	10 miles N. E.		30.00	77	76	N.
	7	40 10	59 1	25 miles E.		30.02	79	72	E. S. E.
	8	40 41	61 47	50 miles E. S. E.		29.9	77	79	S.
	9	41 49	62 20	20 miles E.		29.38	66	65	W.
	10	41 36	63 23			30.00	62	68	N. W. by W.
	11	41 31	63 49	15 miles E.		29.09	68	58	Calm.
	12	41 42	65 27			29.6	54	52	W. N. W.
	13	41 19	66 20			29.7	55	51	W. by N.
	14	40 52	67 33			29.8	60	54	W. N. W.
	15	40 52	68 16			29.8	61	57	Calm.

Ship London, F. H. Hebard, Master,

September	4	48 3	28 25 D.R.			29.5	65	63	S. E.
	5	47 58	30 49			29.4	64	63	S. S. W.
	6	47 42	32 30			29.6	68	65	S. W. to S. S. W.
	7	47 29	34 15			29.4	64	64	S. S. W.
	8	46 7	37 3			29.5	64	64	N. W.
	9	44 31	38 40 D.R.			29.9	65	69	N. W.
	10	45 36	40 0 D.R.			29.2	65	69	W. N. W.
	11	45 28	40 0 D.R.			29.3	64	65	W. N. W.
	12	43 30	42 0 Obs.			29.7	64	70	N. W.
	13	43 52	44 30			29.6	66	73	N. W.
	14	44 7	45 18			29.8	69	64	N. W. by W.
	15	45 2	46 50	South ¼ knot.		30.1	69	53	W. S. W. to W.

Extracts from Log-books.

from Liverpool to New York.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
Calm.	N. W.	Calm and pleasant last evening, saw a meteor going from S. W. to N. E.—latter part very light from N. W.
W. N. W.	N. W.	Light airs veering 3 or 4 points, and pleasant—tacked as the wind veered—latter part light breezes.
N. N. E.	E.	Light airs and pleasant throughout.
E. S. E.	S. E.	Very light airs and very pleasant weather—ends the same.
S.	S. W.	Moderate breezes and squally—now double-reefed topsails—strong breezes and high sea—we have steered N. W. and N. W. by W. all day, and still have made but very little latitude—I have never found so much current this side of Cape Hatteras before, a good part of the time the temperature of the water has been as high as 80° and 81°—at meridian barometer falling very rapidly and a gale of wind coming quite suddenly—at 6 P. M. hove to under main topsail—wind S. W. blowing a perfect gale—Bar. 29.02—midnight the same—barometer inclined to rise.
W. S. W.	W. N. W.	Commences with a gale from West, and squally with a very high sea—middle part moderating—made sail—very high sea—now under double-reefed and whole courses—barometer going up, most too fast I fear—latter part moderate, made all sail at 7—tacked to W. S.W.
N. W. by W.	N. W. by W.	Light airs and pleasant—at 6 calm, and ends so.
S. E.	S. W.	Calm until 5 A. M., then light breezes and pleasant—middle part very light airs—latter part the same with fog.
W. N. W.	W. N. W.	Moderate breezes and pleasant—at 5.4 tacked to W. S. W.—at 1.30 tacked to N. N. W.—at 6 to S. W. by W.—latter part strong breezes—double-reefed topsails.
W. by N.	W. by N.	Strong breezes and cloudy—at 6 tacked to N. by W.—set single-reef and topgallant sails—at 5 P. M. light airs, made all sail.
	Calm.	Light airs—ship going about 2 knots—sometimes calm, last part calm.
E.	Calm.	Calm until 6 P. M., then very light airs from N. E.—calm most part of the time—latter part light airs from N. E.

from London to New York.

S. S. E.	S. S. W.	First part, fresh and cloudy weather—Middle part, strong gale, with rain.
S. S. W.	Calm.	Comes in squally—2 P. M. east—Middle part, light, variable, and cloudy—Latter calm.
S. S. W.	South.	Comes in calm—2 P. M. light breeze—Middle part, light squalls of rain and light winds—8 P. M. heavy rain squall—Ends fine, south.
N. W.	North.	Comes in light and variable—10 P. M. squally, N. W.—Middle part, moderate, cloudy—6 A. M tacked to N. W.—Latter part, rain.
North.	N. N. W.	Comes in light—2 to 6 P. M. squally, and light rains from West to N. W.—8 P. M. wind fresh, north—Ends moderate, with heavy westerly swell all the twenty-four hours.
N. W.	N. W.	Moderate and cloudy, with westerly swell—Latter part saw much gulf-weed, and some flying-fish—At meridian tacked north.
W. N. W.	West.	Comes in light and cloudy—Middle part, strong gales and rain—Double-reefed, took in jib, spanker, and mainsail—8 P. M. split fore and main topsails, blowing in gusts a hurricane from west, and a tremendous sea—Hove to under bare poles—Ends clear over head, but no horizon.
W. N. W.	N. W.	Comes in violent gale—Middle part, the same; lying to, ship laboring much—8 A. M. set the topsails and foresail—ends heavy gale and high sea.
W. N. W.	N. W.	Comes in heavy gale—Middle part more moderate—6 A. M. made all sail—Ends moderate and cloudy, with heavy swell—Latter part, saw much gulf-weed and some flying fish.
S. E.	W. N. W.	Comes in fresh—8 P. M. calm—10 P. M. light air S.E. and rainy—Middle part, fresh, S. E. and high seas; double reefed—8 A. M. moderate, with high sea—Made sail—10 A. M. took a shift of wind from N. W.—Saw gulf-weed and fish.
Calm.	S. W.	Comes in cloudy and fresh—3 P. M. tacked to W. S. W.—Middle part calm—4 A. M. light breezes, S. W.—Cloudy—Rain—10 A. M. clear, calm, and warm—Sea smooth—the evening quite bright from 9 to 12 P. M.—Aurosani.
Calm.	N. W.	Comes in light—Middle part calm and cloudy—Ends light and variable—Saw right whales, also spars and deals.

Extracts from Log-books.

Steam Schooner Ohio, J. H. Browne, Master,

Date.		Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M.		WINDS.
							Air.	Water.	First Part.
1850.		° ′	° ′				°	°	
September	4	20 4 N.	none.			29.82	83	81	Calm.
	5	18 35	38 57 W.	none.		29.86	82	81	Calm.
	6	17 6	37 25	none.		29.88	83	81	E. by N.
	7	15 27	36 29	none.		29.92	84	81	E. N. E.
	8	13 40	34 39	none.		29.85	83	81	E. by N.
	9	12 12	33 30	none.		29.78	83	81	E. N. E.
	10	11 42	33 40			29.82	83	81	Calm.
	11	11 7	33 21	none.		29.90	84	81	Calm.
	12	10 29	32 20	none.		29.80	84	81	Variable.
	13	9 17	30 20	N. E. 1.0		29.86	82	81	S. W. by S.
	14	7 51	28 14	N. E. by E. 1.5		29.90	84	81	S. W. by S.
	15	6 31	26 53	E. N. E. 9		29.90	81	81	W. S. W.

Extracts from Log-books.

from New York to San Francisco.

WINDS.		REMARKS.
Middle Part.	Latter Part.	
S. S. E.	E. S. E.	Latter part light breezes and cloudy weather.
E.	E. N. E.	Calm during the first 6 hours—the remainder of the day strong breezes and good weather.
E. N. E.	E. N. E.	Fresh and cloudy throughout the day.
E. by N.	E. by S.	Stiff breezes with an occasional squall, attended with showers of rain.
E. N. E.	E. N. E.	Fresh breezes with passing clouds filled with wind.
E. N. E.	Calm.	Fresh gale to 6 P. M., then moderated gradually to a dead calm.
Calm.	S. E. by S.	Calm for the rest of the day, with pleasant weather. The trades carried me up to the track laid down in your directions, and then left me to enjoy the benefit of a dead calm. I never had them further North than E. N. E., (except for 12 hours N. E.) I was close hauled continually, and had to make several tacks.
Calm.	Variable.	Calm for the most part—latter part variable airs.
Calm.	N. N. W.	Strong breezes during the latter part—meridian inclined to be squally—had no perceptible current these ten days, although the chart represents one setting to the N. W.
S. W.	S. W. by S.	Fresh gales—squally with rain throughout.
S. W.	S. W.	Brisk breezes and passing clouds—yesterday and to-day had a strong current, occasioned I suppose, by the S. W. monsoon—was by the wind all day, but made a S. E. by E. ¼ E. course.
S. W.	S. W.	Fresh breezes with passing squall clouds.

The Pilot Chart and New Routes.

Letter C of the series is a chart of the winds: it shows the points of the compass from which the wind blows in all parts of the ocean, and for every month in the year. The numbers of this series are called the "Pilot Charts," of which the North and South Atlantic, in two sheets, each, and "Coast of Brazil within the Trade Wind Region," in one sheet, and the sixth sheet of the South Pacific, have been published. Several other sheets, both of the Pacific and Indian oceans, are in press. See Plate I, as an illustration of the manner in which the figures for Plate V are obtained.

Sheets of this series are also in hand for the entire Pacific and Indian Oceans.

The officers employed upon them from time to time have been Lieutenants Herndon, Dulany, H. N. Harrison, Ball and Forrest; Passed Midshipmen Davenport, Powell, De Koven, Wainwright, Balch, Roberts, De Krafft, Woolley, Jackson, Murdaugh, Semmes, Johnson and Lewis, and Professor Benedict.

The "Brazil Pilot" is on a scale, to the square, of 2° of latitude by 1° of longitude, and extends from the equator to 23° South.

The rest of the series is on a scale of 5° to a square: that is, the ocean is divided off into districts of 5° of latitude by 5° of longitude. The Pilot chart, therefore, consists of a number of engraved squares without regard to figure of the earth, with four inscribed concentric circles in each; and in these circles are radii, drawn so as to represent every alternate point of the compass-card: thus; N.; N. N. E.; N. E.; E. N. E.; East; and so on around the compass. See Plate V.

After all the log-books within reach have been examined, and the observations collated for this letter of the series as in Plate I, the results are collected for each district, arranged according to months, and entered each set in its *wind-rose*, Plate V, as the circumscribed square with its concentric circles and points of the compass is called. These entries are made in such a manner as to show at a glance the prevailing winds for any month in any part of the ocean. Not only so: the navigator sees at a glance how many days of observation have been discussed for each month in any district; and of these he sees the number of times calms have been found, and the number of times the winds have been reported as coming from each of the sixteen points of the compass.

Thus in the wind-rose for the district between 5° and 10° N., 15° and 20° West, and marked A, Plate V, he would observe that in August 705 observations as to the course of the wind had been made here, and 13 as to the calms; *i. e.*, out of $\frac{718}{8}$ days, or parts of days, passed by ships in this district during the month of August of various years, the prevailing condition of the weather for periods of eight hours duration, was found to be calm thirteen times; and the winds were observed to blow from E. 4 times;* E. S. E., 17; S. E., 5; S. S. E., 165; S., 280; S. S. W., 171; S. W., 23; W. S. W., 26; W., 8; W. N. W., 2; N. W., 1; N. N. W., 2; N. N. E., 1; and the other points 0.

The object has been to get for these charts at least one hundred observations for each month in every

*Taking "time" to mean a period of eight hours, or three "times" to make a day.

square of the ocean; this would require for the three great oceans 1,669,200 observations upon the direction of the winds alone.

In some of the wind-roses, or districts of 5° square, we have obtained more than a thousand observations for a single month; whereas, in neighboring districts and for other months, we are left without a single observation—so limited and marked are the commercial paths over the ocean, according to the seasons.

In the South Atlantic, between the route to and fro around Cape Horn, and the route to and fro around the Cape of Good Hope, there is a part of the ocean of immense extent, that is seldom traversed by any vessel. The pilot charts, therefore, are silent with regard to the winds there.

As the wind is found to blow in any part of any given district or division of 5° square, so it is assumed to blow in all other parts of that district.

The pilot charts, therefore, give us the number of times that the wind, in any part of the ocean, is found in a given number of times to come from each point of the compass; and consequently, by studying the pilot chart, we see the ratio between the number of winds from any one point, and the number of winds from all the other points of the compass.

With such data it is practicable to calculate, according to the doctrine of chances, the track which will give the shortest average passage under canvass from port to port for any month.

This I have done for the routes generally, between Europe and America; and from the ports of the United States, as far South as the parallel of Rio de Janeiro.

In order to select the best average track, from one place to another, as from the ports of the United States to Rio, or to those of Europe, the pilot charts are discussed in the following manner:

Blank charts on a scale of 5° to an inch at the equator, Mercator's projection, are constructed and lithographed for the whole ocean, twelve times over, so as to have one complete set for each month.

In every space of 5° square, a sort of compass-card is drawn as in Plate VI.

In the centre of this card are written two numbers—the upper number shows the times, counting 8 hours as "a time"—the winds have been observed in that square for the given month, which in this case is July; (see A—Plate VI;) and the lower number shows the per cent. of "the times" in which calms, according to the number of observations made, and the principles of averages, ought to prevail for as much as 8 hours at a time. Thus, in said square A there have been discussed for the pilot charts, in the month of July, 433 observations, and of these 8, or 2 per cent., represented calms as the prevailing condition of the atmosphere for that month and part of the ocean.

These two quantities are thus stated in order to enable me as well as those who take the charts for their guide, to form some estimate as to the degree of confidence due, or as to the weight to be attached to, the courses recommended and the routes proposed.

Thus more weight is attached to a course that should be recommended through square A, than to one through square B; because, in A, average results are derived from 433 observations; whereas in B, they depend upon only 21; and calms, it appears, prevail there 11.1 per cent. of the time, which is probably out of proportion.

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The object, however, is to show the proportion according to the ratio of per centage, of the winds from each point of the compass, and the per centage by which, according to that showing, a vessel in attempting to sail 100 miles, or any other distance through that square on any given course, would in the average have to increase that distance on account of the average amount of adverse winds.

Thus suppose a vessel should wish to sail West through square B in July:—an inspection of the plate will show, supposing the 21 observations give a fair average as to the winds in that square for that month, that 16.5 per cent. of the winds there, are from the West; that 11 per cent. are from W. S. W.; 3.5 from W. N. W.; 16.5 from S. W.; and 5.5 from N. W.; all these winds are adverse for a West course, and consequently, they would compel her to turn off from a West course so as to increase the distance required, 37.4 per cent.

In truth, it appears from those 21 observations, that 49.5 per cent. of all the winds that blow here in July, are between W. and S. S. W., inclusive; that it is calm 11.1 per cent. of the time; and that consequently, it is an unfavorable part of the ocean for a vessel to pass through, that wants to get from Europe to the United States, *i. e.*, that wants to get to the southward and westward; it moreover appears that a vessel would have no difficulty except on account of the calms, in getting to the eastward through this same region.

Again, take square C, which is between two lower parallels, and in which we have the experience of 41 vessels to guide us:—a vessel to make a W. S. W. course through this square, in July, would have to contend against 53.7 per cent. of winds directly ahead, with the chances of having to increase her distance 93.7 per cent. Here we again see the prevalence of head winds for vessels bound to the United States, and perceive that it is a bad part of the ocean for a vessel so bound to be in, though there are no calms.

It is thus that the chart for July, for the whole ocean, is filled up from the Pilot Chart, with the per cent. of calms and head winds for each month. This is an operation which involves an immense amount of labor.

This being done, the next step in the process, is to find out the best course for a vessel bound in any other direction, to proceed in any given month.

To do this, it is necessary to find out that track, which, with the average per centum of increased distance on account of head winds, and the increase on account of detour, shall give the shortest distance from port to port—for when that is found, it is called the shortest average route. This route when thus found, is the route which vessels are recommended in the Sailing Directions to take for the several months, to and from Europe, to the equator, &c.

This is a tedious operation; for a satisfactory solution of this problem is not to be attained, without many trials. For instance, after crossing the meridian of 25° W., bound from Liverpool to New York, it is comparatively easy, in July, as a mere inspection of plate VI shows, to make westing between the parallels of 40° and 45°. But the head winds, and the detour they cause a vessel to make, when she comes to try it, may involve such an increase of distance as to make it better to take the chances by some other route; so that it is not the difficulty of getting through one square alone that has to be considered at a time, but the difficulties of getting through all united.

It may turn out, after this tentative process has been repeated again and again, that when we come to examine and compare such results, we may find two routes widely differing, yet each requiring nearly the same distance to be accomplished. In that case, each track is traced from port to port; the per centage of head winds and detour got at carefully for each square through which it passes, and then in the Sailing Directions the preference is given to that track which is least liable to calms, to adverse currents, and to other collateral draw-backs, perplexities, and delays; and which has in its favor the shortest distance, and the greatest number of chances for fair winds.

The centre figures in each square, plate VI, stand as before remarked, for the whole number of observations and the per centum of calms. The next figures which are arranged along the inner circle, are the per centum of head winds for the courses on which they stand, and the outer circle of figures express the number of miles that adverse winds will compel a vessel to turn out of the way, if she attempt to sail 100 miles direct on the course on which these figures stand.

Thus it will be perceived, that no navigator can reasonably expect that the new routes which I recommend, are to give the short passages *always*, and in every individual case. They give the shortest passages on the average, and thus offer the best chances for a short passage at all times—that's all. Those chances as the charts shew may, and sometimes will, turn up adversely. Thus, a vessel trading to Europe, may be told in the Sailing Directions, that her best route in July passes through square D, and that her course through it, is East. Once in a hundred times, however—and just once in a hundred on the average—the pilot chart to which she is referred for a guide, tells her the wind in that square comes from the East; and she may find it, when she gets there, directly in her teeth:—she may be the unfortunate hundredth vessel; we cannot tell. All that I pretend to tell the navigator in such cases is where he will find the greatest number of chances in his favor, and what is the best route for him to pursue. In like manner, he may be recommended, not to attempt to stand W. S. W. through C, for then the chances are 54 in a hundred that he will have the wind directly in his teeth; still a vessel may pass through this square 7 times, and each time find, as the chart shews it is possible, though hardly probable she may find, the wind each time exactly in the opposite direction.

With this full explanation as to the process by which the new routes here recommended are discussed and discovered, the intelligent navigator who adopts them, will perceive that these discoveries and these routes are no matter of opinion with me; but that they are the results of the experience of all combined, whose observations have been used in the construction of the charts.

In the European voyages I have found not much room for improvement as to routes, except to those shipmasters who are just entering that trade; to them, these charts give all the information as to winds, currents, and routes that is possessed by the oldest and most experienced "Packet Captains."

When navigators generally shall agree to follow these new routes, the average sailing passage between Europe and America will, it is believed, from what has already been done, be considerably shortened.

But the new routes which these charts have suggested to the equator, and which lead through parts of the ocean in which the winds and currents were not so well understood as they are along the tracks to Europe, have been attended with more decided advantage, and the most signal success. Practically, they have brought the markets of India and the southern hemisphere many days nearer to our doors.

The route of all vessels bound into the southern hemisphere, whether their destination be the markets of South America, of the Pacific or Indian ocean, is the same as far as the equator: and these charts have actually shortened the average passage hence to the equator, from two days to two weeks, or more, according to the season of the year; this is shown by the results of actual trial. More than a hundred passages have been made by these charts, and according to the routes prescribed. The average length of passage by the old route from the ports of the United States to the line, is forty-one days. The average passage by the new routes has been so far, for January, 31 days; for February, 25; for March, 27½; April, 28½; May, 34; June, 33; July, 40; (by the old route in this month the passage is 48 days,) for August, 41; for September, 39; for October, 37; November, 32, and December, 34, against 38½ by the old route for December.

As I write, I receive the abstract logs of the U. S. S. "Saratoga," (Captain Walker,) and of the merchant barque "Dragon," (Captain Andrew.)

They sailed at the same time, both in the month of September last, (1850;) the "Saratoga" took the old route; went as far as 19° of west longitude; and crossed the equator the forty-second day out. The "Dragon" took the new route; crossed the equator the thirty-fourth day; and had passed the parallel of Rio de Janerio in 23° S., before the "Saratoga" had reached the line; thus making a gain of 1500 miles upon her competitor, with a saving that far of ten days or two weeks on the passage.

Thus the importance of the undertaking to collect and embody the experience of every navigator as to the winds and currents of the sea, and so to present the results of all this information, that each may have the benefit of the experience of all, is brought home to our merchants; they reap benefits from it daily. Encouragement is therefore given for the vigorous prosecution of the work.

Upwards of 20,000 sheets of these charts have been distributed, and the demands for them are daily increasing.

The Thermal Chart.

Letter D of the series, designates the thermal charts; they show the temperature of the surface water of the ocean, wherever and whenever it has been observed. These temperatures are characterized by colors and symbols in such a manner that by a mere inspection of the charts, the temperatures for any one month may be recognized and distinguished from the rest. The scale is Fahrenheit; and the temperatures are put down just as they are given in each Log-book, without any attempt to correct for error of thermometer. The thermal chart of the North Atlantic, compiled by Lieutenant Gantt, in eight large sheets, is in press. That of the South Atlantic is in process of construction by Lieutenant Gardner, and is nearly ready for the press.

The isothermal lines for 80°, 70° and so on, for every 10° of ocean temperature, have been drawn for each month upon these charts by Professor Flye.

They afford to the navigator and the philosopher, much valuable and interesting information touching the circulation of the oceanic waters, including the phenomena of cold and warm currents; they also cast light upon the subject of the hyetographic and climatic peculiarities of various regions of the earth; they show that the profile of the coast line of inter-tropical America gives expression to the mild climate of Southern Europe; they increase to a marked extent our stock of knowledge concerning the Gulf Stream—that great phenomena of the ocean;—for they show that the warm waters of this stream as it pursues its course to Europe, have a vibratory motion, so to speak, across its course, like a pendulum slowly propelled by heat on one side, and repelled by cold on the other: It vibrates to and fro with the season, preserving in the mean time a peculiar system of convolutions that calls to mind the graceful wavings of a pennon as it floats gently to the breeze. Indeed if we imagine the head of the Gulf Stream to be hemmed in by the land in the Straits of Bemini, and to be stationary there, and then liken the tail of the stream itself to an immense pennon floating gently in a current:—such a motion as such a streamer may be imagined to have, very much such a motion do these charts show the tail of the Gulf Stream to have.

These charts were prepared for the press in four sets,—each set shewing the temperatures for one season;—but they are to be published with the temperatures of all four seasons on the same sheet. I have, therefore, not had an opportunity to study them except in sets for one season at a time,—therefore I cannot give as complete an account of all the facts which they develope, as I shall be able to do when they appear with the observations for each month grouped and presented side by side with the observations for all the other months.

In 1844 I read before the National Institute, a paper "on the Gulf Stream and currents of the sea." Up to that time but little was known of this "river in the ocean," except that it exists and conveys an immense body of warm water from the Gulf of Mexico through the Straits of Florida into the Atlantic Ocean, thence along the coast of the United States towards the shores of Europe by the way of the Grand Banks. Beyond this* little or nothing was known with regard to it. But since the appearance of that paper, attention has been

*"Upon a correct knowledge of the force and set of currents in the ocean, often depends not only the safety of vessel and cargo, but the lives of all on board; and, owing to the want of this knowledge, hundreds of vessels, thousands of persons, and millions of property are annually cast away or lost at sea.

"I do not intend to occupy the time of members with a recapitulation here of what we do know with regard to ocean currents; that indeed might soon be told; for we know little or nothing of them, except that they are to be met with here and there at sea, many of them sometimes going one way and sometimes another; and that the waters of some of them are colder and of others warmer than the seas in which they are found. That we should have a better knowledge of them, and of the laws which govern them is not only an important matter to those who follow the sea, or make ventures abroad, but it is also a matter of exceeding interest to all those whose enlarged philanthropy, or ennobling sentiments prompt in them a desire to diffuse knowledge among their fellows, or in any manner to benefit the human race. The mere fact that this meeting is held at all, is evidence ample and complete that it is composed altogether of such. I therefore submit it as a question for the consideration of this meeting, whether it be not competent for the National Institute to devise and set on foot a plan for multiplying observations and extending our information upon these interesting phenomena. A subject of vast importance in the business of commerce and navigation, the currents of the ocean seem to me to be altogether worthy the attention of this society—a series of well conducted observations upon them would be in perfect unison with the great objects of usefulness for which it was created and now exists, and for which its distinguished members and guests have been invited, and are here assembled from all parts of the country.

"Before such an assemblage of mind and intelligence, it is necessary only to mention the meagre state of our information even with very much directed to the Gulf Stream.* The Coast Survey has been at work upon it, and the information collected by that establishment and the officers of the navy, with regard to it, added to that afforded by these charts, may be said to exceed in philosophical extent and value all that was previously known about it.

These investigations confirm, to a remarkable extent, the speculations put forth in that paper; they have converted many of the suggestions of theory into philosophical facts, and given increased importance to the views which I had the honor to present in 1844.

In the paper which, as already mentioned, was read before the National Institute 7 years ago, and repeated, by request, before the Association of American Geologists and Naturalists the same year, it was remarked with regard to the Gulf Stream and its counter current, the ice-bearing current from the North:—

"The Gulf Stream, as it issues from the Straits of Florida, is of a dark indigo blue; the line of junction between it and the '*roily*' green waters of the Atlantic, is plainly seen for hundreds of miles. Though this line is finally lost to the eye as the stream goes North, it is preserved to the thermometer for several thousand miles; yet to this day the limits of the Gulf Stream, even in the most frequented parts of the ocean, though so plainly marked, are but vaguely described on our charts. Thousands of vessels cross it every year; many of them make their observations upon it; and many more, if invited, would do the same. But no one has invited co-operation;† consequently there is no system, and each one that observes, observes only for himself; and when he quits the sea, his observations go with him, and are to the world as though they had not been. * *

"Supposing the pressure of the waters that are *forced* into the Caribbean Sea by the trade winds to be the *sole* cause of the Gulf Stream, that sea and the Mexican Gulf should have a much higher level than the Atlantic. Accordingly, the advocates of this theory‡ require for its support 'a great degree of elevation.' Major Rennell likens the stream to 'an immense river descending from a higher level into a plain.' Now,

regard to that great anomaly of the ocean the Gulf Stream, and there will be—there can be, but one mind, as to the importance of making further observations, and of multiplying facts with regard to it. In simply reminding the society, that all we know of this wonderful phenomenon is contained chiefly in what Doctor Franklin said of it more than 50 years ago, that his facts were collected by chance as it were and his observations made with but few of the facilities which navigators now have, I feel that enough and all has been done that is necessary to be done, in order to impress the Institute with the importance of further observations upon it." * * * *
—*Paper on the Gulf Stream and currents of the sea. Read before the National Institute, April* 2, 1844, *by M. F. Maury, Lieut. U. S. N.*

*"Linked thus with other geological agents, the currents of the sea cannot fail to present themselves to the mind of the geologist as important and interesting subjects for investigation. How much more so are they in the eyes of the navigator; with him, the source of this coast current is a matter of conjecture, and its cause a mystery. And as to its strength, its fluctuations and the laws which govern them, his nautical books are all but silent. Nor has the history of navigation recorded the first series of systematic observations upon it.

"Proceeding further into the Atlantic, we find a vast stream of warm water running counter to this. It is the Gulf Stream bound from the Straits of Florida to the Banks of Newfoundland, and thence to the shores of Europe. What its breadth or its depth may be, we know not. We are told indeed that even at the same place it runs sometimes at the rate of two knots the hour, sometimes at five, and we know that it may always be found within certain broad limits, varying in this too at the same place, from 140 to 340 miles. With this our knowledge of it ends; though more accurate information as to it and its offsets would many a time have saved the mariner from disaster and shipwreck, and even now, would add not a little to the speedy and safe navigation of the Atlantic.

"Though navigators had been in the habit of crossing and recrossing the stream, almost daily, for the space of nearly 300 years, its existence even was not generally known among them, until after Dr. Franklin discovered the warmth of its waters, about 70 years ago. And to this day, the information which he gave us, constitutes the basis, I had almost said the sum and substance of all we know about it."—*Ibid.*

†The wind and current charts have called forth the co-operation here proposed.

‡That the Gulf Stream is caused by the trade winds.

we know very nearly the average breadth and velocity of the Gulf Stream in the Florida Pass. We also know, with a like degree of approximation, the velocity and breadth of the same waters off Cape Hatteras. Their breadth here is about 75 miles against 32 in the 'Narrows' of the Straits, and their mean velocity is three knots off Cape Hatteras against four in the 'Narrows.' This being the case, it is easy to show that the depth of the Gulf Stream off Hatteras is not so great as it is in the 'Narrows' of Bemini by nearly fifty per cent., and that, consequently, instead of *descending*, its bed represents the surface of an inclined plane from the North, *up* which the lower depths of the stream *must* ascend. If we assume its depth off Bemini to be two hundred fathoms, which are thought to be within limits, the above rates of breadth and velocity will give one hundred and fourteen fathoms for its depth off Hatteras. The waters, therefore, which in the Straits, are below the level of the Hatteras depth, so far from descending, are actually *forced up* an inclined plane, whose submarine ascent is not less than ten inches to the mile!

"The Niagara is an 'immense river descending into a plain.' But instead of preserving its character in Lake Ontario as a distinct and well defined stream for several hundred miles, it spreads itself out, and its waters are immediately lost in those of the Lake. Why should not the Gulf Stream do the same? It gradually enlarges itself it is true; but instead of mingling with the ocean by broadspreading as the 'immense rivers' descending into the northern lakes do, its waters, like a stream of oil in the ocean, preserve their distinctive character for more than 3,000 miles.

"Moreover, while the Gulf Stream is running to the North from its supposed elevated level at the South, there is a cold current coming down from the North; meeting the warm waters of the Gulf midway the ocean, it divides itself and runs *by the side of them* right back into those very reservoirs at the South, to which theory gives an elevation sufficient to send out entirely across the Atlantic a jet of warm water said to be more than three thousand times greater in volume than the Mississippi river. This current from Baffin's Bay has not only no trade winds to give it a head; but the prevailing winds are unfavorable to it, and for a great part of the way it is below the surface, and far beyond the propelling reach of any wind. And there is every reason to believe that this polar current is quite equal in volume to the Gulf Stream. Are they not the effects of like causes? If so, what have the trade winds to do with the one more than the other?

"Nay more. At the very season of the year when the Gulf Stream is rushing in greatest volume through the Straits of Florida and hastening to the north with the greatest rapidity, there is a cold stream from Baffin's Bay, Labrador, and the coasts of the north, running to the south with equal velocity. Where is the trade wind that gives the high level to Baffin's Bay, or that even presses upon or assists to put this current in motion? The agency of winds in producing currents in the deep sea must be very partial.

"These two currents meet off the Grand Banks, where the latter is divided. One part of it underruns the Gulf Stream, as is shown by the icebergs which are carried in a direction tending across its course. The probability is, that this 'fork' *continues on towards the south*, and runs into the Caribbean Sea, for the temperature of the water at a little depth there, has been found far below the mean temperature of the earth, and quite as cold as at a corresponding depth off the Arctic shores of Spitzbergen. * * * *

"More water cannot come from the equator or the pole than goes to it. If we make the trade winds to cause the former, some other wind must produce the latter; but these, cold currents for the most part, and for great distances, are *submarine*, and therefore beyond the influence of winds. Hence, it should appear that *winds* have little to do with the general system of aqueous circulation in the ocean.

"The other 'fork' runs between us and the Gulf Stream to the South as already described. As far as it has been traced, it warrants the belief that it too runs *up* to seek the so called *higher* level of the Mexican Gulf. * * * * * * *

"Therefore this immense volume of water, in passing from the Bahama to the Grand Banks, meets with an opposing force in the shape of resistance, sufficient in the aggregate to retard it two miles and a half the minute, and this only in its eastwardly rate. There is, doubtless, another force quite as great, retarding it towards the north, for its course shows that its velocity is the resultant of two forces acting in different directions. If the former resistance be calculated according to received laws, it will be found equal to several atmospheres. And by analogy, how inadequate must the pressure of the gentle trade winds be to such resistance, and to the effect assigned them? If, therefore, in the proposed inquiry we search for a propelling power nowhere but in the higher level of the Gulf, we must admit, in the head of water there, the existence of a force capable of putting in motion and driving over a plain, at the rate of 5 miles the hour, all the waters as fast as they can be brought down by 3,000 such streams as the Mississippi river—a power at least sufficient to overcome the resistance required to reduce from two miles and a half to a few feet per minute, the velocity of a stream that keeps in perpetual motion one-fourth of all the waters of the Atlantic Ocean. * * *

"But, in addition to this, may there not be a peculiar system of laws not yet revealed, by which the motion of fluids in such large bodies is governed when moving through each other in currents of different temperature. That currents of sea-water, having different temperatures, do not readily commingle, is shown by the fact already mentioned: that the line of separation between the warm waters of the Gulf and the cold waters of the Atlantic is perfectly distinct to the eye for several hundred miles; and even at the distance of a thousand miles, though the two waters have been in contact and continued agitation for many days, the thermometer shows that the *cold water on either side still performs the part of river banks* in keeping the warm waters of the stream in their proper channel.

"In a winter's day off Hatteras, there is a difference between these waters of near 20°. Those of the Gulf being warmer, we are taught to believe that they are lighter; they should therefore occupy a higher level than those through which they float. Assuming the depth here to be 114 fathoms, and allowing the usual rates of expansion, figures show that the middle of the Gulf Stream here should be nearly 2 feet higher than the contiguous waters of the Atlantic. Were this the case, the surface of the stream would present a double inclined plane, from which the water would be running down on either side, as from the roof of a house. As this ran off at the top, the same weight of colder water would run in at the bottom; and thus, before this mighty stream had completed half its course, its depths would be brought up to the surface, and its waters would be spread out over the ocean. Why then does not such a body of warm water, flowing and adhering together through a cold sea, obey this law, and occupy a higher level? If it did, the upper edges of its *cold banks* would support a lateral pressure of at least 100 lbs. to the square foot; and vessels in crossing it, would sail over a ridge as it were; on the east side of which, they would meet an easterly current; and on the west side, a westerly current. * * * * * *

"The maximum temperature of the Gulf Stream is 86°, or about 9° above the ocean temperature due the latitude. Increasing its latitude 10°, it loses but 2° of temperature. And, after having run 3,000 miles towards the north, it still preserves, even in winter, the heat of summer. With this temperature it crosses the 40th degree of north latitude, and there, overflowing its *liquid banks*, it spreads itself out for thousands of square leagues over the cold waters around, and covers the ocean with a mantle of warmth that serves so much to mitigate in Europe the rigors of winter. Moving now more slowly, but dispensing its genial influences more freely, it finally meets the British Islands. By these it is divided, one part going into the polar basin of Spitzbergen, the other entering the Bay of Biscay, but each with a warmth considerably above ocean temperature. Such an immense volume of heated water cannot fail to carry with it beyond the seas a mild and moist atmosphere. And this it is which so much softens climate there. * * *

"May there not exist between the waters of the stream and their *fluid banks*, always heaving and moving to the swell of the sea, a sort of *peristaltic* force, which, with other agents, assists to keep up and preserve this wonderful system of ocean circulation? * * * *

"The line of meeting between the waters of the Gulf Stream and the Atlantic is distinct to the naked eye for several hundred miles. This unreadiness of cold and tepid sea-water to commingle has been often remarked upon, and seems to impart to one current the power of dividing and turning others aside. Thus the Gulf Stream bifurcates the Labrador current, one part of which underruns the Gulf Stream, and the other takes a southwestwardly direction along the coast. * * * *

"*It would be curious to ascertain the routes of these under-currents on their way to the tropical regions,* which they are intended to cool. One has been found at the equator 200 miles broad, and 23° colder than the surface water. Unless the land or shoals intervene, it no doubt comes down in a spiral curve. * *

"What time more fit,—what occasion more suitable than the present, for maturing a plan of operations, and for setting on foot a system of observations upon the Gulf Stream, and its kindred phenomena of the sea."*

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* From this question may be traced the origin of the undertaking which has resulted in the "wind and current charts." The association appreciating the importance of the subject, and the suggestions connected with it, readily came forward and used their influence in behalf of the undertaking. It was remarked to them then:

"Gentlemen here, and good men everywhere, can do much to aid in this plan by giving it their countenance, and using their influence with masters, by inducing them to send to Washington an abstract of their logs, though it contain only the track of the vessel, with the winds and temperatures. Even this would be valuable, and anything additional would be much more so. Our whalemen do collect, and have it in their power to give much truly valuable information. That which they collect concerns the meteorologist, the naturalist, and others, not less than the navigator and geologist. Indeed, the ocean, with its almost unsealed book of mysteries, presents to the votary of science, whatever be the name of his association, a common highway, upon which each society, like every nation, may make its ventures, and return in vessels laden with treasures to enrich the mind and benefit the human race."—*Extract from a "Paper on the Currents of the Sea as connected with Geology, read before the Association of American Geologists and Naturalists, May 14, 1844—by M. F. Maury, Lieut. U. S. N."*

Thus, by a process of reasoning and argument, it was shown more than seven years ago that the Gulf Stream, as far as the Banks of Newfoundland, flows through a *bed* of cold water, which cold water performs to the warm the office of *banks* to a river;* and which "cold banks" thus pointed out, were discovered with the deep-sea thermometer by Lieut. George M. Bache, U. S. N., in 1846, while operating in connection with the Coast Survey. They partake so decidedly of the character of *banks to a river*, that in the annual report of the Coast Survey for 1846, and elsewhere, these banks were likened to a "cold wall;" and by Lieut. Bache in his report to the superintendent of the survey, to "a bank of cold water against which the Gulf Stream butts up."†

It was also theoretically shown that the Gulf Stream actually flows up hill: ‡

That its bottom is a bed of cold water: §

That it bifurcates a cold stream from the north, near the Banks of Newfoundland, and that one fork of this stream pursues thence, on the other side of the Gulf Stream, a *southwestwardly* course as a current of cold water, for the most part submarine :||

That it is bifurcated by the British Isles :¶

And that its surface is a double inclined plane, having the ridge, or line of meeting of the two planes near the axis of the stream—from which the surface water, like the rain from the roof of a house, runs off towards each side.**

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* "The cold water on either side, still at the distance of a thousand miles, performs the part of *river banks* in keeping the warm water of the (Gulf) Stream in the proper channel."—*Paper on the Gulf Stream and Currents of the Sea.*

† "Here on the left we have the main currents of the (Gulf) Stream turned to the eastward by Cape Hatteras, and *butting up against a bank of cold water*, which it overflows."—*Report of Coast Survey*, 1846, *Appendix, No.* 4, *page* 50.

‡ "It is easy to show that the depth of the Gulf Stream off Hatteras is not so great as it is in the "narrows" off Bemini by nearly 50 per cent., and that consequently, instead of *descending*, its bed represents the surface of an inclined plane from the north, up which the lower depths of the stream *must* ascend. If we assume its depth off Bemini to be 200 fathoms,[1] which are thought to be within limits, the above rates of breadth and velocity will give 114 fathoms for its depth off Hatteras. The waters, therefore, which in the Straits are below the level of the Hatteras depth, so far from descending, are actually forced up an inclined plane, whose submarine ascent is not less than 10 inches to the mile."—*Paper on the Gulf Stream and Currents of the Sea, read before the National Institute by M. F. Maury, Lieut. U. S. N.*, *April* 2, 1844.

[1] Its depth in the Florida Pass has been ascertained by the officers of the United States ship "Albany," Commander Platt, acting under the instructions of Commodore Warrington, to be 500 fathoms. That is, bottom has been obtained at that depth. Whether the Gulf Stream water reaches all the way to the bottom, is another question.

§ "As this," (the warm water of the Gulf Stream made specifically lighter by its temperature,) "ran off at the top, *the same weight of colder water* would run in at the bottom."—*Ibid.*

"The Gulf Stream bifurcates the Labrador current; one part of which *underruns* the Gulf Stream."—*Paper on the Currents of the Sea as connected with Geology; read before the Association of American Geologists and Naturalists, May 14th,* 1844, *by M. F. Maury, Lieut. U. S. N.*

|| "Apparently, in obedience to the laws here hinted at, there is a constant tendency of polar waters towards the tropics, and of tropical waters towards the poles."—*Lieut. Maury on the Gulf Stream.*

"It would be curious to ascertain the routes of these under currents on their way to the tropical regions, which they are intended to cool. One has been found at the equator, 200 miles broad, and 23° colder than the surface water. Unless the land or shoals intervene, it no doubt comes down in a spiral curve; meeting the warm waters of the Gulf midway the ocean, (the cold current) divides itself, and runs by the side of them right back into those very reservoirs at the South."—*Ibid.*

¶ "It finally meets the British Islands. By these it is divided—one part going into the polar basin of Spitzbergen; the other entering the Bay of Biscay."—*Ibid.*

** "In a winter's day off Hatteras, there is a difference between these waters of near 20°. Those of the Gulf being warmer, we are taught to believe that they are lighter; they should therefore occupy a higher level than those through which they float. Assuming the depth here to be 114 fathoms, and allowing the usual rates of expansion, figures show that the middle of the Gulf

Thus most, if not all the conditions which the study of the subject induced me in 1844 to announce as theoretically to exist, have since, as already remarked, been converted into physical facts, by the operations of the Coast Survey, or by the navigators who have been observing in connection with the wind and current charts.

The observations made in 1846 by Lieut. George M. Bache, U. S. N., for the Coast Survey,* and continued in 1847† and 1848‡ by Lieutenants S. P. Lee and Richard Bache upon the deep sea and surface temperatures in and about the Gulf Stream, and confirmed as to the surface temperatures by these charts, as well as by the observations of Lieut. J. C. Walsh, U. S. N., while observing in connexion with them in 1850—this mass of careful observations thus collected—all goes to confirm the theoretical suggestions of 1844 with regard to the *cold banks* and currents of cold water over or through which the Gulf Stream finds its way to the northward.

The officers of the Coast Survey already alluded to, announced the banks of the Gulf Stream off the coasts of North Carolina and Virginia, to be a "wall of cold water." They also found, as had already been predicted, the water at great depths to be a very low temperature—38° of Fahrenheit.

They also found on the surface of the ocean, east of the Gulf Stream, layers or streaks of warm water; it was inferred by them that this warm water comes from the Gulf Stream,—that it sent off a branch in the direction of the Island of Bermuda. It was concluded, therefore, that here was a bifurcation of this stream.

In 1850, Lieut. Walsh, who was sent out in the U. S. schooner "Taney," to make certain observations which Congress had authorized the Secretary of the Navy to have made, in connection with my researches concerning the winds and currents of the sea, found like layers or streaks of warm and cold water, and came to a like conclusion as to this bifurcation or "off-set" of the Gulf Stream.

In a letter giving me an account of his cruise, which was unfortunately interrupted by his vessel proving to be unseaworthy, he says; "we discovered the *hot waters of the Gulf Stream* extending as far East as 72° 10′, in a latitude so far South as 33° 30′. The column of water temperature in the Abstract, from May 23 to 29, while engaged in the search for Ashton Rock, will satisfy you of this interesting and important fact, for you will notice that whenever we reached that longitude in our various tracks between the latitudes of 33° 30′ and 34° North, we experienced a sudden change of as much as 5° and 6° in the surface temperature,—70° to 76°:—this must be a branch or off-set from the Gulf Stream." This "discovery" is claimed by the Coast Survey.

Stream here should be nearly two feet higher than the contiguous waters of the Atlantic. Were this the case, the surface of the stream would present a double inclined plane, from which the water would be running down on either side, as from the roof of a house. As this ran off at the top, the same weight of colder water would run in at the bottom; and thus, before this mighty stream had completed half its course, its depths would be brought up to the surface, and its waters would be spread out over the ocean. Why then does not such a body of warm water, flowing and adhering together through a cold sea, obey this law, and occupy a higher level?"

* *Vide* "Annual Report of the Coast Survey for 1846."

† *Vide* "Annual Report of the Coast Survey for 1847."

‡ *Vide* "Annual Report of the Coast Survey for 1848."

Now, these charts do not show that the temperature of the ocean between these parallels beyond the usual limits of the Gulf Stream is permanently any higher than it is between the same parallels generally, until you approach the coast of Africa. The isotherms of 70° for each month, generally, after leaving the Gulf Stream, stretch off to the Eastward, going up as high in some months as the parallel of 45°. Recrossing the parallel of 40° North, between the meridians of 15° and 20° W., they then make a sharp turn to the Southward and Eastward, showing all the surface water between these lines and the equator to be permanently 70° and upwards. It is not probable, therefore, that the Gulf Stream can supply such an extent of ocean with its warm waters; nor is it clear that the warm water of the cool and warm streaks, reported as above, comes from the Gulf of Mexico. The cool water is probably the intruder from below; indeed, these charts have revealed a natural process of heating and cooling the surface of the ocean, which I am not aware has been discovered before. It is exceedingly beautiful, and goes far to explain this phenomenon of the streaks: when the rays of the sun are operating with their greatest intensity in the northern hemisphere, they then raise the temperature of the equatorial surface of the ocean to the highest pitch. Its waters thus becoming lighter, flow to the north in a gentle surface current of warm water; and this current is probably too feeble to be detected by vessels in the ordinary course of navigation.

Thus the isotherm of 80°, for example, will pass from its extreme southern to its extreme northern declination—near 2,000 miles—in about three months.

Being now left to the gradual process of cooling by evaporation, atmospherical contact, and radiation, it occupies the other eight or nine months of the year, in slowly returning south to the parallel whence it commenced to flow northward. How natural that in flowing north it should go in layers; and in cooling, that some parts should cool faster than the others; also, that the cool water from below should now and then be forced up through the mantle of warm water with which the heat has covered certain parts of the ocean. When we come down to the lower temperatures—the isotherm of 60° for example—the reverse takes place. In this case the most rapid motion of this isotherm is due to a movement of the waters from the hyperborean regions.

Between the meridians of 25° and 30° west, the isotherm of 60° in September, ascends as high as the parallel of 56° N. In October, it reaches the parallel of 50° north. In November, it is found between the parallels of 45° and 47°, and by December, it has nearly reached its extreme southern descent between these meridians, which it accomplishes in January, standing then near the parallel of 40°. It is all the rest of the year in returning northward to the parallel whence it commenced its flow to the South in September.

Now it will be observed, that this is the season—from September to December—immediately succeeding that in which the heat of the sun has been playing with greatest activity upon the polar ice. Its melted waters which are thus put in motion in June, July, and August, would probably occupy the fall months in reaching the parallels indicated.

These waters, though cold and rising gradually in temperature as they flow south, are probably fresher; and if so, probably lighter than the sea water; and therefore it may be, that both the warmer and cooler systems of these isothermal lines are made to vibrate up and down the ocean by a gentle surface current in the season of quick motion; and in the seasons of the slow motion, by a gradual process of calorific absorption in the one case, and by a gradual process of cooling in the other.

We have the same phenomena exhibited by the waters of the Chesapeake Bay during the winter.

At this season of the year, the charts show that water of very low temperature is found projecting out and over-lapping the usual limits of the Gulf Stream. The outer edge of this cold water, though jagged, is circular in its shape, having its centre near the mouth of the bay. The waters of the bay being fresher than those of the sea, may therefore, though colder, be lighter than the warmer waters of the ocean. And thus we have repeated here, though on a smaller scale, the phenomenon as to the flow of the cold waters from the North, which force the surface isotherm of 60° from latitude 56° to 40° during three or four months.

We have, in the making of ice and in the melting of it again, examples of this irregularity of outline on a still smaller scale. In the freezing of an ordinary pond, the fascicles of ice shoot out, and represent with their spires, the jagged edges, or the cold and warm streaks alluded to. They perfectly illustrate in freezing, the manner in which a gentle current of warm water overflowing a surface of cold water may be supposed to send out its couriers or advance streams ahead; and, in melting, the reverse, or the case of the cold water intruding upon the warmer.

Changes in the color or depth of the water, and the shape of the bottom, &c., would also cause changes in the temperature of certain parts of the ocean, by increasing or diminishing the capacities of such parts to absorb or radiate heat.

From these facts, and in the view which I am induced to take of them, I am led to infer that the mean temperature of the atmosphere between the parallels of 56° and 40° North, and over that part of the ocean in which we have been considering the fluctuation of the isothermal line of 60°, is at least 60° of Fahrenheit—and upwards, from January to August, and that the heat which the waters of the ocean derive from this source, atmospherical contact and radiation, is one of the causes which move the isotherm of 60° from its January to its September parallel.

It is well to consider another of the causes which are at work upon the currents in this part of the ocean, and which tend to give the rapid southwardly motion to the isotherm of 60°.

We know the mean dew point must always be below the mean temperature of any given place; and that consequently, as a general rule at sea, the mean dew point due the isotherm of 60°, is higher than the mean dew point along the isotherm of 50°, and this again higher than that of 40°—this than 30°, and so on.

Suppose, merely for the sake of illustration, that the mean dew point for each isotherm be 5° lower than the mean temperature, we should then have the atmosphere which crosses the isotherm of 60°, with a mean dew point of 55°, gradually precipitating its vapors until it reaches the isotherm of 50°, with a mean dew point of 45°. By which difference of dew point the total amount of precipitation over the entire zone, between the isotherms of 60° and 50° has exceeded the total amount of evaporation from the same surface.

Now, as a general rule in the Atlantic ocean, and it may be inferred in the Pacific also, the prevailing direction of the winds, to the North of the 40th parallel of North latitude, is from the southward and westward, in other words, it is from the higher to the lower isotherms; passing, therefore, from a higher to a lower temperature over the ocean, the total amount of vapor deposited by any given volume of atmosphere, as it is blown from the vicinity of the tropical towards that of the polar regions, is greater than that which is taken up again. How the land may modify this position is another question. I speak of the rule at sea, not of the exceptions on the land.

Now then, these investigations have brought out prominently before us the fact, that there is near the tropics, both of Cancer and Capricorn, a belt of calms across the great oceans. That on the equatorial side of these belts, the winds at the surface of the sea blow permanently towards the equator—i. e., they come from a cooler and go to a warmer region; thus increasing their capacity for moisture, and consequently taking up more vapor in this part of their circuit than they precipitate down upon it again.

On the polar side of these calm belts of the tropics, the prevailing direction of the wind on the surface of the ocean is towards the poles—i. e., from a warm to a colder temperature; and therefore in this part of their circuit, these winds must deposite more vapor than they can take up again.

These facts, though they be not new, yet they are pressed by the charts so forcibly upon us, that we are led irresistibly to the theorétical conclusion that the trade-wind regions of the ocean are the evaporating regions, and that as a general rule in all other regions of the world, except the deserts, and a few others, mostly on the land, the evaporation is less than the precipitation, and that the excess is returned by the rivers and the rains in the shape of currents from towards the poles to the evaporating regions of the Torrid Zone;—and that the total amount of rain and river water discharged into the sea, without the limits of the evaporating region, expresses the volume by which the cold currents exceed the warm currents of the sea—designating as cold currents all those which run into the Torrid Zone; and all those as warm, which bring their waters from it.

These charts indicate that upon the ocean, the area comprehended between the isotherms of 40° and 50° Fahrenheit, is less than the area comprehended between isotherms 50° and 60°; and this again less than the area between this last and 70°;—for the same reason that the area between the parallels of latitude 50° and 60° is less than the area between the parallels of latitude 40° and 50°; and they indicate that *theoretically* more rain to the square inch ought to fall upon the ocean between the colder isotherms of 10° difference, than between the warmer isotherms of the same difference.

Thus, to make myself clear: the aqueous isotherm of 50° in its extreme northern reach, touches the parallel of 60° N. Now, between this and the equator there are but three isotherms; 60°, 70° and 80°, with the common difference of 10°. But between the isotherm of 40° and the pole, there are at least five others, viz.: 40°, 30°, 20°, 10°, and 0°, with a common difference of 10°. Thus to the North of the isotherm 50°, the vapor which would saturate the atmosphere from zero, and perhaps far below, to near 40° is deposited; while to the South of 50° the vapor which would saturate it from the temperature of 50° up to that of 80°, can only be deposited. At least such would be the case if there were no irregularities of heated plains, mountain ranges, land, &c., to disturb the ocean laws of atmospherical circulation.

Having therefore theoretically at sea, more rain in high latitudes, we should have more clouds: and therefore it would require a longer time for the sun, with his feeble rays, to raise the temperature of the cold water, which from September to January has brought the isotherm of 60° from latitude 56° to 40°, than it did for these cool surface currents to float it down.

After this southward motion of the isotherm of 60° has been checked in December by the cold, and after the sources of the current which brought it down have been bound in fetters of ice, it pauses in the long nights of the northern winter, and scarcely commences its return till the sun recrosses the equator, and increases its power, as well in intensity as in duration.

Thus we have here, for the first time beautifully developed, the effects of night and day, of clouds and sunshine, upon the currents of the sea. These effects are modified by the operations of more powerful agents, which reside upon the land; nevertheless, feeble though those of the former class be, a close study of the thermal charts will indicate that they surely exist.

Now returning towards the South :—we may on the other hand infer that the mean atmospherical temperature for the parallels between which the isotherm of 80° fluctuates, is below 80° at least, for the nine months of its slow motion. This vibratory motion suggests the idea that there is probably somewhere between the isotherm of 80° in August, and the isotherm of 60° in January, a line or belt of invariable, or nearly invariable temperature, which extends on the surface of the ocean, from one side of the Atlantic to the other. This line, or band, may have its cycles also, but they are probably of long periods.

Theoretically, such a line ought to be found for any given year, but its place for one entire year may not coincide with its place for another, though the motion of such a belt from year to year would probably be very small.

The observations upon which these charts are founded run through a period of half a century; consequently they show the temperature for the months only, without regard to the year, and therefore they do not enable us to decide satisfactorily as to the existence of such a belt of uniform, or nearly uniform, ocean temperatures for any one year.

Taking the isotherms of 50° and 60° to illustrate the manner generally, in which the waters of different temperatures run into each other, we shall find that their line of separation is not smooth, but jagged. The line of junction between the warm and cold waters of the sea, is not unlike the sutures of the skull bone on a grand scale. The waters of one temperature are dovetailed and fitted into those of another, in apparently the most irregular manner; but nevertheless, like the sutures of the skull when they come to be examined closely, these lines of articulation clearly indicate traces of symmetry. They have their laws.

Now a vessel,—when waters of marked differences of temperature meet,—that sails along near their line of junction, will come across layers or streaks of water, at one time warmer, at another cooler. Where a jagged point of warmer water is found in one month to thrust itself up into a body of cooler water, perhaps the next month it will be found that this obtruding of the warm water has disappeared, and given place to the intrusion from the cooler water, of an articulating surface equally irregular in its outlines. Such layers of cooler and warmer streaks of water are generally to be found along that part of the usual sailing route between New York and the north of Europe, which runs with the Gulf Stream.

A better idea as to these irregularities in the temperature of the ocean, cannot be conveyed than by quoting from the logs of a few of the many vessels in that trade, which are co-operating with me in collecting materials for the "Wind and Current Charts," and from which it will be seen that it is by no means an extraordinary occurrence for the water thermometer, in the course of one good day's sail, to pass through a range—up and down—of 50°.

EXTRACT FROM ABSTRACT LOGS.

1850.	Latitude.	Longitude.	Temperature of water.	Change of Temperature.	
	° ′	° ′	°	°	
May 6	39.43 N.	64.0 W.	66	+ 20	Ship "Prince Albert," Capt. Meyer,—New York to London. 1850.
7	41.5	62.10	42	— 24	
8	42.20	60.0	41	— 1	
9	40.27	59.15	66	+ 25	
10	41.55	56.10	48	— 18	
11	41.34	52.0	60	+ 12	
12	41.5	50.10	60	0	
13	42.20	46.0	51	— 9	
14	44.10	42.20	68	+ 17	
15	45.20	40.30	62	— 6	
May 9	40.36 N.	67.23 W.	46	— 1	Ship "Ticonderoga," Captain Farran,—New York to Liverpool. 1850.
10	41.10	63.30	62	+ 16	
11	41.0	59.32	54	— 8	
12	41.33	55.44	45	— 9	
13	41.26	52.8	60	+ 15	
14	40.52	49.0	64	+ 4	
15	41.50	47.33	51	— 13	
16	42.19	47.5	44	+ 3	
17	43.19	44.34	64	+ 10	
May 27	38.41 N.	70.41 W.	54	+ 3	Ship "Queen of the West," Capt. Hallet,—New York to Liverpool. 1850.
28	38.56	64.17	78	+ 24	
29	41.20	59.10	52	— 26	
30	41.31	55.23	57	+ 5	
31	44.16	48.34	40	— 17	
June 1	44.16	43.15	57	+ 17	
2	45.28	30.58	61	— 4	
3	46.29	35.53	55	— 6	
May 30	40.30 N.	66.5 W.	60	0	Ship "Princeton," Captain Russell,—New York to Liverpool. 1850.
31	41.45	65.0	42	— 18	
June 1	41.1	63.37	60	+ 18	
2	40.16	61.41	48	— 12	
3	41.14	57.37	62	+ 14	
4	41.49	56.49	64	+ 2	
7	42.21	50.18	44	— 20	
9	44.18	42.29	60	+ 16	
10	44.38	38.42	52	— 8	
11	46.10	33.57	58	+ 6	

EXTRACTS—Continued.

1850.	Latitude.	Longitude.	Temperature of water.	Change of Temperature.	
	° ′	° ′	°	°	
June 13	41.35 N.	52.55 W.	66	+ 4	Ship "Ivanhoe," Captain King,—New York to Liverpool. 1850.
14	42.8	48.21	49	— 17	
15	43.0	44.39	66	+ 17	
June 10	41.55 N.	51.40 W.	63	+ 13	Ship "New York," Captain Marshall,—New York to Liverpool. 1850.
11	41.47	48.20	54	— 9	
June 30	40.29 N.	61.14 W.	62	+ 2	Ship "Roscius," Captain Eldridge,—New York to Liverpool. 1850.
July 1	41.29	59.41	74	+ 12	
2	41.30	53.20	70	— 4	
3	41.37	48.38	58	— 12	
4	41.27	46.14	68	+ 10	
June 17	42.49 N.	51.50 W.	53	+ 3	Ship "West Point," Captain Allen,—New York to Liverpool. 1850.
18	43.35	49.20	47	— 6	
19	45.4	44.0	57	+ 10	
Feb. 6	42.53 N.	52.49 W.	38	— 3	Ship "Philadelphia," Capt. Stotesbury,—New York to Liverpool. 1850.
7	43.58	48.08	31	— 7	
8	44.37	43.44	57	+ 26	
Dec. 19	40.46 N.	68.24 W.	46		Royal Mail Steamer "Asia," Captain Judkins, from New York to Liverpool. 1850.
20	42.55	62.50	50	+ 4	
21	44.23	56.54	40	— 10	
22	46.50	51.24	40	0	
23	48.50	44.55	30	— 10	
24	50.41	37.52	46	+ 16	
25	51.22	29.27	52	+ 6	
26	51.34	20.48	53	+ 1	
27	51.17	12.59.45	57	+ 4	
Dec. 17	40.10 N.	55.51	68	— 3	Ship "Argo," Captain Crawford,—New York to Havre. 1849.
18	42.02	52.30	47	— 21	
19	42.52	48.48	38	— 9	
20	43.00	45.40	37	— 1	
21	42.33	45.26	61	+ 24	

These extracts are taken at random. They will give those who have not access to the charts some idea of the changes of temperature in these streaks of cold and warm water. They will also afford a clue as to the frequency with which these cold and warm streaks change their positions.

There is on this route a peninsula or island of cold water, which hangs down into the Gulf Stream like a curtain dropped from the North. Its position, as well as its dimensions, vary. It often covers several degrees in extent—and it affords instances of the greatest and most sudden changes that are known to take place in the temperature of the surface waters of the sea. It is generally found about the parallel of 45°, and the meridian of 50°. Covering frequently an area of hundreds of miles in extent, its waters differ as much as 20°, 25°, 30°; and, in rare cases, even as much as 35° of temperature from those about it.

These waters, doubtless, come down from the cold regions of the North, and are perhaps in the strongest part of that current.

The bottom of the sea in that region—the Grand Banks—assists, no doubt, in forcing this mass of cold waters to the surface; and the fact that they penetrate far down across the usual track of the Gulf Stream, at times almost cutting it in two as it were, seems to indicate that their momentum here is greater than the momentum of the warm waters of the Gulf Stream, which they push aside; or it may be that this part of the ocean is very shallow. It would be interesting to ascertain as to this with lead and line.

Between this peninsula of cold water and Newfoundland there is a layer or branch of warm waters; perhaps these are brought there by a bifurcation of the Gulf Stream. Here we have clearly and unexpectedly unmasked the very seat of that agent which produces the Newfoundland fogs. It is spread out over an area frequently embracing several thousand square miles in extent, covered with cold water, and surrounded on three sides, at least, with an immense body of warm. May it not be that the proximity to each other of these two very unequally heated surfaces out upon the ocean would be attended by atmospherical phenomena not unlike those of the land and sea breezes? These warm currents of the sea are powerful meteorological agents. I have been enabled to trace, in thunder and lightning, the influence of the Gulf Stream in the eastern half of the Atlantic as far North as the parallel of 55° N.; for there, in the dead of winter, a thunder storm is not unusual.

Reviewing now what has been said concerning the layers of cold and warm water along the European route of the Gulf Stream, and returning to the cool and warm streaks mentioned by Lieut. Walsh, and claimed by the Coast Survey as the discovery of a "branch" from the Gulf Stream: it appears probable that the warm waters which they encountered, and reported as coming from the Gulf Stream, are the warm waters properly due the latitude, and the effect of the South America shore line as far as Cape St. Roque, in sending North its warm waters. The difference of temperature may be partly due, also, to the warm waters of the surface being separated into streaks by the cooler waters of the submarine current which by the agitation of the ocean are here and there brought to the surface through the thin layer of warm surface water.

If we draw a line of a degree or two in breadth from the capes of the Chesapeake and the Delaware Bays towards Cape St. Roque in Brazil, we shall find in this direction, after crossing the Gulf Stream, a remarkable layer of cold water. This layer extends to the equator, and is more clearly marked at some seasons of the year than at others:—so much so that I have been at a loss to account for it. Like an immense lake, it is surrounded with waters of a higher temperature. It cannot therefore be brought there by a cold surface current. It is strictly a *layer*, in contradistinction to a current.

The only idea that has suggested itself in explanation of this phenomenon is in the conjecture that there may be stretching off in this direction, a submerged mountain range or ridge at the bottom of the sea, across which the cold waters of this submarine current as it forces itself down towards the equator, are brought to the surface by the agitation of the waves.

Standing out like peaks in this range are the islands of Fernando de Noronha, the Penedo de San Pedro, and the Bermudas. The islands and mountains of Cuba occupy a position which a mountain spur from this sunken range might be supposed to occupy,

Lieut. Walsh, in the "Taney," was directed to run across this supposed submarine range of mountains, a zig-zag line of deep-sea soundings from the equator to the capes of Virginia. But unfortunately his schooner proved unseaworthy, and he had to abandon this interesting part of his work.

Capt. Powell, of the U. S. S. "Jno. Adams," in 1850, found himself on a shoal in the South Atlantic, and the fact was first made known entirely by the change in temperature of the surface water. Finding the water to become cool, he got a cast of the deep-sea lead, and found bottom. These facts, as far as they go, give some sort of plausibility to the conjecture, concerning this streak of cool water. Lieut. Commanding S. P. Lee, about to sail in the "Dolphin," has instructions thoroughly to investigate it.

The isotherms of 60°, 50°, and 40°, take a northeastwardly direction across the Atlantic, and show the waters of the ocean to be as warm, indeed warmer, between latitude 60° and 65° off the shores of Europe, than they are on this side near the parallels of 40° and 45°.

That the Gulf Stream is roof-shaped: that is, it is higher in the middle and lower at the edges—and that it has a roof-current running from the middle or axial line to either edge, as suggested in 1844, has been proved by experiments since made with regard to it, by officers of the navy.

Thus, in lowering a boat to try a current, they found that the boat would invariably be drifted towards one side or other of the stream, while the vessel herself was drifted along in the direction of it. Now were it possible to make a vertical section across the Gulf Stream, the top of it would appear convex, and the bottom concave, unless where the bottom of it reaches the bottom of the sea.

This feature of the Gulf Stream throws a gleam of light upon the *locus* of the Gulf weed, by proving that its place of growth cannot be on this side (west) of the middle of that stream. No Gulf weed is ever found west of the axis of the Gulf Stream; and, if we admit the top of the stream to be higher in the middle than at the edges, it would be difficult to imagine how the Gulf weed should cross it, or get from one side of it to the other.

The inference, therefore, would be, that as all the Gulf weed which is seen about this stream is on its eastern declivity, the *locus* of the weed must be somewhere within or near the borders of the stream, and to the east of the middle. And this idea is strengthened by the report of Captain Scott, a most intelligent shipmaster, who informs me that he has seen the Gulf weed growing on the Bahama Banks. I have specimens of it which he had the kindness to send me, with seed vessels, plucked up from the bottom while at anchor on the edge of the Gulf Stream. Hence we account for the fact that the Gulf weed should be seen on the eastern and not on the western borders of the Gulf Stream.

A study of the thermal charts will reward the student with new and better ideas as to the system of oceanic circulation. Plate VII exhibits the mean geographical position of the isotherms for various degrees of Fahrenheit from 80° down for each month. These lines are taken from the Thermal Charts, series D.

Let us take the isotherm of 80° for September as an illustration:—the greatest effect of the solar heat is produced upon the land during the month of August; but this chart shows that it is September before the North Atlantic Ocean is fully supplied with its annual store of heat for the winter.

We see clearly enough by the monthly isotherm for 80°, that the western half of the Atlantic Ocean is heated up, not by the Gulf Stream alone, as is generally supposed, but by the great equatorial cauldron to the West of Long. 35°, and to the North of Cape St. Roque, in Brazil. The lowest reach of the 80° isotherm for September—if we except the remarkable equatorial flexure which actually extends from 40° to 2° N., and rises up again to 35° N.—to the West of the meridian of Cape St. Roque is above its highest reach to the East of that meridian. And now that we have the fact, how obvious, beautiful and striking is the cause!

Cape St. Roque is in 5° S. Now study the configuration of the Southern American continent from this Cape to the Windward Islands of the West Indies, and take into account also, certain physical conditions of these regions:—The Amazon always at a high temperature because it runs from West to East, is pouring an immense column of warm water into this part of the ocean. As this water and the heat of the sun raise the temperature of the ocean along the equatorial sea-front of this coast, there is no escape for the liquid element, as it grows warmer and lighter, except to the North. The land on the South prevents the tepid waters from spreading out in that direction as they may do to the East of 35° W., for here there is a space about 18° of Long. broad in which the sea is clear both to the North and South.

They must consequently flow North. A mere inspection of the thermal chart is sufficient to make obvious the fact, that the warm waters which are found East of the usual limits assigned the Gulf Stream, and between the parallels of 30° and 40° N. do not come from the Gulf Stream, but from this great equatorial cauldron, which Cape St. Roque blocks up on the South, and which forces its overheated waters up to the 40th degree of North latitude, not through the Caribbean sea and Gulf Stream, but over the broad surface of the left bosom of the Atlantic ocean.

Here we are again tempted to pause and admire the beautiful revelations which in the benign system of terrestrial adaptation, these researches unfold and spread out before us for contemplation. In doing this, we shall have a free pardon from those at least who delight "to look through nature up to nature's God."

What two things in nature can be apparently more remote in their physical relations to each other, than the climate of western Europe and the profile of a coast line in South America? Yet this chart reveals to us not only the fact that these relations between the two are most intimate, but makes us acquainted with the arrangements by which such relations are established.

The barrier which the South American shore line opposes to the escape on the South, of the hot waters from this great equatorial cauldron of St. Roque, causes them to flow North, and, in September, as the winter approaches, to heat up the western half of the Atlantic Ocean, and to cover it with a mantle of warmth above summer heat as far up as the parallel of 40°. Here heat to temper the winter climate of western Europe is stored away, as in an air chamber to furnace-heated apartments; and during the winter, when the fire of the solar rays sinks down, the westwardly winds and eastwardly currents, are sent to perform their office in this benign arrangement. Though unstable and capricious to us they seem to be, they nevertheless "fulfil His commandments" with regularity, and perform their offices with certainty. In tempering the climates of Europe with heat in winter, that has been bottled away in the waters of the ocean during summer, they are to be regarded as the flues and the regulators for distributing it at the right time, at the right places, in the right quantities.

By March, when "the winter is passed and gone," the furnace which had been started by the rays of the sun in the previous summer, and which, by autumn, had heated up the ocean in our hemisphere, has gone down. The cauldron of St. Roque, ceasing in activity, has failed in its supplies, and the chambers of warmth upon the northern sea, having been exhausted of their heated water, which has been expended in the manner already explained, have contracted their limits. The surface of heated water which, in September, was spread out over the western half of the Atlantic, from the equator to the parallel of 40° North, and which raised this immense area to the temperature of 80°, and upwards, is not to be found in early spring on this side of the parallel of 8° N.

The isotherm of 80° in March, after quitting the Caribbean sea, runs along parallel with the South American coast, towards Cape St. Roque, keeping some 8° or 10° from it. Therefore the heat dispensed over Europe from this cauldron falls off in March. But at this season, *the sun comes forth with fresh supplies;* he then crosses the line and passes over into the northern hemisphere; and the charts shew that the process of heating the water in this great cauldron for the next winter is now about to commence.

In the meantime, so benign is the system of cosmical arrangements, another process of raising the temperature of Europe commences. The land is more readily impressed than the sea, by the heat of the solar rays: at this season then, the summer climate due these transatlantic latitudes is modified by the action of the sun's rays directly upon the land. The land receives heat from them, but instead of having the capacity of water for reserving it, it imparts it straightway to the air, and thus the proper climate, because it is the climate which the Creator has, for his own wise purposes, allotted to this portion of the earth, is maintained until the marine cauldron of Cape St. Roque is again heated and brought into the state for supplying the means of maintaining the needful temperature in Europe during the absence of the sun in the other hemisphere.

In like manner the Gulf of Guinea forms a cauldron and a furnace, and spreads out over the South Atlantic an air chamber for heating up in winter, and keeping warm, the extra-tropical regions of South America. Every traveller has remarked upon the mild climate of Patagonia and the Falkland Islands.

"Temperature in high southern latitudes," says a very close observer who is co-operating with me in collecting materials for the charts, "differs greatly from the temperature in northern. In southern latitudes there seems to be no extremes of heat and cold as at the North.

"Newport, R. I., for instance, latitude 41° N., longitude 71° W., and Rio Negro, latitude 41° S., and longitude 63° W., as a comparison:

"In the former, cattle have to be stabled and fed during the winter, not being able to get a living in the fields an account of snow and ice.

"In the latter, the cattle feed in the fields all the winter, there being plenty of vegetation and no use of hay.

"On the Falkland Islands, (latitude 51—2° S.,) thousands of bullocks, sheep, and horses, are running wild over the country gathering a living all through the winter."

We should therefore have, on the eastern side of the South Atlantic, the counterpart of the warm isotherms which stretch up on the western side of the North.

The water in the equatorial cauldron of Guinea cannot escape North: the shore line will not permit it. It must therefore overflow to the South, as that of St. Roque does to the North, carrying to Patagonia and the Falkland Islands, beyond 50° S., the winter climate of Charleston, South Carolina, on our side of the North Atlantic; or of the "Emerald Island," on the other.

From this source and from the Lagullas current, which receives its heat from the Indian Ocean, the South Atlantic is covered with a mantle of warmth which tempers to such a remarkable degree the climate of South America.

Because Western Europe had a mild climate and an ocean to the westward, and the eastern shores of North America a severe winter climate and an ocean to the eastward, a generalization has been deduced as to the climates of countries which have an ocean to the west, and of those which have an ocean to the east, which does not hold good.

This cauldron in the Gulf of Guinea and the Indian Ocean, which heats water for the South Atlantic, causes this rule, so far as the extra-tropical climate of South America is concerned, to have its exceptions.

All geographers have noticed, and philosophers have frequently remarked upon, the conformity as to the shore-line profile of equatorial America and equatorial Africa.

It is true, we cannot now tell the reason, though explanations, founded upon mere conjecture, have been offered, why there should be this sort of jutting in and jutting out of the shore line, as at Cape St. Roque and the Gulf of Guinea, on opposite sides of the Atlantic; but one of the purposes at least, which this peculiar configuration was intended to subserve is without doubt now revealed to us.

We see that by this configuration, two cisterns of hot water are formed in this ocean, one of which distributes heat and warmth to Western Europe; the other, at the opposite season, tempers the climate of Eastern Patagonia.

Phlegmatic must be the mind that is not impressed with ideas of grandeur and simplicity as it contemplates that exquisite design, those benign and beautiful arrangements, by which the climate of one hemisphere is made to depend upon the curve of that line against which the sea is made to dash its waves in the other. Impressed with the perfection of terrestrial adaptations, he who studies the economy of the great cosmical arrangements is reminded that not only is there design in giving shore lines their profile, the land and the water their proportions, and in placing the desert and the pool where they are;—but the conviction is forced upon him also, that every hill and valley, with the grass upon its sides, have each its office to perform in the grand design.

Returning now to the study of Plate VII, and to the contemplation of the isotherms of 80°, for the different months, we are struck with the remarkable bending of all these lines towards the equator, on the eastern side of the Atlantic. This feature in them indicates, more surely than any direct observations upon the currents can do, the presence, along the African shores, of a large volume of cooler and running waters.

These are the waters which, heated up in the cauldron of St. Roque, in the Caribbean Sea, and Gulf of Mexico, have been made to run to the North, loaded wirh heat, to temper climates there. Having performed this office, they are obedient still to the "Mighty Voice" which the winds and the waves obey. They are returning by this channel along the African shore to be again replenished with warmth and to keep up the system of beneficent and wholesome circulation designed for the ocean.

The thermal charts abound with beautiful results and instructive facts, all of which are expressed by the charts themselves much more clearly and forcibly than any written description of mine can present them.

It is proposed to construct from the same journals, which have afforded the materials for these thermal charts of the Atlantic, which journals give the temperature of the air, also, another set of thermal charts which shall relate to the temperature of the atmosphere over the ocean, though Professor Dove, by means of his valuable thermal charts of the atmosphere, has rendered this labor much less interesting than in the absence of his exquisite work it would have been; for it has already been shown by my charts, in connection with his, that the remarkable bending of his isotherms as they enter the land along the western shores of Northern Europe and America, is owing in a great degree to the manner in which the aqueous curves of equal temperature approach those shores.

These charts will show very conclusively, and in a manner the most striking, that the mean temperature of the ocean at the surface is higher than that of the atmosphere.

The Track Chart.

The charts numbered series A, are the "Track Charts." Charts of this letter have been published for the North Atlantic, in eight large sheets, and for a part of the South Atlantic. The rest of the South Atlantic is in press; and the remaining numbers of this series, both for the Indian and Pacific oceans, are in process of construction. They are on a scale of 0.8 in. to a degree at the Equator.

The different sheets of this series show at a glance the frequented and unfrequented parts of the ocean; they inform the navigator as to the general character of the wind and weather, the force and direction of the currents encountered by those who have preceded him in the same part of the ocean, and at the same season of the year.

I have obtained* a list of arrivals at San Francisco from the Atlantic ports of the United States and Europe, up to the middle of December, 1850. Taking the shortest passage for each month by American, English, French and Dutch vessels, we find that the American vessels which arrived there after the shortest passage in

* San Francisco Herald, January 1, 1851.

May, June, July, September, November and December, had each these charts on board. Of the vessels thus furnished, the shortest passage was by the Sea Witch in 97 days, the average of the six being 114 days.

The shortest of the other six which did not have the charts was 119 days, and the average 128.

Mean average, taking the shortest passage only for each month:

For American	vessels,	122 days.
" English	"	167½ "
" French	"	182¾ "
" Dutch	"	190½ "

The average passage of *all* the American vessels that arrived during the year is 187½ days, *i. e.* 73½ days longer than the mean of the 6 shortest passages with the charts on board; 59½ longer than the six shortest without the charts—20 days longer than the average of the 8 shortest by English; 4¾ days longer than the 8 shortest by French, and 3 days shorter than the mean of the 7 shortest passages by Dutch vessels.

These charts are highly prized by practical navigators, and are eagerly sought after by them.

This series as far as published is the work of Lieutenant Whiting, Passed Midshipmen Wyman, Gibbon, Beaumont, Temple and Wooley; and of Professors Flye and Benedict, all of the Navy.

The Trade Wind Chart.

Those charts of the series, marked letter B, are illustrative of the trade winds and the regions of calms and monsoons contiguous thereto. They are constructed according to a peculiar system of engraved squares.

This series, published only for the Atlantic, shows that the N. E. trade winds occupy a belt or zone extending in length from East to West across that ocean, having a variable breadth of from 17° to 35° of latitude. Its average mean breadth is about 23°; and in its extreme range it extends from 3° South to 35° North, according to the season of the year.

This zone makes two vibrations in a year. It reaches its extreme northern declination usually in September. Then returning and following the Sun, it reaches its southern extreme in March and April. Being stationary for two or three months, between 3° and 4° North it commences to return North, and in the months of August, September and October, its other stationary period, it is seldom or never found to the South of the parallel of 9° N. The parallel of 9° N. may be taken as the mean limit of the equatorial border of the zone of N. E. Trades.

The S. E. trade winds occupy a similar zone in the South Atlantic, with a like vibratory motion. The mean equatorial limit of this zone instead of being near the parallel of 9° South, to correspond with the zone of the northern hemisphere, is in about 3° North.

It is a remarkable phenomenon, discovered in the course of these investigations, that the S. E. trade winds blow with more force than do their congeners of the northern hemisphere. They have force enough to push the latter with their belt back towards the North, intruding occasionally in the late summer, and in the early fall months, as far as the parallel of 9° North. Whereas, out of many thousands of records examined, it does not appear that the belt of N. E. trade winds is ever found to cross the parallel of 3° South.

The two zones of winds are characterised by a like difference of strength in the Pacific. The S. E. trade winds of the Atlantic ocean have force enough to push their equatorial limits over into the northern hemisphere, and to maintain them there during the greater part of the year. The reverse is never the case: the N. E. trades have not the force to crowd out the S. E. trades, and to maintain themselves for any month of the year in the southern hemisphere.

The prevailing direction of what are called the N. E. trade winds is, as nearly as the observations which mariners usually furnish, enable me to determine, about E. N. E.

By resolving the forces which it is supposed are the principal forces that put those winds in motion, viz: calorific action of the Sun, and diurnal rotation of the earth, we are led to the conclusion, that the latter is much the greater of the two in its effects upon the trade winds of the northern hemisphere. But not to such an extent is it greater in its effects upon those of the southern. We have seen that those two opposing currents of wind are so unequally balanced that one recedes before the other, and that the current from the southern hemisphere is larger in volume; *i. e.*, it moves a greater zone or belt of air. The S. E. trade winds discharge themselves over the equator,—*i. e.*, across a great circle,—into the region of equatorial calms; while the N. E. trade winds discharge themselves into the same region over a parallel of latitude, and consequently over a small circle. If therefore we take what obtains in the Atlantic as the type of what obtains entirely around the earth, as it regards the trade winds, we shall see that the S. E. trade winds keep in motion more air than the N. E. do, by a quantity at least proportional to the difference between the circumference of the earth at the equator, and the circumference of the earth at the parallel of latitude of 9° N. For if we suppose that those two perpetual currents of air extend the same distance from the surface of the earth, and move with the same velocity, a greater volume from the South would flow across the equator in a given time, than would flow from the North over the parallel of 9° in the same time; the ratio between the two quantities would be as rad. to the sec. of 9°. Besides this, the quantity of land lying within and to the North of the region of the N. E. trade winds is much greater than the quantity within and to the South of the region of the S. E. trade winds. In consequence of this, the mean level of the earth's surface within the region of the N. E. trade winds is, it may reasonably be supposed, somewhat above the mean level of that part which is within the region of the S. E. trade winds. And as the N. E. trade winds blow under the influence of a greater extent of land surface than the S. E. trades do, the former are more obstructed in their course than the latter, by the forests, the mountain ranges, unequally heated surfaces and other such like inequalities.

As already stated, the charts show that the momentum of the S. E. trade winds is sufficient to push the equatorial limits of their northern congeners back into the northern hemisphere, and to keep them at a mean, as far North as the 9th parallel of North latitude. Besides this fact, our investigations also indicate that while the N. E. trade winds, so called, make an angle in their general course of about 23° with the equator (E. N. E.,) those of the S. E. make an angle of 30° or more with the equator (S. E. by E.) I speak of those in the Atlantic: thus indicating that the latter approach the equator more directly in their course than do the others, and that consequently, the effect of the diurnal rotation of the earth being the same for like parallels, North and South, the calorific influence of the Sun, exerts more power in giving motion to the southern than to the northern system of Atlantic trade winds.

That such is the case in nature is rendered still more probable from this consideration: all the great deserts are in the northern hemisphere, and the land surface is also much greater on our side of the equator. The action of the Sun upon these unequally absorbing and radiating surfaces in and behind, or to the northward of the N. E. trades, probably tends to retard these winds, and to draw large volumes of the atmosphere that otherwise would be moved by them, back to supply the partial vacuums made by the heat of the Sun, as it pours down with such intensity its rays upon the vast plains of burning sands and unequally heated land surfaces in our overheated hemisphere. The N. W. winds of the southern, are stronger than the S. W. winds of the northern hemisphere.

The charts show that the influence of the land upon the normal directions of the wind at sea, is an immense influence. It is frequently traced for a thousand miles or more out upon the ocean.

For instance: the action of the Sun's rays upon the great deserts and arid plains of Africa, in the summer and autumnal months, is such as to be felt nearly across the Atlantic ocean between the equator and the parallel of 13° North. Between this parallel and the equator, the trade winds are turned back by the heated plains of Africa, and are caused to blow a regular southwardly monsoon for six months.

This monsoon is a discovery which has been fully and completely developed by the charts and the investigations connected with them. They (the monsoons) blow towards the coast of Africa from June to November, inclusively. They bring the rains which divide the seasons in these parts of the African coast. The region of the ocean embraced by the monsoons is cuniform in its shape, having its base resting upon Africa, and its apex stretching over 'till within 10° or 15° of the mouth of the Amazon.

Indeed, when we come to study the effects of South America and Africa, (as developed by these charts,) upon the winds at sea, we should be led to the conclusion—had the foot of civilized man never trod the interior of these two continents—that the climate of one is humid; that its valleys are for the most part covered with vegetation which protects its surface from the Sun's rays; while the plains of the other are arid and naked; and for the most part act like furnaces in drawing the winds from the sea to supply air for the ascending columns which rise from its overheated plains.

Pushing these facts and arguments still further, these beautiful and interesting researches seem already sufficient almost to justify the assertion, that were it not for the Great Desert of Zahara and other arid plains of Africa, the western shores of that continent within the trade wind region would be almost, if not altogether, as rainless and sterile as the desert itself.

These investigations, with their beautiful developments eagerly captivate the mind; giving wings to the imagination, they teach us to regard the sandy deserts, the arid plains, and the inland basins of the earth, as compensations in the great system of atmospherical circulation. Like counterpoises to the telescope, which the astronomer regards as incumbrances to his instrument, these wastes serve as make-weights, to give certainty and smoothness of motion;—facility, and accuracy to the workings of the machine.

The meteorological and physical researches with which the "Wind and Current Charts" are connected, relate only to the sea. Already the mariner has felt and acknowledged the importance of them. Commerce and navigation are reaping benefits from them of great moment. The merchants of Bombay and American navigators, with that regard for the practical and useful which adorns their character and makes them renowned, have nobly stepped forward, and volunteered to co-operate with me in collecting facts for the further prosecution of the work. More than a thousand ships are now daily and hourly occupied in all parts of the ocean in making and recording, each a prescribed series of observations upon the winds and the currents, the rains, the calms, the storms, the thunder and the lightning;—the fogs, and clouds, and drift;—the temperature of the air and water; and all other subjects and objects, facts and phenomena, which are of interest to navigation and to science. By a recent order of the Board of Admiralty also, every captain and master in the English navy are required to keep a "*Track Chart*" of the ship.

Enough of "Abstract Logs" has already been collected at this office to make upwards of two hundred large manuscript volumes, averaging each from two to three thousand days' observations, and the number is constantly increasing; indeed, the materials increase faster than I have force to discuss them.

When we travel out upon the ocean, and get beyond the influence of the land upon the winds, we find ourselves in a field particularly favorable for studying the general laws of atmospherical circulation.

Here, beyond the reach of the great equatorial and polar currents of the sea, there are no unduly heated surfaces, no mountain ranges, or other obstructions to the circulation of the atmosphere; nothing to disturb it in its natural courses. The sea, therefore, is the field for observing the operations of the general laws which govern its circulation. Observations on the land will enable us to discover the exceptions. But from the sea we shall get the rule. Each valley, every mountain range and local district, may be said to have its own peculiar system of calms, winds, rains, and droughts. But not so the surface of the broad ocean.

In this connection I beg leave to call the attention of meteorologists on shore to the importance of introducing a special column in their journals, to show what are the rainy winds at each station, and for each season of the year.

Upon every water-shed which is drained into the sea, the precipitation may be considered as greater than the evaporation for the whole extent of the shed so drained, by the amount of water which runs off into the sea. In this view, all rivers may be regarded as immense rain gauges; and the volume of water annually discharged by any one, as an expression of the quantity which is annually evaporated from the sea, carried back by the winds, and precipitated throughout the whole extent of the valley that is drained by it. Now, if we knew the rain winds from the dry, for each locality and season generally throughout such a basin, we should be enabled to determine, with some degree of probability at least, as to the part of the ocean from which such rains were evaporated. And thus, notwithstanding all the eddies caused by mountain chains, and other uneven surfaces, we might detect the general course of the atmospherical circulation over the land as well as the sea, and make the general courses of circulation in each valley as obvious to the mind of the philosopher as is the current of the Mississippi, or of any other great river, to his senses. That river so abounds with eddies, that it is difficult to tell by regarding small portions of its surface only, which way the water is flowing. But when we come to regard the drift wood and the whole river, we are left in no doubt as to the onward course of the main stream itself, with all its eddies and whirlpools.

These investigations as to the winds at sea, indicate that the vapors which supply the sources of the Amazon with rain, are taken up from the Atlantic ocean by the N. E. and S. E. trade winds.

These investigations show that the trade wind regions of the ocean, beyond the immediate vicinity of the land, are, for the most part, rainless regions; and that the trade-wind zones may be described in a hyetographic sense as the evaporating regions.

They also show, or rather indicate as a general rule, that, leaving the polar limits of the two trade wind systems, and approaching the nearest pole, the precipitation is greater than the evaporation, until the point of maximum cold is reached.

They also seem to indicate as a *general* rule, that the S. E. and N. E. trade winds which come from a lower and go to a higher temperature, are the evaporating winds, *i. e.*, they evaporate more than they precipitate; while those winds which come from a higher and go to a lower temperature, are the rain winds, *i. e.* they precipitate more than they evaporate. That such is the case, these charts indicate; reason teaches it to us; and philosophy tells us it is so.

The results of these charts, therefore, suggest the inquiry as to the sufficiency of the Atlantic, after supplying the sources of the Amazon and its tributaries with their waters, to supply also the sources of the Mississippi and the St. Lawrence, and of all the rivers, great and small, of North America and Europe.

A careful study of the rain winds, in connection with the "Wind and Current Charts," will probably indicate to us the "springs in the ocean," which supply the vapors for the rains that are carried off by those great rivers.

"All the rivers run into the sea: yet the sea is not full; unto the place from whence they come thither they return again."

Returning now to the trade winds of the Atlantic:—There is between the two systems, a region of calms, known as the equatorial calms. It has a mean average breadth of about six degrees of latitude. In this region, the air which is brought along to the equator by the N. E. and S. E. trades, ascends.

If we liken the belt of equatorial calms to an immense atmospherical trough, extending, as it does, entirely around the earth, and liken the N. E. and S. E. trade winds to two streams discharging themselves into it, we shall see that we have two currents perpetually running in at the bottom; and that therefore we must have as much air as the two currents bring in at the bottom, to flow out at the top. What flows out at the top is carried back north and south, by these upper currents, which are thus proved to exist and to flow counter to the trade winds.

Using still further this mode of illustration;—if we liken the calm belt of Cancer, and the calm belt of Capricorn; each to a great atmospherical trough extending around the earth also, we shall see that in this case the currents are running in at the top and out at the bottom: here the current from the equator meets in the upper regions, the currents from the poles; the two descend; and the atmosphere which they thus pour into these belts runs out at the bottom—on one side towards the equator, as the perpetual trade winds;—on the other, towards the poles as the prevailing winds of the regions between these belts and the polar circles.

The belt of equatorial calms is a belt of constant precipitation. Capt. Wilkes, of the Exploring Expedition, when he crossed it in 1838, found it to extend from 4° N. to 12° N. He was ten days in crossing it, and during those ten days rain fell to the depth of 6.15 inches, or at the rate of 18 feet and upwards during the year.

This belt of calms vibrates up and down the ocean as the belts of the trade winds do. In the summer months it is found between the parallels of 8° and 14° of North latitude, and in the spring between 5° S. and 4° N.

By this chart the navigator can tell what places within the range of this zone, have, during the year, two rainy seasons, what one, and what are the rainy months for each locality.

Were the N. E. and the S. E. trades with the belt of equatorial calms of different colors and visible to an astronomer in one of the planets, he might, by the motion of these belts or girdles alone, tell the seasons with us.

He would see them at one season going North, then appearing stationary, and then commencing their return to the South. But though he would observe that they follow the Sun in his annual course, he would remark that they do not change their latitude, as much as the sun does his declination; he would therefore discover that their extremes of declination are not so far asunder as the tropics of Cancer and Capricorn, though in certain seasons the changes from day to day are very great. He would observe that these zones of winds and calms have their tropics or stationary nodes, about which they linger near three months at a time; and that they pass from one of their tropics to the other in a little less than another three months. Thus he would observe the whole system of belts to go North from the latter part of May till some time in August. Then they would stop and remain stationary till winter, in December; when again they would commence to move rapidly over the ocean, and down towards the South, until the last of February or first of March; then again they would become stationary and remain about this, their southern tropic, till May again.

The zone of the S. E. trade winds would present to him its northern edge inclined somewhat to the equator: commencing near the coast of Africa and tracing the usual outlines of this edge over towards South America, he would discover that it approached the equator at an angle of about 15°; and our supposed astronomer would announce that the equatorial edge of the zone of S. E. trades in the Atlantic is inclined towards the equator at an angle of 15°—that it lies W. 15° N., and E. 15° S.

Turning his attention now to the belt of N. E. trade winds, he would observe the equatorial edge of this zone to be somewhat, though not altogether, symmetrical with the equatorial edge of the S. E. trade wind zone of the other hemisphere. On the African side it is farthest from the equator, which it approaches at an angle of about 10° (W. by S.) until it reaches the meridian of about 40° west. Here it is deflected to the North and trends off in the direction of W. N. W. Here we begin to experience the effect of the North American continent upon the trade winds at sea. The rarefication caused by the lands of northern Texas and the arid plains in that quarter, is sufficient in summer to convert the N. E. trades of the Gulf of Mexico into a prevailing wind from the southward and eastward.

In the Pacific and within a certain distance from the land, the N. E. trade winds are, by the same influences, as these researches into the winds and currents of the sea have revealed, converted into a southerly monsoon.

By tracing on a chart the equatorial limits of the N. E. and S. E. trade winds, as herein described, it will be perceived that there is left between the two systems a wedge-shaped band having its broadest part on the African side of the Atlantic. The region of the ocean which the Planetary Astronomer would observe this band or belt to cover, is the region which is occupied by the equatorial calms and the African monsoons that fall between the systems of N. E. and S. E. trade winds. And were the belt which represents these calms different from the rest as to color, the imaginary astronomer would see it as somewhat of an irregular curve not having the northern and southern edges concentric. The concave side of this curved belt is turned to the E. of N., and has its centre near the shores of Greenland.

As before remarked, the newly discovered monsoons of the North Atlantic ocean also come within the belt of equatorial calms. They give the peculiar wedge-shaped form to the regions between the two systems of trade winds.

Having completed the physical examination of the equatorial calms and winds, if the supposed observer from some distant sphere should now turn his telescope towards the poles of our earth, he would observe a zone of calms bordering the N. E. trade winds on the North, and another bordering the S. E. trade winds on the South. These calm zones also would be observed to vibrate up and down with the trade wind zones—partaking of their motions and following the declination of the sun.

On the polar side of each of these two calm zones there would be a broad band extending up into the polar regions, the prevailing winds within which are the opposites of the trade winds, viz: S. W. in the northern and N. W. in the southern hemisphere.

The equatorial edge of these calm belts is near the tropics, and their average breadth is 10° or 12°. On one side of these belts the winds blow perpetually towards the equator; on the other, their prevailing direction is towards the poles.

These belts therefore may also be considered as nodes in the general system of atmospherical circulation.

The atmosphere which the N. E. and S. E. trade winds keep in perpetual motion towards the equator has for its node the equatorial calms. Here it ascends, boils over, divides, and flows over in the upper regions of the atmosphere, one part going to the northern, the other to the southern hemisphere, to complete the "circuit of the winds," and to supply the sources of the trade winds with air.

Arrived near the Tropic of Cancer, the northern current meets, in the upper regions of the atmosphere, the return current which the prevailing winds of the north temperate zone have carried as a surface current to the hyperborean regions of the North. These two currents produce another node or calm region, in which the atmosphere descends, and from which it issues both to the North and the South, assuming, on one side, the character of N. E. trades; on the other the character of the S. W. passage winds.

This node has its fellow in the southern hemisphere, where there is a like meeting of upper currents; only from one side of the zone of the calms of Capricorn, the wind issues as the S. E. trades; from the other as the N. W. passage winds of that part of the southern hemisphere, which is extra-tropical. See Plate II, in which the two outer lines marked A, B, and so on, are drawn to represent the vertical, and the arrows on the shaded ground the horizontal, motion of the atmosphere.

Along the polar borders of these two calm belts, we have another region of precipitation, though generally the rains here are not so constant as they are in the equatorial calms. The precipitation near the tropical calms is nevertheless sufficient to mark the seasons; for whenever these calm zones, as they go from North to South with the sun, leave a given parallel, the rainy season of that parallel, if it be in winter, is said to commence. Hence we may explain the rainy season in Chili at the South, and in California at the North.

This letter of the series of the charts will enable any one who consults it, to tell to what places the tropical calms bring rain, and in what months the rainy season commences and ends for any parallel.

To complete the physical examination of the earth's atmosphere, which we have supposed an astronomer in one of the planets to have undertaken according to the facts developed by the wind and current charts, it remains for him to turn his telescope upon the icy regions of the poles. (For that *we* should complete the examination in this respect, it would be necessary to obtain the log book of ships in the anti-commercial regions of the ocean, which we cannot do. As the sea is most open near the South pole, the principles of the general law of atmospherical circulation would be better developed probably by observations in the Antarctic, than in the Arctic regions.)

For the want of such observations, but with the light which these charts throw on the subject for our guide, let us pursue the S. W. passage winds of the northern hemisphere into the Arctic regions, and see theoretically, with the imaginary telescope, how they get there; and being there, what becomes of them.

From the parallel of 40° up towards the pole, the prevailing winds in the northern hemisphere as already reported, are the S. W. passage winds, or as they are more generally called by mariners the "Westerly" winds; these, in the Atlantic, prevail over the "Easterly" winds in the ratio of about two to one.

Now if we suppose, and such is probably the case, these "Westerly" winds to convey in two days a greater volume of atmosphere towards the Arctic circle than those "Easterly" winds can bring back in one, we establish the necessity for an upper current by which the difference may be returned to the tropical calms of our hemisphere. Therefore there must be some place in the polar regions at which these S. W. winds cease to go North, and from which they commence their return to the South, and this locality must be in a region peculiarly liable to calms. It is another atmospherical node in which the motion of the air is upward, with a decrease of barometric pressure. It is marked P, Plate II.

If we now return to the calm belt of the northern tropics, and trace theoretically a portion of air that in its circuit shall fairly represent the average course of these S. W. passage winds, we shall see that it approaches the pole in a loxodromic curve; that as it approaches the pole it acquires from the spiral convolutions of this curve which represents its path, a whirling motion, in the direction of the hands of a clock moving *backwards*, and that the portion of atmosphere whose path we are following, would gradually contract its gyrations, until it would finally ascend, turning against the hands of a watch, as it whirls around.

After reaching the upper regions of the atmosphere, through this whirl, its course would be to the southward; or rather, owing to the effect of the axial rotation of the earth, its course would be from the northward and eastward, until it should meet also in the upper regions a like portion from the ascending node formed in the calms near the equator. This place of meeting in the upper regions of the atmosphere, as already remarked, takes place in the zone of the calms of Cancer. Here the two currents, the one from the poles, the other from the equator, balance each other, produce a calm, or the descending node for the northern hemisphere, with an increase of barometric pressure.

In the southern hemisphere a like process is going on; only there the N. W. passage wind would, as it arrives near the Antartic calms, acquire a motion with the Sun, or in the direction of the hands of a watch.

That such is the case, the investigations that are carried on here do not prove, but they, and a process of reasoning guided by analogy, derived from what they do show, suggest that such is *probably* the case.

The general course of the circulation of the atmosphere, as partly established and partly suggested by these researches and other sources of information is: an upper current from the poles, as far as the tropical calms, towards the equator; thence a descent and a surface current (N. E. and S. E. trades) to the equatorial calms. Here an ascent takes place, through which air is supplied for an upper current each way towards the poles, as far as the zone of tropical calms. Here there is a descent; and a continuation towards the polar regions as a surface current, (S. W. passage winds in the northern, N. W. in the southern hemisphere,) until it approaches, in part, the calms of the Arctic and Antarctic regions. Here it commences to whirl about in the manner already stated, forming the supposed polar calms, in which it ascends, and so commences its return towards the equator by reversing the circuit just described. Vide Plate II.

The following is a part of the history connected with these researches:

Extract from a letter to the Prussian Minister, Baron Von Gerolt, dated, National Observatory, June 20, 1850.

"Speaking in advance somewhat of my publication, but leaning, nevertheless, upon the indications already given by the investigations which are in progress at this office with regard to the winds and currents of the sea, and the phenomena connected therewith, I may remark that certain conclusions have been forced upon me, with such veri-similitude, that it only remains for Professor Ehrenburgh, with his microscope, to write the final Q. E. D. to them.

For instance, my investigations of the winds at sea, so far as they bear upon the subject, seem to indicate that the rivers and fresh water of the northern temperate and frigid zones, are, for the most part, evaporated from the South torrid; or, more properly speaking, that they are taken up from the sea by the S. E. trade winds. Such at least is the indication; and certain facts so tend in their bearings, as to convert this indication into a conclusion that does not appear altogether forced.

As a general rule, most of the land is in the northern, and most of the water in the southern hemisphere. But notwithstanding the absence of evaporating surface in the northern hemisphere, most of the precipitation takes place there, if we regard the waters that are discharged into the ocean by the rivers as an expression of the excess of the precipitation over the evaporation that takes place in the basins drained by these rivers. The basin of the Amazon is in both hemispheres; it is, therefore, common, and should not be counted as peculiar to either. The Rio de la Plata is the only great river then in the southern hemisphere; whereas, in the northern, are all the rivers, great and small, which give drainage to Europe, Asia, and America.

The question then comes up: Does the Atlantic afford evaporating surface sufficient to supply all the rivers of Europe and America with rain water? and, if so, by what winds do the vapors, that make these rains, travel both East and West from the same place?

Very little of America and no part of Europe is within the region of the N. E. trade winds; and the trades, because they come from a colder and go to a warmer climate, are eminently evaporating winds. But how is it to the North of the N. E. trade winds, where, on the surface of the earth, the S. W. are the prevailing winds? Here, as a general remark, the winds are going from a warmer to a colder climate, and therefore ought, it would seem, to precipitate more than they evaporate. Thus, take the isotherm of 60° Fahr. in the Atlantic, as an example: the mean dew point, we will suppose along this line, is between 50° and 60°, or at any other degree below 60°—suppose 55°—that we may choose for the illustration.

Now let us proceed still further North in this ocean until we reach the isotherm of 30°: on this line the mean dew point must be below 30°, how much we cannot say, nor is it material for the illustration that we should say. It is certainly below the mean dew point of 60°. Now what becomes of the vapor that has caused the mean dew point on the isotherm of 60° to change to that which belongs to the isotherm of 30°? It has been precipitated, and the capacity of the air to retain moisture has been lessened proportionably. In thus viewing the case, the question arises: Whence are the vapors taken which supply with rain the sources of the rivers of the North temperate and frigid zones?

You will understand me as speaking in general terms, without regard to any of the exceptions caused by anomalies, such as the Gulf Stream and the like.

Where the N. E. and S. E. trade winds meet, they produce what is known as the belt of equatorial calms. This is one of the valves in the great atmospherical machine, through which the air that is brought from the North and the South by these trade winds, rises and escapes into the upper regions of the atmosphere, and thence returns to supply the sources of the trades with fresh air to make more winds of.

Now the question is: Does the air which is brought to this valve by the S. E. trades continue on towards the North in the upper regions of the atmosphere, while that which comes down as the N. E. trades continues on towards the South in like manner? or, does the air which the S. E. trades bring to this calm place, rise up and return to the South? or does the air of the two trades intermingle here, and go, a part of it indiscriminately, either to the North or to the South as chance may determine?

I am inclined to favor an affirmative reply the first of these interrogatories; and for these reasons, in addition to those already alluded to:

1st. Winter, late fall, and early spring, are the seasons of our greatest precipitation; and this is the time when the sun is pumping up the vapor with the greatest energy from the southern, and with the least from the northern oceans—and so too when the sun is pumping up vapor from the northern hemisphere with all his energies, precipitation is most active in the southern.

2d. The belt or band over which the S. E. trades prevail is much broader than that over which the N. E. trades prevail; consequently, supposing the velocity of each trade-wind to be the same, or nearly the same, the S. E. trade takes up more moisture because it sweeps over a broader belt of ocean; and, sweeping over a broader belt, it remains longer in contact with the evaporating surface; and consequently it may be supposed, it brings more moisture to the belt of equatorial calms whence the ascent takes place.

A large portion of this moisture is deposited in the equatorial calms, which we know is a region of constant precipitation. But where is the rest precipitated—in the northern or southern hemisphere? In the former, I suppose; because the rivers and the rain gauge, as far as it has been observed, tell us that the total amount of precipitation in the northern, is greater than that in the southern hemisphere; indeed, it is not necessary to consult the rain-gauge to learn this; the rivers themselves are sufficient rain-gauges for this purpose; for we have only to consider the volume of water annually discharged into the ocean by northern rivers, to see in it an expression for an amount by which the total precipitation is in excess of the total evaporation which takes place in the whole extent of valleys drained by such rivers. Search the southern hemisphere for a like quantity, and the search will be in vain.

Seeing, moreover, that the southern hemisphere has more water and less land than the northern; that it has less rain and fewer rivers, it seems as though, in likening the atmosphere to an immense machine, we might call the southern seas the boiler, and the northern continent, the condenser for the mighty engine.

There is, perhaps, another point upon which an argument, not altogether without plausibility, may be turned in favor of this hypothesis.

The grounds for this argument are drawn from probability, and the argument itself rests on the degree of belief and faith we have in the perfection of terrestrial adaptations.

To state the argument in this point of view, we must consider the atmosphere, not only as a great condensing machine, but as an immense sewer, in which vast quantities of corrupt animal and vegetable matter are continually being cast for re-elaboration, purification, re-arrangement, and re-adaptation to the purposes of the animal and vegetable kingdoms.

Notwithstanding the quantity of matter that the plants and animals of the earth are continually taking from the atmosphere on the one hand, and are as continually casting into it on the other, so admirably arranged is it, and so perfect its system of circulation, now across the seas, now through forests, and again over deserts, burning sands, and frozen heights, that its proportions are never destroyed.

In this system of purification and preservation, we know that vegetation in active growth has much to do.

Now, then, if we consider that the N. E. trade winds, when they arrive at the equator, ascend, return to the North in the upper regions until they reach the parallel of 30° or 40° North, where the descend to the surface, and are known as what the Germans style the S. W. passage winds; if, I say, this be the course of atmospherical circulation, we shall see that the air in our winter time, when vegetation is asleep with us, would probably not be exposed to the processes necessary for its purification; and finally, if such were the system of circulation, the atmosphere of the northern hemisphere would, in process of ages, probably become different from that of the southern hemisphere.*

We have no reason to believe in the existence of any such change in the components of the atmosphere; and I had almost said, *therefore*, in any such partial system of circulation.

On the other hand: if we maintain that the S. E. trade winds blow North after ascending into the upper regions of the atmosphere through the equatorial calms, and that it is those winds, and not the N. E. trades that in their circuit blow our S. W. passage winds; if, I say, we maintain this, we shall see the beautiful adaptation for exposing them to the proper and wholesome vegetable agencies; our winter is the southern summer; then the S. E. trades blow through the southern forests which are then in their stage of activity.

Arrived at the equator—properly prepared for the use of the inhabitants of the North temperate and frigid zones—they ascend into the clouds; and, after reaching the parallel of 30° N., they descend, and are then felt as the vigorous, wholesome, and healthful S. W. passage winds of the northern winter; continuing on towards the North frigid zone, they perform their office for the inhabitants of those inhospitable climates, and approach-

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* The extra-tropical regions of the North have much more land, and therefore it may be supposed many more organs than the South to breathe, consume, and vitiate the atmosphere; consequently in any given time, as in a northern winter, the demands upon the atmosphere are very unequal on opposite sides of the equator. On one side, the animal kingdom is exacting from it in excess—on the other—the southern summer—the vegetable.

Speaking in general terms, it may be said that man with his retinue of domestic animals, counts in the South but as one in a thousand at the North. These myriads of warm-blooded animals in excess, with the fires kindled by man in his northern winter, leave us to infer that more air is required for animal consumption and combustion on one side of the equator than on the other, especially in our winter.

The air thus used, loses the proportions of gaseous combinations required to make it wholesome; whence, therefore, is it purified? Not by the vegetation of the extra-tropical North, certainly, for its vegetation is then asleep.

But if we make this air return to the South by the route suggested, it will pass through the N. E. trade-wind region, and be partly replenished by the perpetually active vegetation there. Then rising in the equatorial calms, and overleaping, in the upper regions, the S. E. trades, it descends to the surface in the extra-tropical South, where it is summer, and where the forces of vegetation are in their most active operation.

Returning in the upper regions towards the North, from this part of its circuit, it first strikes the surface again as the S. E. trades, where vegetation is again perpetually active. Being now completely purified, it rises up again in the equatorial calms, overleaps in the upper regions the N. E. trades, and descends in the extra-tropical North, fresh with supplies in wholesome proportions for breathing lungs and winter fires.

And thus, though we cannot tell the reason why this earth was provided with zones of perpetual summer, alternate winter and opposite seasons, we may nevertheless see through the atmosphere one of the purposes for which this arrangement of seasons, combination of climates, and proportion of vegetable surface was intended to subserve.

In this view we see room for the harmony of nature. We have not a single physical fact going to prove that such is *not* the course of the circulation of the atmosphere about the surface of the earth; but we have many facts and circumstances which, though they do not prove, yet they suggest, that such is the course.

Thus, using a figure of speech, we may liken these evergreen places through which the winds go and return, to the lungs of the earth, with their three lobes: one in each of the two trade-wind regions, and one now at the North, now at the South, changing from one side to the other, as the summer comes and goes.—M. F. M.

ing the polar regions in spirals, they whirl continually around or about the pole in a direction contrary to that of the hands of the watch.

Returning thence in the upper regions towards the South, as unfit for further use, they are next felt on the surface within or near the tropics, where vegetation is again in activity, to fit them for the inhabitants of that region; reaching the equatorial calms, they ascend, and are next felt on the surface in the South temperate zone as the N. W. passage winds.

Continuing on towards the South pole, and approaching it in spirals, they whirl about, but in a direction with the hands of a watch, and opposite to that which they took about the North pole.

Ascending into the upper regions of the atmosphere, they are next felt on the surface as S. E. trade winds; reaching the equator, ascending, and coming over into the northern hemisphere, they are again felt to the North of the N. E. trades as the S. W. passage winds.

Let us suppose that this part of the circuit from the Antarctic regions be made in our summer, and of course in the southern winter, when the vegetation here is not so active in its demands upon this atmosphere in motion, as it was in the other part of the supposed circuit.

But there this same atmosphere that has been but partially purified for northern use in the southern forests and fields, reaches us in our summer, when vegetation is in full activity, and when, therefore, all disproportions are properly compensated.

I have faith in the "great first thought." I believe that the animal and vegetable kingdoms are in exact counterpoise; that through the dominions of nature all things are in exact and rigid proportions; that there is not a green leaf too much on one side, or an insect too many on the other. And because of this belief, I find plausibility and satisfaction in supposing that the general system of atmospherical circulation is as I have been endeavoring to represent it.

In this belief I am strengthened by my reading of a text of Scripture, (and the Bible no more than Nature can be wrong, for the Author of both is One,) which seems to apply to such a system of circulation:

"The wind goeth toward the South, it turneth about unto the North, it whirleth about continually; and the wind returneth again according to his circuits."

Compare this with what I have already said, and which my investigations taught me was the probable course of atmospherical circulation before I remembered me of what Solomon had said, and I think you will find with me, not proof, but grounds to suppose that such may be the system of circulation.

Cannot Professor Ehrenberg afford us the proof? Has he not discovered in the rain drops, or the snow-flakes, or the hail-stones of the northern temperate, or frigid zone, infusoria, or microscopic organisms of the southern hemisphere? He has.

I have requested my friend Lieut. De Haven, who has sailed in command of the American expedition in search of Sir John Franklin, to collect for me specimens of colored snow, rain, and hail. I made this request with the hope that a microscopic examination would lead to the discovery of some animalculæ or other foreign matter in them, which would serve as a clue to guide me to the place whence the water that is precipitated there was probably evaporated.

Would the Professor, think you, be willing to undertake the examination of such specimens, provided they be obtained?

I find since writing the above, by looking over his work which you are so kind as to lend me, and which I received the moment before commencing to thank you for it; that in his microscopic examination of sea-dust and bloody rain, he has already thrown much light upon this very question; his researches bear directly upon my investigations here touching the winds and currents of the sea.

In Lyons and Genoa both he has found microscopic organisms to fall from the air, and the "fatherland" of some of these creatures he traces to South America. What a beautiful link, bright and strong, is not this in the chain of evidence, circumstantial and direct, tending to prove that the general circulation of the atmosphere is such as our investigations indicate it to be.

According to this—according to the indications of the wind and current charts, and the unpublished results derived from the investigations carried on at this office, if "trade wind dust" or "blood-rain" could be found in Oregon and the regions thereabout, I should expect, were specimens sent to Professor Ehrenberg, that he would discover in them organisms whose *habitat* is Polynesia.

I shall make inquiries for drops of blood-rain, colored snow, hail-stones, and specimens of showers of dust from that quarter. * * * * * * * * * *

Respectfully, &c.,

M. F. MAURY.

Every seaman has seen or heard "of the Sirocco dust" of the Mediterranean, and of the "African dust," or "Red Fogs" of the Cape de Verds and the adjoining ocean.

This dust is of a brick red or cinnamon color, and it sometimes comes down in such quantities as to cover the sails and rigging, though the vessel may be hundreds of miles from the land. This dust had generally been supposed to come, as its name imports, from Africa.

Now, the generous mariner, who has had the heart to follow me around with "the wind in his circuits," will perceive that proof is yet wanting to establish it as a fact, that the N. E. and S. E. trades, after meeting and rising up in the equatorial calms, do cross over and take the tracks represented by C and G—Plate II.

Statements and reasons and arguments enough, have already been made and adduced, to make it highly probable that such is the case; and though the theoretical deductions showing such to be the case, be never so good, positive proof that they are true, cannot fail to be received with delight and satisfaction.

Were it possible to take a portion of this air, as it travels down the S. E. trades, and represents the general course of atmospherical circulation, and to put a tally on this portion of air, by which we could always recognise it again, then we might hope, actually, to prove by evidence the most positive, the channels through which the air of the trade winds, after ascending at the equator, returns whence it came.

The air is invisible, and it is not easily perceived how either marks or tallies may be put upon it, that it may be traced in its paths through the clouds.

The skeptic, therefore, who is hard of belief that the general circulation is such as Plate II represents it to be, might consider himself safe in his unbelief, were he to declare his willingness to give it up, the moment any one should put tallies on the wings of the wind, which would enable him to recognise that air again and those tallies, when found at other parts of the earth's surface.

As difficult as this seems to be, it has actually been done. Ehrenberg, with his microscope, has established beyond a doubt, that the air which the S. E. trade winds bring to the equator, does rise up and pass over into the northern hemisphere.

This Sirocco or African dust has turned out to be tallies put upon the wind in another hemisphere; and this beautiful instrument enables us to detect the marks on these little tallies as plainly as though they had been labels of wood.

This dust, when subjected to microscopic examination is found to consist of infusoria and organisms, whose *habitat* is not Africa, but South America, and in the S. E. trade wind region of South America. Prof. Ehrenberg has examined specimens of it from the Cape de Verds and the regions thereabout, from Malta, Genoa, Lyons and the Tyrol, and he has found such a similarity among them, that would not have been more striking, had these specimens been all taken from the same pile.

South American forms he recognises in all of them; indeed they are the prevailing forms in every specimen he has examined.

Speaking of the dust which fell at Lyons, he says—

"The fact is very especially remarkable in this fall of dust, that, notwithstanding its agreement with the Atlantic dust, which always showed dead and empty shells of organisms, the *eunotia amphyoxis has often been found with its green ovaries, and therefore capable of life.*"

The following are the general results and characteristics of the new sirocco dust as announced by him:

"1. The dust of the sirocco hurricane of the 17th of October, 1846, at Lyons, differs from the ordinary European and North African dust, but agrees entirely with the meteoric dust which, since 1830, have been observed in the Atlantic ocean, near the Cape Verd Islands, and in the sirocco at Malta and Genoa. The specimens of all these kinds are as though they were taken from one and the same well mixed package of dust, although their highly various origin, and their innumerable multitude, are perfectly demonstrated.

"2. Besides, the direction of the wind, (which, according to the most recent and fortunate collections and conclusions of meteorologists—Dove—gives no indication of the source of the storm,) no internal nor external evidence of the dust pronounces for its origin in Africa, but there are many forms there chiefly or wholly native to South America.

"3. Moreover, the Lyons dust cannot have arisen from the far interior of a continent, but only from a coast region, if it have generally a single origin, since it contains marine forms now living.

"4. The contents of this last sirocco dust are again not only like those of the very distant Cape Verd Islands, but even so very like what has fallen there for sixteen years, that the difference is far exceeded by the agreement, and seems only to lie in the defect of our knowledge.

"5. As no uniform mixture, in such great numbers and so great intervals of time and space, can arise, even though the investigations include so few occasions, neither from one limited place, where, indeed, varying moist seasons produce varying organisms, nor generally can it be an unimportant instantaneous upraising of a local dust by whirlwind. It appears to belong necessarily to a more constant series of relations, a constant cloud-dust swimming in the atmosphere, and always receiving new contents, which a hurricane accidentally meeting may scatter in any direction.

"6. In how far certain historical kinds of thick fog, (of course excepting that arising from peat fires,) coincide with the phenomenon, we cannot now decide; but it may be useful to point out the possibility of such a coincidence.

"7. The whole number of organic corpuscules detected in the nine kinds of dust yet known, and so strikingly similar, amounts now to 19 species, namely:

Polygastrica,	57
Phytolitharia,	46
Polythalamia,	8
Particulæ plantarum molles,	7
Insectorum fragmenta,	1
	119

Of these, seventeen kinds,	8 Polythalamia,
" " "	7 Polygastrica,
" " "	2 Phytolitharia, (spongolithides,)

belong to the sea water; the remaining 102, with the exception, perhaps, of the few new kinds, are fresh water forms.

"8. *Living forms have been brought in the more recent dust*, which, however, gives no scientific negative to the idea of an extensive sphere of life in the atmosphere. The cotemporaneous phytolitharia are earth-forms —parts of not independent plants.

"9. The dust bears no trace of volcanic action. * * * * * *

As in the Atlantic meteor-dust, so also in that of Lyons, the Phytolitharia are very numerous, which points to important conditions in the relations of the terrestrial surface, and the residue of vegetation, and *contradicts the formation of the substance in the atmosphere itself.*

"Comparing now the dust of this year (1847) from Tyrol, with the sirocco-dust of Malta, Genoa, and Lyons, previously described, and with the previously analysed meteor-dust of the Cape Verd Islands and the Atlantic, we obtain the following highly remarkable relations:

"1. The color and the whole exterior in all characters, fineness, adhesiveness of parts, weight, are not in the dry Tyrol snow-dust as in the ordinary atmospheric dust of storms, but entirely and wholly similar to the sirocco and Atlantic dust.

"2. The organic contents which so highly characterize the Atlantic meteor-dust, and are similarly found in the sirocco-dust, are also found to agree in a very remarkable manner in the snow-dust. * * *

"The analysis already published of the meteor-dust, fallen from 1830 to 1847, in the harmattan or trades, sirocco and fohn, show a great similarity in the intermingling of organic particles. Such an intermingling might be expected *a priori*, from every storm. But that in all, *similar* particles, and *great numbers of different particles, should similarly occur*, is very striking, and becomes yet more so when we consider *that for seventeen years, and in different times of the year, they remain so similar that even the predominating forms, numerically, of one kind of dust, are also the predominating forms in all the rest.* That materials existing on the surface of the earth are so similarly carried about by storms is not supposable, if we give up the highly improbable notion that all the hitherto investigated meteors and storms had their origin at precisely the same limited locality of one and the same country. Wherever life is found, the seasons of the year or of rains alternate, and with them alternate, not only in theory but according to my own frequent and direct experience, either the mode or the number of individual living forms. Considering the intermixture of marine animals, their constant similarity in number, and the always recurring predominance of the same forms, we see that no possibility remains of supposing that the meteor-dust, which the European sirocco and the German fohn wind bring, and which covers the Atlantic Ocean *only in the region of the trades*, even in the European winter (January and February,) should *always originate directly from the West Indies.* Impossible as it is to conceive of all the storms now compared from 1830 to 1847, as having a continuous genetic connection, it is equally impossible also to imagine the masses of dust transported by them, with such a degree of similarity, *not to have a genetic connection.*" * * * * * * * * * *

"The more," continues this eminent microscopist, "the more I have busied myself with these examinations of atmospheric dust, the more confident have I become that the subject is of great, manifold and rapidly increasing import; that it conflicts with not a few important and weighty ideas, and draws out and establishes other new and important scientific notions. This is but the beginning of a future great department of knowledge. I hope that the following attempt to deduce results from the observations which I have collected with some trouble and very great care and circumspection, may not lead to giving too great prominence to what is unimportant, nor fail to place what is important in a light that may suggest farther and correct investigations.

"1. The phenomena here collected, under the name of trade-wind dust, have been hitherto known as dust-hurricanes, red dust-rain, red volcanic-ashes-rain, &c. &c.

"The name trade-wind dust was here first applied to the Atlantic meteor-dust. The connection of this with the trade wind, and not with the harmattan, was definitely pronounced in 1816 by Captain Tuckey; it was made known and published from the Prussian merchant-ship, Captain Wendt, in 1830; in 1837, by Bennett; and in 1839, by Captain Hayward. And Admiral Roussin separated the constant coast-cloud from the periodic harmattan, in 1817.

"5. In the microscopic analysis of this dust, fresh water and land forms are by far the most predominant. Only the following genera belong alone to the sea water:

Coscinodiscus,	Grammatophora,
Diploneis,	Biddulphia,
Goniothecium,	

"And beside these, all the Polythalamia and some spongoliths are sea formations. Sp. Clavus, censcephala Caput serpentis, obtusa, robusta.

"Known African characteristic forms are not to be found. The great number of forms are found in various parts of the world, even in Europe and Africa. The following are American:

Arcella constricta,	Eunotia quaternaria,	Stauroneïs dilatata,
Desmogonium guyanense,	quinaria,	Surirella peruana,
Eunotia Camelus,	Gomphonema Vibrio,	Synedra Entomon,
depressa,	Himantidium Papilio,	Fragmenta incerta,
Pileus,	Zygodon,	
	Navicula undosa,	

"There is in Africa no trade wind and no surface of red dust which can supply the trade wind. The sand of the Sahara is white and gray; the cloud-dust of the trades is cinnamon-colored. Since, according to experience, an upper trade wind corresponds with the lower at the Peak of Teneriffe, and since the lower is not an African wind, but different from the harmattan, it follows that only the upper wind can carry the dust to Africa; and since probably it does not continue beyond, falling there, and becoming the lower trade wind, it precipitates the dust in that region. The fact that South American forms have been observed in the dust of the trade winds gave rise originally to this theory, and is still favorable to it, and moreover the number of these forms continually increases. The American dust, therefore, raised up in the region of equatorial calms and ascending (South American) currents of air, and carried by the upper eastward trade winds to Africa, by this vertical downward current, is returned to America through the lower western trades, unless it have been previously deposited in space.

"That this dust is coarsest near Africa may be explained by this direct sinking down in that region, while lower in the ocean it is more sifted out; but the dust of March 9, 1838, is not coarser than that from San Jago in the Cape Verd Islands, in 1833. Thus, the place of falling down may always show the coarsest parts.

"It is worthy of remark, that North America is seldom reached by the dust, and no ship in the Pacific Ocean, whence we may conclude that the constant dust-cloud zone of the upper atmosphere truly belongs only to the Atlantic northern trades; and over America, when it begins to appear in the South, wholly fails in the North, as over the Sandwich Islands, and consequently cannot be brought down by fire-meteors and meteoric stones."*

It is now proved that there is a perpetual upper current of air from South America to Northern Africa;

* Vide "Passat-Staub und Blut-Regen, ein grosses organisches unsichtbares Wirken und Leben in der Atmosphäre.—Mehere Vortrage von Dr. Christian Gottfried Ehrenberg: Berlin, 1849."

and that the volume of air in these upper currents which flows to the northward is nearly equal to the volume which flows to the Southward with the N. E. trade winds, there can be no doubt.

The "rain-dust" has been observed most frequently to fall in spring and autumn; that is, the fall has occurred after the equinoxes, but at intervals from them varying from 30 to 60 days—more or less. To account for this sort of periodical occurrence of the falls of this dust, Ehrenberg thinks it "necessary to suppose *a dust-cloud to be held constantly swimming in the atmosphere by continuous currents of air, and lying in the region of the trade winds, but suffering partial and periodical deviations.*"

Now, any one who will take the trouble to consult the "Trade Wind Charts" of the Atlantic Ocean, will see that at the time of the vernal equinox the equatorial calms are "raging" between the parallels of 4° N. and 5° S., and that consequently the places between these parallels are then in their rainy season.

The "rain-dust," therefore, it may be inferred, could not well be taken up between these two parallels at such a season. The earth is then flooded with rain, and there prevails a great calm; and as the air is saturated with moisture, and consequently as there is no—little or no—evaporation going on at such a time and place, it is difficult to imagine how any of the microscopic organisms of a locality so situated should be taken up in the atmosphere.

But if the examination of these charts be carried a little farther, it will be perceived that at the time of the vernal equinox, the valley of the lower Oronoco is then in its dry season,—everything is parched up with the drought, the pools are dry, and the marshes and plains arid wastes. All vegetation has ceased, the great serpents and reptiles have buried themselves for hibernation;* the hum of insect life is hushed; and the stillness of death reigns through the valley.

Under these circumstances, the lightest breeze, raising dust from lakes that are dried up, and lifting motes from savannahs that are parched up, will bear them away like clouds in the air.

This is the period of the year when the surface of the earth in this region, strewed with impalpable and feather-light remains of animal and vegetable organisms, is swept over by whirlwinds, gales, and tornadoes of terrific force; this is the period for the general atmospheric disturbances which have made characteristic the equinoxes. Do not these conditions appear sufficient to afford the "rain-dust" for the spring showers?

At the period of the autumnal equinox, another portion of the Amazonian basin is parched with drought, and liable to winds that fill the air with dust, and with the remains of dead animal and vegetable matter; these impalpable organisms which each rainy season calls into being, to perish the succeeding season of drought, are perhaps distended and made even lighter by the gases of decomposition which has been going on in the period of drought.

May not, therefore, the whirlwinds which accompany the vernal equinox sweep over the lifeless plains of the lower Oronoco, take up the "rain-dust" which descends in the northern hemisphere in April and May; and may it not be the atmospherical disturbances which accompany the autumnal equinox that take up the microscopic organisms from the upper Oronoco and the great Amazonian basin for the showers of October?

* Humboldt.

If there be reason in this question, and plausibility in the answer it suggests, an affirmative reply would authorize us to infer that the "fatherland" of the "rain-dust" is one place for the spring and another for the autumn; and therefore it might be expected that the microscope would detect certain infusoria that are peculiar each to its own dust and locality.

These are the periods and these the conditions most favorable for raising the "sea-dust," and may we not therefore refer to these conditions, and suggest that in them is to be found reason for the greater liability of the "rain-dust" to fall in April and May, October and November, than at other times.

If one season of the year be most favorable to the taking up of the Infusoria, another season may be most favorable for letting them down again. The charts indicate the former; the microscope shows the latter to be the case.

And may we not therefore regard the interval between the time most favorable for the ascent, and the time in which the descent is most liable to occur, as a sort of general indication as to the length of the time required for the transportation; and therefore as to the rate of motion of the atmosphere in its general channels of circulation?

These suggestions as to the taking up the dust in the valley of the Oronoco derive weight from the observations of the closest of observers:

The Baron von Humboldt, in his "Aspects of Nature," thus contrasts the wet and the dry seasons there:

"When under the vertical rays of the never-clouded sun, the carbonized turfy covering falls into dust, the "indurated soil cracks asunder as if from the shock of an earthquake. If at such times two opposing currents "of air, whose conflict produces a rotary motion, comes in contact with the soil, the plain assumes a strange "and singular aspect. Like conical shaped clouds, the points of which descend to the earth, the sand rises "through the rarefied air on the electrically-charged centre of the whirling current, resembling the loud water-"spout, dreaded by the experienced mariner. The lowering sky sheds a dim, almost straw-colored, light on "the desolate plain. The horizon draws suddenly nearer, the steppe seems to contract, and with it the heart "of the wanderer. The hot, dusty particles which fill the air increase its suffocating heat, and the east wind "blowing over the long-heated soil brings with it no refreshment, but rather a still more burning glow. The "pools which the yellow, fading branches of the fan-palm had protected from evaporation, now gradually dis-"appear. As in the icy North the animals become torpid with cold, so here, under the influence of the parching "drought, the crocodile and the boa become motionless and fall asleep, deeply buried in the dry mud. *

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" * * * The distant palm bush, apparently raised by the influence of the contact of unequally "heated and therefore unequally dense strata of air, hovers above the ground, from which it is separated by "a narrow intervening margin. Half concealed by the dense clouds of dust, restless with the pain of thirst "and hunger, the horses and cattle roam around, the cattle lowing dismally, and the horses stretching out "their long necks and snuffing the wind, if haply a moister current may betray the neighborhood of a not-"wholly dried-up pool. * * * * * * *

" * * * At length, after the long drought, the welcome season of the rain arrives; and then " how suddenly is the scene changed! * * * * * *

" * * * Hardly has the surface of the earth received the refreshing moisture, when the pre- " viously barren steppe begins to exhale sweet odors, and to clothe itself with kyllingias, the many panicules " of the paspulum, and a variety of grasses. The herbaceous mimosas, with renewed sensibility to the " influence of light, unfold their drooping, slumbering leaves, to greet the rising sun; and the early song of " birds, and the opening blossoms of the water-plants, join to salute the morning." * * * *

The color of the "rain-dust," when collected in parcels, and sent to Ehrenberg, is "brick-red;" or "yellow ochre;"—when seen by Humboldt in the air, it was less deeply shaded, and is described *by him* as imparting a "straw-color" to the atmosphere. In the search of spider lines for the diaphragm of my telescopes, I procured the finest and best threads from a cocoon of a mud-red color; but the threads of this cocoon, as seen singly in the diaphragm, was of a golden color; there would seem, therefore, no difficulty in reconciling the difference between the colors of the rain-dust, when viewed in little piles by the microscopist, and when seen attenuated and floating in the wind by the great traveller.

It appears, therefore, that we here have placed in our hands a clue, which, attenuated and gossamer-like though it at first appears, is nevertheless palpable and strong enough to guide us along the "circuits of the wind" into "the chambers of the South."

The frequency of the fall of "rain-dust" between the parallels of 17° and 25° N., and in the vicinity of the Cape Verd Islands, is remarked upon with emphasis by the author. It is worthy of remark; because in connection with the investigations at the Observatory, it is significant.

The latitudinal limits of the northern edge of the N. E. trade winds are variable. In the spring they are nearest to the equator, extending sometimes at this season not further from the equator than the parallel of 15° N.

The breadth of the calms of Cancer is also variable; so also are their limits. The extreme vibration of this zone is between the parallels of 17° and 38° North, according to the season of the year.

According to the Charts, this is the zone in which the upper currents of atmosphere that ascended in the equatorial calms, and flowed off to the northward and eastward, descend. This, therefore, is the zone in which the atmosphere that bears the "rain-dust" descends to the surface; and this, therefore, is the zone, it might be supposed, which would be the most liable to showers of this "dust." This is the zone in which the Cape Verd Islands are situated; they are in the direction which theory gives to the upper current of air from the Oronoco and Amazon with its "rain-dust," and they are in the region of the most frequent showers of "rain-dust," all of which are in striking conformity with the theory of circulation.

It is true that in the present state of our information, we cannot tell why this "rain-dust" should not be gradually precipitated from this upper current, and descend into the stratum of trade winds, as it passes from the equator to higher northern latitudes. Neither can we tell why the vapor which the same winds carry along, should not, in like manner, be precipitated on the way; nor why we should have a thunder storm, a gale of wind, or the display of any other atmospherical phenomenon to-morrow, and not to-day—all that we can say is, that the conditions of to-day are not such as the phenomenon requires for development.

Therefore, though we cannot tell why the rain-dust should fall not always in the same place, we may nevertheless suppose that it does not, in passing the same parallels, always meet with the conditions—electrical and others—favorable to the descent—and that these conditions might occur now in this place, now in that. But that the fall does occur always in the same atmospherical vein or general direction, my investigations would suggest, and Ehrenberg's researches prove.

Judging by the fall of rain-dust, we may suppose that the currents in the upper regions of the atmosphere are remarkable for their general regularity, for their general direction and sharpness of limits, so to speak.

We may imagine that certain electrical conditions are necessary to a shower of "rain-dust," as well as to a thunder storm, and that the interval between the time of the equinoctial disturbances in the atmosphere to the fall of these showers, though it does not enable us to determine the true rate of motion in the general system of atmospherical circulation, yet it assures us that it is not less on the average than a certain rate.

I do not offer these remarks as an explanation with which we ought to rest satisfied; I rather offer them in the true philosophical spirit of the distinguished microscopist himself:—simply as affording, as far as they are entitled to be called explanation, that explanation which is most in conformity with the facts before us, and which is suggested by the results of a novel and beautiful system of philosophical research.

Thus, though we have tallied the air, and put labels on the wind to "tell whence it cometh and whither it goeth," yet there evidently is an agent concerned, whose functions are manifest but whose presence has never yet been recognized.

Where the air which the N. E. trade winds meets in the equatorial calms that of the S. East, and the two rise up together, what is it, where is the power which guides that from the North over to the South, and that from the South up to the North?

The following letter may perhaps throw some light upon the answer to this question:

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*On the probable Relation between Magnetism and the Circulation of the Atmosphere.**

The discoveries of Faraday in dia-magnetism are calculated to guide me and to illuminate the darkness in which I have found myself so often surrounded, as I endeavored to follow the "wind in his circuits" over the trackless wastes of the ocean.

Oxygen composes one-fifth part of the atmosphere and is magnetic.

The discovery that it is magnetic, presents itself to the mind as a great physical fact which is to serve as the keystone for some of the most grand among the sublime and beautiful structures which philosophy is erecting for monuments to the genius of the age.

* See letter to Hon. Wm. A. Graham, January 30, 1851; Appendix Washington Astronomical Observations, 1846.

The facts elicited from the Wind and Current charts, had already pointed me to the work of some agent whose office in the grand system of atmospherical circulation was neither understood nor recognized.

In following these facts to their legitimate conclusions, and in studying all the phenomena that these charts have successfully revealed touching the grand system of the distribution of moisture and the circulation of the atmosphere over the surface of the earth, I have often been induced to suspect that some other agent besides heat and the rotation of the earth on its axis, was concerned in the matter.

Never suspecting the character of this agent, its foot prints have at least been detected; and there is reason to suppose that Faraday has discovered its lurking place to be in the oxygen of the atmosphere.

These charts had enabled me to trace from the belt of calms, near the tropic of Cancer, which extends entirely across the seas, an efflux of air both to the North and to the South; from the South side of this belt the air flows in a never-ceasing breeze, called the N. E. trade winds, towards the equator.

On the North side of it, the prevailing winds come from it also; but they go towards the N. E. They are the well known southwesterly winds which prevail along the route from this country to England in the ratio of two to one.

Now these last named winds are going from a warmer to a colder climate; and therefore it may be supposed that nature exacts from them what we know she exacts from the air under similar circumstances, but on a smaller scale before our eyes, viz: more precipitation than evaporation.

Where then does the vapor, which these winds carry along, come from? was one of the questions suggested by the charts.

We saw that the air of which the N. E. trade winds are composed, and which comes out of the same zone of calms, as do these southwesterly winds, so far from being saturated with vapor at its exodus, was dry;—the N. E. trade winds are for the most part dry winds;—we perceived that going from a lower to a higher temperature their evaporating powers were increased; that they had to travel in their oblique course, towards the equator, a distance of near 3,000 miles; that as a general rule they evaporated all the time, and all the way, and precipitated little or none on their route; that they were not saturated with moisture until they had arrived fully up to the region of equatorial calms, a zone of constant precipitation.

This calm zone of Cancer borders also, it was perceived, upon a rainy region.

Where then does the vapor, which is here on the northern edge of this zone of Cancer, condensed into rains—and where also does the vapor which the rain winds that flow out on the polar side of this zone—where? was the oft-repeated question,—does the vapor which is condensed into rains for the extra-tropical regions of the North, come from?

It might possibly be taken up by the N. E. trade winds; and it might be the residuum, which, after supplying the equatorial calms with their rain, was carried up in the ascending column of air there, and which residuum was brought back in the upper regions of the atmosphere by the current which we know perpetually blows up there, counter to the trade winds.

We know that there is an upper current of perpetual winds from the equatorial to the tropical calms,—

that the volume of air moved by these two upper currents, North and South, to Cancer and Capricorn, is equal to the volume that is felt on the surface, as the N. E. and S. E. trade winds.

I knew of no law of nature which would forbid the supposition that the air which has been brought down as the N. E. trade winds to the equatorial calms, should, after ascending there, return by the counter and upper currents to the calm zone of Cancer, here descend and re-appear on the surface as the N. E. trade winds again. I knew of no agent in nature which would *prevent* it from taking this circuit; but while I knew of no agent in nature that would prevent it from taking this circuit, I knew on the other hand, of circumstances which rendered it probable that such in general is not the course of atmospherical circulation—that it did not take this circuit. I speak of the rule, not of the exceptions; these are infinite, and for the most part are caused by the land.

And I moreover knew of facts which greatly strengthen the supposition, that after arriving at the calms of Cancer and descending, the winds which have come in the upper regions of the atmosphere from the equator, do not return to the equator on the surface, but continue on the surface towards the pole.

And these are the circumstances which favor the conjecture that the winds which flow in the upper regions of the atmosphere from the equator to the calms of Cancer, do not, after arriving and descending in the midst of these calms, turn about and go back to the equator with the N. E. trades: on the contrary, these are the facts and circumstances which give strength to the supposition that they continue on towards the pole, as the prevailing southwesterly winds of the extra-tropical North.

We have seen that on the North side of this calm zone of Cancer, the prevailing winds on the surface are from this zone towards the pole; in other words, if s represent the total volume of atmosphere which blows on the surface towards the North on the polar side of Cancer, and ϕ the total volume which moves on the surface from the pole towards the calms of Cancer, then s being the rule and ϕ the exception, we shall have $s > \phi = s'$. Therefore s' is the quantity which must return in the upper regions of the atmosphere from the Arctic regions to the calm zone of Cancer; and if we take s'' as the quantity which comes from the equator in the upper regions of the atmosphere to this same zone of calms, we shall have the momentum of s'' equal to the momentum of s' as proved by nature in the fact that she has established near each tropic, a zone, or belt of calms.

The Cancer zone of calms in the Atlantic ocean is known to American seamen as the "Horse Latitudes," from the circumstance that the vessels formerly engaged in carrying horses from New England to the West Indies, found it so difficult to cross this zone: they would often be detained in the calms for many days, during which time the large cargo of horses would exhaust the stock of water, become frantic with thirst, and to save a part, the rest would have to be thrown overboard; hence the name of "Horse Latitudes" to the calms near the tropics of Cancer, and which I have called by the name of that sign.

This is the place where the upper currents of air represented by s' and s'' meet; they balance each other, produce a calm, and descend to re-appear as surface winds, one blowing to the North and the other to the South from this calm belt.

Now s' could not bring the vapors here which form the rains that are precipitated between this calm belt and the polar regions, because s' had already performed the circuit as a surface wind between this zone and those regions; it had been subjected to a temperature far below zero, and had given out all the moisture that a dew point so very low could extract from it; and as it had returned in the upper regions of the atmosphere where it encountered no fluid surface to replenish it with moisture, it had no vapor on its arrival from the North at the calms of Cancer, to make rains of.

Hence if s' returned to the North as a surface wind after descending in the calm zone of Cancer, it would first have to remain a long time in contact with the sea, in order to be supplied with vapor enough to fill the great rivers, and supply the rains for the whole earth between us and the North pole.

In this case we should have an evaporating region on the North as well as on the South side of this zone of Cancer; but the charts show no such region; I speak exclusively of the ocean.

Therefore, I inferred that s' does not come out on the North side of this calm zone, but on the South side; thence to take the circuit of the N. E. trade winds, and to be replenished with vapor; and if it be admitted that such is the general course of s' it must of necessity be admitted that δ'' must re-appear on the North side of this zone as the prevailing surface wind which precipitates on its way to the Arctic regions, the residuum or vapor that it has taken up in the trade-wind region, and brought from the equatorial calms.

Moreover, if δ'' have the vapor which by condensation is to water with showers the extra-tropical regions of the northern hemisphere; nature, we may be sure, has provided a guide for conducting δ across this belt of calms, and for sending it on in the right way. Here it is that I saw the foot prints of an agent whose character I could not comprehend. It was this guide.

Heat and cold, the early and the latter rain are not distributed over the earth by chance; they are dispensed no doubt according to design, and in obedience to laws that are as certain and as sure in their operations as the morning stars in their songs of praise.

If there were really a general mingling in the calms of Cancer, of the atmosphere which comes from the North with that which comes from the South—of the moist and the dry air as it descends here to the surface of the earth—if it depended upon chance whether the dry air should come out on this side, or on that, of the calms of Cancer;—or whether the moist air should return whence it came or not;—if such were the case in nature, we perceive that so far from any regularity as to seasons, we should have, or might have, years of droughts the most excessive, and then again seasons of rains the most destructive; but so far from this we find for each place a mean annual proportion of both, that year after year is preserved with remarkable regularity.

Therefore, seeing reasons why s' and δ'' should cross each other in the calms of Cancer, and seeing no reasons why they should not, I was led to the inference that here probably is a node in the circulation of the atmosphere, where the wind from the North meets the wind from the South, and that each after a pause, continues on its course and returns again to complete his circuit. The fact, it appeared to me, was probable, but the cause a mystery; that is, did this crossing of currents not take place, here would be a barrier in the atmosphere: and we, the inhabitants of the extra-tropical regions of the North, would have an atmosphere, between the calms of Cancer and the pole, always to breathe.

Having thus shown that there is no reason for supposing that the upper currents of air when they meet over the calms of Cancer and Capricorn, are turned back to the equator; but having shown that there is reason for supposing that the air of each current after descending, continues on in the direction towards which it was traveling; we may go further, and by a similar train of circumstantial evidence, afforded by the charts, and other sources of information, show that the air moved on the surface by the two systems of trade winds, when arrived at the belt of equatorial calms, and having ascended, continues on thence, each current towards the pole which it was approaching while on the surface.

There is no reason for supposing that the atmosphere does not pass freely from one hemisphere to another; on the contrary, many reasons for supposing that it does, present themselves.

If it did not—the proportion of land and water, and consequently of plants and warm blooded animals, being so different in the two hemispheres—we might imagine that the constituents of the atmosphere in them, would, in the course of ages, probably, become different; and that consequently in such a case, man could not safely pass from one hemisphere to the other.

I considered the manifold beauties in the whole system of terrestrial adaptations:—I reflected what a perfect and wonderful machine is this atmosphere:—how exquisitely balanced and beautifully compensated it is in all its parts.—We all know that it is perfect:—that in the performance of its manifold offices it is never once left to the guidance of chance—no, not for a moment:—therefore I was led to ask myself why the air of the N. E. trades when arrived at the zone of equatorial calms, should, after ascending, rather return to the North than the South.—Where and what is the principle upon which its course is decided?

Here again, I found circumstances which induced me to suppose it probable, that it neither turned back to the North, nor mingled with the air which came from the regions of the S. E. trades, ascended, and then flowed indiscriminately to the North or the South.

But I saw reasons for supposing that what came to the equatorial calms as N. E. trade winds, continued to the South as an upper current; and that what had come to the same zone as S. E. trade winds, ascended and continued over into the northern hemisphere as an upper current, bound for the calm zone of Cancer.

And these are the principal reasons upon which this supposition was based:

At the seasons of the year when the sun is evaporating most rapidly in the southern hemisphere, the most rain is falling in the nothern. Therefore I supposed that much of the vapor which is taken up there is precipitated here.

The evaporating surface in the southern hemisphere is greater, much greater than that in the northern: still all the great rivers are in the northern hemisphere;—the Amazon being regarded as common to both. And this, as far as it goes, is corroborative of the above.

Independently of other sources of information, the charts taught me to believe that the mean temperature of the tropical regions was higher in the northern than in the southern hemisphere; for they show that the difference is such as to draw the equatorial edge of the S. E. trades far over on this side of the equator, and to give them force enough to keep the N. E. trade winds out of the southern hemisphere almost entirely.

Consequently, as before stated, the S. E. trade winds being in contact with a more extended evaporating surface, and continuing in contact with it for a longer time or through a greater distance, they would probably arrive at the trade wind place of meeting, more heavily laden with moisture than the others.

Taking the laws and rate of evaporation into consideration, I could find no part of the ocean of the northern hemisphere from which, according to the indications of the charts, the sources of the Mississippi, the St. Lawrence and the other great rivers of our hemisphere could be supplied.

It appeared to me, therefore, that the extra-tropical regions of the northern hemisphere stood in the relation of a condenser to a grand steam machine, the boiler of which was in the region of the S. E. trade winds; and that the trade winds of this hemisphere performed the like office for the regions beyond Capricorn.

The calm zone of Capricorn is the duplicate of that of Cancer, and the winds flow from it as they do from that: both North and South: with this difference, that on the polar side of the Capricorn belt they prevail from the N. W., instead of the S. W.; and on the equatorial side from the S. E., instead of N. E.

Now if it were so, that the vapor of the N. E. trade winds were condensed in the extra-tropical regions of the southern hemisphere, the following path, on account of the effect of diurnal rotation of the earth upon the course of the winds, would represent the mean circuit of a portion of the atmosphere moving according to the general system of its circulation over the Pacific ocean, viz: coming down from the North as an upper current, and appearing on the surface of the earth in about longitude 130° W., and near the tropic of Cancer, it would here commence to blow the N. E. trade winds of that region.

Its course would be towards the equator, somewhat in the direction of the King's Mill group of Islands. Meeting no land in this long oblique track over the tepid waters of a tropical sea, it would, somewhere to the East of these Islands, arrive at the belt of equatorial calms, which always divides the N. E. from the S. E. trade winds.

Here depositing a portion of its vapor as it ascends, it would with the residuum take, on account of diurnal rotation, a course in the upper regions of the atmosphere to the S. E. as far as the calms of Capricorn. Here it descends and continues on towards the coast of South America in the same direction, appearing now as the prevailing N. W. wind of the extra-tropical regions of the southern hemisphere.

Travelling on the surface from warmer to colder regions, it must, in this part of its circuit, precipitate more than it evaporates.

Now this is the route by which, on account of the land in the northern hemisphere, the N. E. trade winds have the fairest sweep over that ocean. This is the route by which they are longest in contact with an evaporating surface: the route by which all circumstances are most favorable to complete saturation; and this is the route by which they can pass over into the southern hemisphere, most heavily laden with vapors for the extra-tropical regions of that half of the globe; and this is the supposed route which the N. E. trade winds of the Pacific take to reach the equator, and to pass from it.

Accordingly, if this process of reasoning be good, that portion of South America between the calms of Capricorn and Cape Horn, upon the mountain ranges of which this part of the atmosphere, whose circuit I am considering as a type, first impinges, ought to be a region of copious precipitation. I accordingly turned to the hyetography of Berghaus and Johnson, and find it stated on the authority of Captain King, that upwards of 12* feet of rain fell there in 41 days!

Passing the snow-clad summits of the Andes, this same wind tumbles down upon the eastern slopes of the range, and then traverses the almost rainless and barren regions of Patagonia and South Buenos Ayres.

These conditions, the direction of the prevailing winds and the amount of precipitation, were regarded as evidence afforded by nature, if not in favor, certainly not against the conjecture that such had been the voyage of this vapor through the air. At any rate, here was proof of the immense quantity of vapor which these winds of the extra-tropical regions carry along with them towards the poles, and I could imagine no other place than that suggested, whence these winds could get so much vapor.

I am not unaware of the theory or of the weight attached to it, which requires precipitation to take place in the upper regions of the atmosphere on account of the cold there; irrespective of proximity to mountain tops and snow-clad hills.

But the facts and conditions developed by these charts are in many respects irreconcilable with that theory. With a new system of facts before me, I have, independent of all preconceived notions and opinons, set about to seek among them for explanations and reconciliations.

Arrived at this stage in the process of deduction and finding conformity, the next step was to trace back the vapor that supplies the sources of the Mississippi river and its tributaries with rains, to its place in the ocean whence it came; (for that the vapor of water is distributed over the earth by the winds, and not by permeation, my researches abundantly prove.)

It rains more in the valley drained by that river than is evaporated from it again. The difference for a year is the volume of water annually discharged by that river into the sea.

At the time and place that the vapor which supplies this immense volume of water was lifted by the atmosphere up from the sea, it was reasoned that the thermometer stood higher than it did at the time and place where it was condensed and fell down as rain in the Mississippi valley.

I looked to the South for the springs in the sea which supply the fountains of this river with rain. But I could not find spare evaporating surface enough for it in the first place; and if the vapor, I could not find the winds which would convey it to the right place.

The prevailing winds in the Caribbean sea, and southern parts of the Gulf of Mexico, are the N. E. trade winds. They have their offices to perform in the river basins of tropical America, and the rains which they may discharge into the Mississippi valley now and then are exceptions, not the rule.

The winds from the North cannot bring vapors from the great lakes to make rains for the Mississippi, for two reasons; first: the basin of the great lakes receives from the atmosphere more water in the shape of rain than they give back in the shape of vapor. The St. Lawrence river carries off the excess.

* 153 inches.

2d. The mean climate of the lake is colder than that of the Mississippi valley; and therefore, as a general rule, the temperature of the Mississippi valley is unfavorable for condensing vapor from that quarter.

It cannot come from the Atlantic, because the greater part of the Mississippi valley is to the windward of the Atlantic ocean. The winds that blow across it go to Europe with their vapors; and in the Pacific, from the parallels of California down to the equator, the direction of the wind at the surface is from, not toward, the basin of the Mississippi. Therefore it seemed to be established with some degree of probability—or if that expression be too strong—with something like apparent plausibility, that the rain winds of the Mississippi valley, as the general rule, do not get their vapors from the North Atlantic ocean, nor from the Gulf of Mexico, nor from the great lakes, nor from that part of the Pacific ocean over which the N. E. trade winds prevail.

The same process of reasoning which induced me to look to the trade-wind region of the northern hemisphere for the sources of the Patagonian rains, induced me to look to the trade wind regions of the South Pacific ocean, for the vapor springs of the Mississippi.

I therefore last summer addressed a circular letter to the farmers and planters of the Mississippi valley, requesting to be informed as to the direction of the rain winds of each locality; and with the view of acquiring some idea as to the general hygrometric condition of the atmosphere, I asked also to be informed as to the kind and quality of fruits and the like.

To this I have received the following replies:—

From J. M. Janney, Warren county, Ohio.
Lat. 39° 30′ N.; Long. 84° W.

Winds from the southwest, with but few exceptions, bring rain; this is the result of eleven and a half years' observation.

Farm situated between the Miami rivers. There are no mountains nearer than the Cumberland and Alleghany; the one lying in a southeast direction, and the other east of this locality. The nearest point to these elevations is perhaps not short of 225 or 250 miles. Lake Erie, situated about 100 miles northeast of us, is the nearest sheet of water.

The fruits are apples, pears, cherries, strawberries, raspberries, currants, gooseberries, quinces, and peaches. Grapes also thrive well. The products of the soil are maize, wheat, oats, flax, rye, and potatoes.

I may observe that the cold South winds often prevail through the winter; and during the spring *cool*, rather piercing northwest winds frequently assail us; during the prevalence of which drought is almost sure to exist. Snow-storms generally come from the southwest, but occasionally we have a heavy storm of this kind from the East. To me it is obvious that the winds that bring us rain sweep through the great Mississippi and Ohio vallies in their course northeast. [That is, they are southwest winds.]

From Wm. J. Payne, near Rushville, Rush county, Indiana.
Lat. 39° 30′ N.; Long. 85° 30′ W.

The winds are various: the West wind sometimes brings most rain during some years; but the southwest winds are more prevalent, and bring rain the greatest number of years.

Fruits are, peaches, apples, pears, and cherries.

Productions—Corn, wheat, oats, rye, &c.

From Louis Moore, Carrollton, Mississippi.

Lat. 33° 30′ N.; Long. 90° W.

On an average, the winds that bring us rain are the southwest. Farm situated in a hilly district, some 150 miles from the sea-coast. The most common fruits are apples, peaches, &c., and melons in abundance.

Agricultural staples are cotton, corn, oats, potatoes, &c.

From Turner Vaughan, La Guardo, Tennessee.

Lat. 36° 30′ N.; Long. 86° 30′ W.

Winds S. by W. bring the most rain, and W.N.W. the most storms; the latter, however, are unfrequent here, and very partial, owing, perhaps, to remoteness from the *sea.*

Whenever the lightning appears to linger in the North at eventide, rain almost invariably follows speedily; not so in South.

Farm situated twenty-five miles above Nashville; surface undulating, abounding in lime-stone. Hemp and corn do well, tobacco also; wheat and cotton inferior; grapes tolerable.

From Thomas Meaux, Amelia county, Virginia.

Lat. 37° 20′ N.; Long. 78° W.

Point of observation about thirty miles W. S. W. from Richmond.

Prevalent wind in spring, summer, and autumn from S. W., rain falling in showers during these seasons. Gusts and tornadoes, with black clouds come from N. W. in late summer; protracted rains in spring and fall come from N. E.

Prevalent winds in winter E. to W. northwardly. Rains and snows in winter from N. E. Lowest observed temperature 6° Fahrenheit, at sunrise, Jan. 29, 1844; highest, 97°, noon, in shade, 20 July, 1844.

These observations made for twenty years.

From Willis Fawcett, St. Charles, Missouri.

Lat. 39° N.; Long. 90° 30′ W.

Wind from any point of the eastern half of the horizon will bring rain generally, after blowing twelve hours. It frequently happens that we have winds in a dry time to blow much longer, even several days, from that direction, without rain; but on the wind's shifting to the opposite side, we are sure of rain. I think our rains during summer come most frequently from the S. E. Wind from the S. W. is generally accompanied by good dry weather. West and N. W. are dry. I have noticed that thunder and lightning in the North is almost invariably followed here by storms of rain and hard wind within twelve or twenty-four hours.

My farm is on an alluvial prairie plain, (probably formed by the washings of the Missouri and Mississippi) six miles below St. Charles.

The apple is our main dependence. Peaches also flourish finely; as do plums, cherries, (except the black,) strawberries, gooseberries, wild and cultivated. Wheat and corn are the principal productions. Timothy hay will soon be exported from our neighborhood to a considerable extent. I cultivate wheat and corn almost exclusively.

Thus showing, as far as this evidence goes, that the S. W. winds—the winds suggested by the charts—are, except in Western Missouri, the rainy winds. These winds, like those between the same parallels upon the ocean, are going from a higher to a cooler temperature; and these winds in the Mississippi valley not being in contact with the ocean, or with any other evaporating surface to supply them with moisture, must bring the moisture with them from some sea or another.

Therefore, though it may be urged, in as much as the winds which brought the Patagonian rains came direct from the sea, that they therefore took up their vapors as they came along; yet it could not be so urged in this case; and if these winds could pass with their vapors from the equatorial calms through the upper regions of the atmosphere to the calms of Cancer, and then as surface winds into the Mississippi valley, it was not perceived why the Patagonian rain winds should not bring their moisture by a similar route. These last are from the N. W., from warmer to colder latitudes; therefore being once charged with vapors they must precipitate as they go, and take up less moisture than they deposit.

This was circumstantial evidence. No fact had yet been elicited to prove that the course of atmospherical circulation suggested by my investigations is the actual course in nature. It is a case in which I could yet hope for nothing more direct than such conclusions as might legitimately flow from circumstantial evidence.

My friend Lieut. De Haven was about to sail in command of the American Expedition in search of Sir John Franklin. Infusoria are sometimes found in sea-dust, rain-drops, hail-stones or snow-flakes; and if by any chance it should so turn out that the *locus* of any of the microscopic infusoria which might be found descending with the precipitation of the Arctic regions should be identified as belonging to the regions of the S. E. trade winds, we should thus add somewhat to the strength of the very slender clue by which we were seeking to enter into the chambers of the wind, and to "tell whence it cometh and whither it goeth."

It is not for man to follow the "wind in his circuits," and all that could be hoped, was after a close examination of all the facts and circumstances which these charts have placed within my reach, to point out that course which seemed to be most in accordance with them, and then having established a probability or even a possibility as to the true course of atmospheric circulation, to make it known and leave it for future investigations to confirm or set aside.

It was at this stage of the matter* that my friend Baron von Gerolt, the Prussian Minister, had the kindness to place in my hand Ehrenberg's work, "Passat-Staub und Blut-Regen."

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* See my letter to him, page 144, also, paper read by me before the American Association at its meeting in Charleston, March, 1850.

Here I found the clue* which I hoped, almost against hope, De Haven would place in my hands.

That celebrated microscopist reports that he found South American infusoria in the blood-rains, and sea-dust of the Cape Verd Islands,—Lyons, Genoa, and other places.†

Thus confirming as far as such evidence can, the indications of the "Wind and Current Charts," and increasing the probability that the general course of atmospherical circulation is in conformity with the suggestions of the charts as I had interpreted them, viz: that the trade winds of the southern hemisphere after arriving at the belt of equatorial calms ascend and continue in their course towards the calms of Cancer as an upper current from the S. W., and that after passing this zone of calms, they are felt on the surface as the prevailing S. W. winds of the extra-tropical parts of our hemisphere; and that for the most part they bring their moisture with them from the trade wind regions of the opposite hemisphere.

Continuing on towards the North pole from the S. W. they enter the Arctic regions on a spiral curve, continually lessening the gyrations until, whirling about in a *direction contrary to the hands of a watch,* this air ascends and commences its return as an upper current towards the calms of Cancer.

It returns to this zone from the opposite direction, N. E., by which it approached the pole.

The atmosphere in this part of the circuit is moving in the direction called s' in a previous part of this paper.

Arrived at the calms of Cancer, s' meets δ'' in the upper regions of the atmosphere.

They both descend—and the fact that the barometer stands higher here‡ than upon any other parallel, shows that here there is an increased atmospheric pressure, caused in part by accumulation produced by the opposing forces of s' and δ''; and in part by the downward currents.

Having descended, s' is forced out on the equatorial side of the zone, and appears on the surface as Δ—the N. E. trade winds—and so continues until it reaches the belt of equatorial calms.

Here then is precipitation, an ascent of atmosphere, and a fall of the barometer: Δ now becomes δ or an upper current flowing in a S. E. direction—*i. e.*, from N. W. towards the zone of the calms of Capricorn. Here it is met by the upper current from the Antarctic regions, descends with a rise in the barometer again, and appears on the polar side of this zone of calms, as Δ'—the prevailing N. W. surface winds in the extra-tropical regions of the southern hemisphere.

Δ' now approaches the Antarctic regions in a *spiral, gyrating with* the hands of a watch and contracting its convolutions as it draws nearer and nearer the pole, where theoretically there is another atmospherical node in which Δ' ascends with a low barometer, and commences its return towards the equator as δ' in the upper regions of the atmosphere.

The same cause—diurnal rotation—which made the Δ' on the surface to approach from the N. W., now operates to make it return as δ' in the direction whence it came.

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* *Vide* page 148.

† *Vide* page 150; "Passat-Staub, etc."

‡ Humboldt.

Arriving in the upper regions at the calm zone of Capricorn δ meets δ'; the two descend, and δ' continues to flow in towards the equator as Δ', the S. E. trade wind.

Arrived at the zone of equatorial calms, it ascends, and continues thence in the upper regions of the atmosphere as δ'', until it reaches the calm zone of Cancer. Here it descends, and continues on as the S. W. passage winds of the northern hemisphere, whose circuit has been already described.

Thus, at the risk of repetition and of being thought tedious, I have described the progress which the Wind and Current Charts had enabled me to make in the theory of atmospherical circulation; and I have presented that theory as far as it had been developed in my own mind, when I received yesterday No. 1, vol. i, 4th series, of the London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, containing a synopsis of Dr. Faraday's "Experimental Researches in Electricity," 24th, 25th, 26th, and 27th series; and also the letter of Prof. Von Feilitzsch on the *Physical distinction of Magnetic and Diamagnetic Bodies.*

This account, though meagre, is the first account that I have seen of the Doctor's discoveries relative to the magnetism of the atmosphere.

A new era in our knowledge of the laws, and the agents concerned in the general system of atmospherical circulation, will probably be dated from these discoveries.

With the accounts of them before me, I feel somewhat in the condition of the tempest-tossed mariner who has been buffeting with the waves in storm, clouds, and darkness, until he feels himself almost bewildered and lost in the mist that surrounds him; when suddenly a light appears, and, like the grateful mariner, I wished, before taking a fresh departure, to bring up my reckoning, and to ascertain how far I was out, in order to show how great was the service rendered by the sympathising hand which put forth that light.

Dr. Faraday has shown that, as the temperature of oxygen is raised, its paramagnetic force diminishes, being resumed as the temperature falls again.

"These properties it carries into the atmosphere, so that the latter is, in reality, a magnetic medium, ever "varying, from the influence of natural circumstances, in its magnetic power. If a mass of air be cooled, it "becomes more paramagnetic; if heated, it becomes less paramagnetic, (or diamagnetic,) as compared with "the air in a mean, or normal condition." *

Now, is it not more than probable that here we have in the magnetism of the atmosphere that agent which guides the air from the South through the calms of Capricorn, of the equator, and of Cancer, and conducts it into the North; that agent which causes the atmosphere with its vapors and infusoria to flow above the clouds from one hemisphere into the other, and whose foot-prints had become so palpable?

With the lights which these discoveries cast, we see why that air, which has completed its circuit to the whirl † about the Antarctic regions should then, according to the laws of magnetism, be repelled from the South, and attracted by the opposite pole towards the North.

And when the S. E. and the N. E. trade winds meet in the equatorial calms of the Pacific, would not

* Phil. Mag. and Journal of Science, 4th Series, No. 1, January, 1851, page 73.

† "It whirleth about continually."—*Bible.*

these magnetic forces be sufficient to determine the course of each current:—bringing the former with its vapors of the southern hemisphere over into this by the courses already suggested?

This force and the heat of the sun, would propel it to the North. The diurnal rotation of the earth propels it to the east; consequently its course first through the upper regions of the atmosphere, and then on the surface of the earth, after being conducted by this newly discovered agent across the calms of Cancer, would be *from* the southward and westward to the northward and eastward.

These are the winds which, on their way to the North, from the South Pacific, would pass over the Mississippi valley, and they appear to be the rain winds there. Whence then, if not from the trade-wind regions of the South Pacific, can the vapors for those rains come?

According to this conjecture, and not taking into account any exceptions produced by the land and other circumstances upon the general circulation of the atmosphere over the ocean, the S. E. trade winds which reach the shores of Brazil near the parallel of Rio, and which blow thence for the most part over the land, should be the winds which, in the general course of circulation, would be carried towards northern Africa, Spain, and the South of Europe.

They might carry with them the infusoria of Ehrenberg, but, according to this theory, they would be wanting in moisture. Now, those portions of the old world are for the most part dry countries, receiving but a small amount of precipitation.

Hence the general rule: those countries to the North of the calms of Cancer, which have large bodies of land situated to the southward and westward of them in the S. E. trade-wind region of the earth should have a scanty supply of rain, and *vice versa*.

Now, the extra-tropical part of New Holland comprises a portion of land thus situated in the southern hemisphere. Tropical India is to the northward and westward of it; and tropical India is in the N. E. trade-wind region, and should give extra-tropical New Holland a slender supply of rain. But what modifications the monsoons of the Indian ocean may make to this rule, or what effect they may have upon the rains in New Holland, my investigations in that part of the ocean have not been carried far enough for a decision.

Taking up the theory of Ampére with regard to the magnetic polarity induced by an electrical current, according as it passes through wire coiled *with* or coiled *against* the sun, and expanding it in conformity with the discoveries of Faraday, we perceive a series of facts and principles which, being applied to the circulation of the atmosphere, make the conclusions to which the charts have led me touching the continual "whirl" of the wind in the Arctic regions *against*, and in the Antarctic *with the hands of a watch*, very significant—much more so than I had supposed them to be.

In this view of the subject we see light springing up from various sources, by which the shadows of approaching confirmation are clearly perceived. One such source of light have we from the university of Greifswald, in Prussia.

Likening the atmosphere with its magnetic spirals of oxygen to the coils of a wire, and the poles of the earth to the ends of the helix used by Professor Von Feilitzsch, we might almost fancy that he was experimenting expressly with the view of throwing light upon the general course of atmospherical circulation.

"If," says he in his letter to Dr. Faraday, "we observe two such neighboring particles near the external "South pole, then will the more near repel a South pole with the intensity s; the more distant will turn to a "North pole with the intensity n', but in such a manner that $n' < s$. But outwardly these two excited mag-"netisms act with the difference of their power $s - n'$; but this is in one case *South polar*, consequently of the "same kind as the exciting South pole. The contrary will take place near the North pole, so that the *disen-"gaged magnetism distributed over the bar becomes South polar on that half which is turned to the South pole, "but North polar on the other half that is turned to the North pole.* A substance where this takes place is "*diamagnetic*, it places itself equatorial.

"When the bar of a magnetic substance is so qualified that the separating action of the molecules on each "other must be taken into consideration, then it can become so strong that the molecules in the middle of the "substance are more strongly magnetic than towards the ends. If we observe once more two such particles "near two such particles near the external South pole, the South pole of the nearest will tend to recede by an "intensity s_{I} from this external South pole, but the more distant will turn towards it a North pole of the in-"tensity n'_{I} but in such a manner that $n'_{\mathrm{I}} < s_{\mathrm{I}}$. Outwardly the two will act with the intensity $n'^{s}_{\mathrm{I}} - s_{\mathrm{I}}$ but this "is North polar, therefore of a contrary nature to the exciting South pole. The contrary will take place near "the pole, so that the *disengaged magnetism distributed over the bar becomes North polar on the half that is "turned to the South pole, but South polar on that half which is turned towards the North pole.* A substance "where this takes place is *magnetic*, it places itself *axial*." *

"Applying the former to the theory of Ampère, I was startled because it has hitherto taught only that "currents which are parallel and directed in the same way attract, but if they are parallel and not directed in "the same manner they are repulsive; therefore, that a current moving in the direction of the hand of a watch, "in a spiral produces a South pole on the entrance point in the spiral, but a North pole on the egression point. "Hitherto only such spirals have been constructed in which the current in every winding shows an equal "intensity."

"But I tried to arrange spirals of the following kind:—one of them is in such a way constructed that on "two copper wires are soldered, to each of them, fifteen thin wires covered over with silk. The first winding "backwarks over the copper wire, i. e. the first convolution of the helices, beginning at the end and proceed-"ing towards the centre is with all the fifteen wires, the second winding is only wound with 14 threads, whilst "the fifteenth is carried along the axis, &c.; consequently every convolution of the fifteen windings has a "thread less, and the ends of all the other threads have direction of the axis. The ends of the fifteen threads "are soldered in the middle, and the two thick wires without touching each other, are so bent that they can "be suspended in the little cups of the apparatus of Ampère, then a current passing through the spiral will "divide itself in such a manner that it is most strong on the external ends of the spiral but decreases more

* Page 48.

"and more to the middle. If the windings of the spiral took place in the direction of the hand of a watch, "then the end of it where the current *enters* will become a South pole, but a *North pole* kept parallel to the "spiral *will repel it*, only the final convolution will be attracted, and it represents the disengaged magnetism "of the final surface."

"A second spiral is wound like that described, only with this difference, that the strongest convolutions "are in the middle, and the feeblest near the ends. This spiral will be attracted by the North pole of a magnet "over the half in which the current moves at first or enters, but the other half will be repulsed by it. The "third spiral has the winding the same strength over the whole extent; it is indifferent to a magnet pole which "is not too near and only the final convolutions are attracted or repulsed."

"Therefore it is permitted to enlarge the theory of Ampère in this manner:—

"—If an electric current passes through a spiral in the direction of the hand of a watch, and,

"*a* If the current is more feeble in every winding as it is nearer to the centre of the spiral, then that half "is attracted by a South pole in which the current enters, except the first winding.

"*b* But if the current is stronger in every winding as it is nearer to the centre of the spiral, then that half "is repulsed by a South pole in which the current enters, including the first winding.

"The contrary will be the case for that half in which the current leaves the helix, and likewise for the "North pole of the magnet opposed."*

Attentively considering the experiments of the Professor of Greifswald, we may trace an analogy between his spirals and the spirals which the currents of the wind in "his circuits" describe about the earth. At the South polar calms, the atmospherical spiral is with the hand of the watch, and as in the case of a spiral so wound about its helix the magnetism is South polar; and so *mutatis mutandis* for the regions of North polar calms.

May we not look therefore to find about the North and South magnetic poles these atmospherical nodes or calm regions, which I have theoretically pointed out there? In other words, are not the magnetic poles of the earth in those atmospherical nodes, the two standing in the relation of cause and effect, the one to the other?

And have we not a clue already placed in our hands by which the motion of the circular storms of the northern hemisphere which are said to travel *against*, and those of the southern which are said to travel *with* the hands of a watch, seems to be connected with the like motion of the wind of each hemisphere in its circuit about its pole? and will not this clue when followed up lead us into the labyrinths of atmospherical magnetism for the solution of the mystery?

Indeed so wide for speculation is the field presented by these discoveries, that we may in some respects regard this great globe itself with its "cups" and spiral wires of air, earth and water, as an immense "pile" and helix, which being excited by the natural batteries in the sea and atmosphere of the tropics, excites in turn its oxygen, and imparts to atmospherical matter the properties of magnetism.

Thus, though it be not proved as a mathematical truth, that magnetism is the power which guides the

* Page 49, 50, Phil. Mag.

storm from right to left, and from left to right, which conducts the moist and the dry air each in its appointed paths, and which regulates the "wind in his circuits," yet that it is such a power, is rendered so very probable that the onus is now shifted, and it remains not to prove, but to disprove that such is its agency.

Of Clouds and the Equatorial Cloud-Ring.

During the progress of these investigations, the attention is frequently arrested:—in wonder and admiration, we pause to contemplate the benign and the beautiful in the system of terrestrial adaptations.

Among the many striking features which this system of research presents for contemplation, the imagination dwells with peculiar delight upon those which are brought out in tracing the offices which are assigned to the clouds in the terrestrial economy.

One need not go to sea to perceive the grand work which the clouds perform in collecting moisture from the crystal vaults of the sky, in sprinkling it upon the fields, and making the hills glad with showers of rain. Winter and summer, "the clouds drop fatness upon the earth." This part of their office is obvious to all; and I do not propose to consider it now.

But the sailor at sea observes phenomena, and witnesses operations in the terrestrial economy which tell him, that in the beautiful and exquisite adjustments of the grand machinery of the atmosphere, the clouds have other important offices to perform besides those of dispensing showers, of producing the rains, and of weaving mantles of snow for the protection of our fields in winter. As important as is this office, the philosophical mariner is reminded that the clouds have other commandments to fulfil, which, though less obvious, are not therefore the less benign or the less worthy of note. He beholds them at work in moderating the extremes of heat and cold, and in mitigating climates. At one time they spread themselves out; they cover the earth as with a mantle; they prevent radiation from its crust, and keep it warm; at another time, they interpose between it and the Sun, and screen it from his scorching rays, to protect the tender plants from his heat, the land from the drought. Having performed this office for one place, they are evaporated and given up to the sunbeam and the wind again, to be borne on their wings away to other places which stand in need of like offices.

Familiar with clouds and sunshine, the storm and the calm, and all the phenomena which the lightning and the blast present, the right minded mariner as he contemplates "the cloud without rain," ceases to regard it as an empty thing; he perceives that it performs many important offices; he regards it as a great moderator of heat and cold. Bound in his ship hence to the southern hemisphere, he enters the region of the N. E. trades, and finds the sky sometimes mottled with clouds, but for the most part clear; continuing his course towards the line, he finds his thermometer to rise higher and higher as he approaches the equator, until, entering the region of equatorial calms and rains, he feels the weather to become singularly oppressive; he discovers here that the elasticity of feeling which he breathed from the trade wind air, has forsaken him.

Escaping from this gloomy region, and entering the S. E. trades, his spirits revive, and he turns to his Log-book to see what changes are recorded there. He is surprised to find, that notwithstanding the oppressive weather of the rainy latitudes, both his thermometer and barometer stood, while in them, lower than in the clear weather on either side of them; that just before entering, and just before leaving the rainy parallels, the mercury of the thermometer and barometer invariably stands higher than it does when within them, even though they include the equator. He has passed a ring of clouds that encircles the earth.

Perceiving this, he is reminded how this cloud-ring, by screening these parallels from the Sun's rays, not only promotes the precipitation which takes place within it at certain periods, but how also the rains are made to change the places upon which they are to fall; and how, by travelling with the calm belt of the equator up and down the earth, this cloud-ring shifts the surface from which the heating rays of the Sun are excluded; and how, by this operation, tone is given to the atmospherical circulation of the world.

In a clear day at the equator, this cloud-ring having slipt to the North or South with the calm belt, the rays of the Sun pour down upon the crust of the earth and raise its temperature to a scorching heat. The atmosphere dances above it, and the air is seen trembling in ascending and descending columns with busy eagerness to conduct the heat off, and deliver it to the regions aloft, where it is required to give momentum to the air in its general channels of circulation. The dry season continues; the Sun is vertical; and finally the earth becomes parched and dry: the heat accumulates faster than the air can carry it away; the plants begin to wither, and the animals to perish. Then comes the mitigating cloud-ring. The burning rays of the Sun are intercepted by it. The place for the absorption and reflection, and the delivery to the atmosphere of the solar heat is changed; it is transferred from the upper surface of the earth to the upper surface of the clouds.

Radiation from the land and the sea below the cloud belt is thus interrupted, and the excess of heat in the earth is delivered to the air, and by absorption carried up to the clouds, and there delivered to their vapors to prevent excess of precipitation.

In the mean time, the trade winds North and South are pouring into this cloud-covered receiver, as the calm and rain belt of the equator may be called, fresh supplies in the shape of ceaseless volumes of heated air loaded to saturation with vapor, which has to rise above and get clear of the clouds before it can commence the process of cooling by radiation. In the mean time, also, the vapors which the trade winds bring from the North and the South, expanding and growing cooler as they ascend, are being condensed on the lower side of the cloud stratum, and their latent heat is set free, to check precipitation and prevent a flood.

While this process and these operations are going on on the nether side of the cloud-ring one not less important is going on on the upper side. There, from sunrise to sunset the rays of the Sun are pouring down without intermission. Every day, and all day long, they operate with ceaseless activity upon the upper surface of the cloud stratum. When they become too powerful, and convey more heat to the cloud vapors than the cloud vapors can reflect and give off to the air above them; then with a beautiful elasticity of character, the clouds absorb the surplus heat. They melt away, become invisible, and retain, in a latent and harmless state, until it is wanted at some other place and on some other occasion, the heat thus imparted.

We thus have an insight into the operations which are going on in the equatorial belt of precipitation, and this insight is sufficient to enable us to perceive that exquisite indeed are the arrangements which nature has provided for supplying this calm belt with heat, and for pushing the snow line there, high up above the clouds, in order that the atmosphere may have room to expand, to rise up, overflow, and course back into the channels of its circulation. As the vapor is condensed and formed into drops of rain, a two-fold object is accomplished: coming from the cooler regions of the clouds, the rain drops are cooler than the air and earth below. They descend, and by absorption take up the heat which has been accumulating in the earth's crust during the dry season, and which cannot now escape by radiation. Thus this cloud-ring modifies the climate of all places beneath it; over-shadowing at different seasons all parallels from 5° S. to 15° N.

In the process of condensation, these rain drops on the other hand have set free a vast quantity of latent heat, which has been gathered up with the vapor from the sea by the trade winds and brought hither. The caloric thus liberated is taken by the air and carried up aloft still further to keep, at the proper distance from the earth, the line of perpetual congelation. Were it possible to trace a thermal curve in the upper regions of the air to represent this line, we should no doubt find it mounting sometimes at the equator, sometimes on this side, and sometimes on that, of it; but always so mounting as to overleap this cloud-ring. This thermal line would not ascend always over the same parallels, it would ascend over those between which this ring happens to be; and the distance of this ring from the equator is regulated according to the seasons.

If we imagine the atmospherical equator to be always where the calm belt is which separates the N. E. from the S. E. trade winds, then the loop in the thermal curve which should represent the line of perpetual congelation in the air would be always found to stride this equator, and it may be supposed that a thermometer kept sliding on the surface of the earth so as always to be in the middle of this rain belt, would shew very nearly the same temperature all the year round; and so too would a barometer, the same pressure.

Returning and taking up the train of contemplation as to the office which this belt of clouds as it encircles the earth performs in the system of cosmical arrangements, we may see that the cloud-ring and calm zone which it overshadows are both ventricle and auricle in the immense atmospherical heart, where the heat and the forces which give vitality and power to the system are brought into play—where strength is gathered and impulse given to the air, sufficient to send it thence through its long and tortuous channels of circulation.

Thus, this ring, or band, or belt of clouds, is stretched around our planet to regulate the quantity of precipitation in the rain belt beneath them; to preserve the due quantum of heat on the face of the earth; to adjust the winds; and send out for distribution to the four corners, vapors in proper quantities to make up to each river basin, climate and season its due quota of sunshine, cloud and moisture. Like the balance wheel of a well constructed chronometer, this cloud-ring affords the grand atmospherical machine the most exquisitely arranged self-compensation. If the Sun fail in his supply of heat to this region, more of its vapors are condensed, and heat is discharged from its latent store-houses in quantities just sufficient to keep the machine in the most perfect compensation. If on the other hand, too much heat be found to accompany the rays of the Sun as they impinge upon the upper circumference of this belt, then again on that side are the means of self-compensation ready at hand:—so much of the cloud surface as may be requisite is then resolved into invisible vessels, in which the surplus heat from the Sun is stored away and held in the latent state until it is called for, when instantly it is set free and becomes a visible and active agent in the grand design.

That the thermometer stands lower beneath this cloud belt than it does on either side of it, has not been shewn, or if shewn, it has not yet been made to appear by actual observation, so far as my researches are concerned; for the observations in my possession have not yet been discussed concerning the temperature of the air. But that the temperature of the air at the surface under this cloud-ring is lower, is a theoretical deduction as susceptible of demonstration as is the rotation of the earth on its axis. It is a well known fact. Indeed nature herself has hung a thermometer under this cloud belt that is more perfect than any that man can construct, and its indications are not to be mistaken.

Where do the vapors which form this cloud-ring and which are here condensed and poured down into the sea as rain, come from? They come from the trade wind regions; under the cloud-ring they rise up; as they rise up, they expand; and as they expand, they grow cool; moreover, it requires no mercurial instrument of human device, to satisfy us that the air which brings the vapor for these clouds, cannot take it up and let it down at the same temperature. Precipitation and evaporation are the converse of each other; and the same air cannot precipitate and evaporate, take up and let down water at one and the same temperature. As the temperature of the air is raised, its capacity for receiving and retaining water in the state of vapor is increased;—as the temperature of the air is lessened, its capacity for retaining that moisture is diminished. These are physical laws; and therefore when we see water dripping down from the atmosphere, we need no instrument to tell us that the elasticity of the vapor so condensed, and falling in drops, is less than was its elasticity when it was taken up from the surface of the ocean as water, and went up into the clouds as vapor.

Hence we infer, that when the vapors of sea water are condensed, the heat which was necessary to sustain them in the vapor state, and which was borrowed from the ocean, is parted with; and that, therefore, they were subjected in the act of condensation to a lower temperature than they were in the act of evaporation. This is what is going on: ceaseless precipitation, under this cloud-ring. Evaporation under it is suspended almost entirely the year round. It is formed by the meeting of the N. E. and S. E. trade winds. The vapor and the air which they bring with them, here ascend—as they ascend they expend, as they expend their temperature falls. Hence we have, first a cloud and then precipitation. We know that the trade winds encircle the earth; that they blow perpetually; that they come from the North and the South and meet each other near the equator; that this line of meeting extends around the world; that in it, the air which the trade winds bring, ascends; and that in this ascent clouds are formed. By the rainy seasons of the Torrid Zone we can trace this cloud-ring stretched like a girdle round about the earth.

In view of these facts, and of these laws, it is useless to consult the thermometer, merely to learn whether the atmosphere under this cloud-ring be warmer or cooler than that on either side of it. Our knowledge of the laws of nature tells us that it is cooler.

In like manner, nature has placed a thermometer on the surface of the land, and of the water, which tells us that the mean temperature of the top of the earth's crust, whether it be land or water, is higher than the mean temperature of the superincumbent air; and so far as the researches connected with these charts have gone, and bear upon the subject, they indicate that it is so.

Where the atmosphere meets the land and water, there is the greatest amount of heat on the earth's surface. At this place of meeting, the thermometer in every latitude attains its maximum. If we descend below this place into the ocean, or rise above it into the air, the mercury in the thermometer is observed to fall.

The heating rays of the Sun as they pass through the atmosphere, impart little or none of their warmth to it. They must first strike the earth itself; their caloric is then absorbed or reflected by the solid and fluid parts of its crust, and given to the air. The land and the water receive the heat from the Sun, and impart it to the atmosphere:—more subtle than they, it is also more mobile and expansible. The moment that that stratum or layer of the atmospherical coating which envelopes the earth, and which happens to be nearest to its crust, receives from it the least accession of heat, that moment it expands, becomes lighter, and flies off with it to the azure vault above. It thus gives place to a cooler layer, which in turn receives from the surface-crust fresh supplies of heat like the other, and conveys it away to the clouds. Thus, while the Sun is heating both the land and the water, the atmosphere is receiving heat from them. The Sun heats them: and they, the air. But the land and the sea do not give to the atmosphere all the heat they receive from the Sun. They radiate off into space a considerable portion of it. Hence we are entitled to infer, that the mean temperature of the upper stratum of earth and water, generally, is higher than the mean temperature of the lower stratum of the air.

For particular localities and seasons there may be exceptions to this rule, as during the long nights of the polar winter, when that portion of the earth receives no heat from the Sun's rays, and radiates profusely.

The Ferro Islands, and places similarly situated, may also form exceptions to the rule. These islands are surrounded by the warm waters of the Gulf Stream, and though standing in latitude 62° N., the ponds there are said to remain unfrozen all the winter. These islands probably receive more caloric by conduction from the air, than by absorption from the Sun's rays, and the air which supplies them with warmth, derives it from the waters which have been heated in the inter-tropical regions of the Atlantic.

The belt of equatorial calms and rains encircles the earth; were the clouds which overhang this belt luminous, and could they be seen by an observer from one of the planets, they would present to him an appearance not unlike the rings of Saturn do to us. Such an observer would remark that this cloud-ring of the earth has a motion contrary to that on its axis of our planet itself—that while the earth was revolving rapidly from West to East, he would observe the cloud ring to go slowly, but only relatively, from East to West. As the winds which bring the cloud vapor to this region of calms, rise up with it, the earth is slipping from under it; and thus the cloud-ring, though really moving from West to East, with the earth, goes relatively slower than the earth, and would therefore appear to require a longer time to complete a revolution.

But unlike the rings of Saturn through the telescope, the outer surface or the upper side to us, of this cloud-ring, would appear exceedingly jagged, rough and uneven.

The rays of the Sun playing upon this peak, and then upon that, of the upper cloud surface, melt away one set of elevations, and create another set of depressions. The whole stratum is, it may be imagined, in the most turgid state; it is in continued throes when viewed from above: the heat which is liberated from below in the process of condensation, the currents of warm air ascending from the earth, and of cool descending from the sky; all, we may well conceive, tend to keep the upper cloud surface in a perpetual state of agitation, upheaval and depression.

Imagine in such a cloud stratum an electrical discharge to take place, the report being caught up by the cloud ridges above, is passed from peak to peak, and repeated from valley to valley, until the last echo dies away in the mutterings of the distant thunder. How often do we hear the voice of the loud thunder rumbling and rolling away above the cloud surface, like the echo of artillery discharged among the hills.

Hence we perceive or infer that the clouds intercept the progress of sound as well as of light and heat through the atmosphere, and that this upper surface is often like Alpine regions.

It is by trains of reasoning like this, that we are continually reminded of the interest which attaches to the observations which the mariner is called on to make. There is no expression uttered by nature which is unworthy of our most attentive consideration; and mariners by registering in their logs the kind of lightning, whether sheet, forked or streaked; and the kind of thunder, whether rolling, muttering or sharp, may be furnishing facts which will throw much light on the features and character of the clouds in different latitudes, and seasons.

As an illustration of the value and interest attached to observations upon "little things" so called, I extract from the Abstract Log of a very close observer who is co-operating with me in the collection of materials for these charts:—"In all my observations," writes this excellent and indefatigable seamen, in his Abstract Log kept for this office—"In all my observations on the tints of tropical flowers, I have found that yellow predominates."

No physical fact is too bald for observation; physical facts are the language of nature, and every expression uttered by her is worthy of our most attentive consideration. And the remark by this observant sailor about the predominance of yellow in tropical flowers, would, as a truism, be regarded with a high degree of interest both by the Botanist and the Chemist.

The Whale Chart.

In 1847, materials sufficient having been collected from the log books of whalers for an investigation into the habits and places of resort of the whale, Lt. Wm. L. Herndon commenced the construction of this "whale chart" for the whole ocean excepting the North Atlantic.

The object of these charts was to show at a glance, where this fish had been most hunted;—when, in what years, and in what months it had been most frequently found—whether in shoals, as stragglers;—and whether sperm or right. They are numbered letter F of the series.

Lieut. Herndon was interrupted in these highly interesting investigations, by orders for sea service. He had proceeded far enough however with the charts to develop some of the first fruits, which, it might be expected, are concealed in a field so abundant with treasures as this may be well supposed to be. But these orders deprived me of the assistance of a most valuable officer, and greatly delayed the work.

The plan of conducting these investigations is by spaces of 5° square, and the observations are so entered as to show at a glance the number of days for each month spent in each square; the number of days in which whales—and whether they are sperm or right—have been seen; also, the years in which whales of either kind were seen, and the years in which they were not seen, in any given square.

As observation after observation in such an immense field was recorded day after day, with the most untiring industry, and as the oft-repeated process finally began to express a meaning, I was surprised to find the lines for entering the right whale were blanks, through certain districts of the ocean, from one side of the chart to the other. Finally it was discovered that the torrid zone is to this animal forbidden ground, and that it is physically as impossible for him to cross the equator as it would be to cross a sea of flame. In short, that there is a belt from two to three thousand miles in breadth, and reaching from one side of the ocean to the other, in which the right whales are never found.

Hence the discovery that the fish called the right whale in the Northern hemisphere is not the fish which goes by this name in the Southern: that the right whale of Behring's Straits and the whales of Baffin's Bay are probably the same animal; and if so, that there is at times at least, an open water communication through the polar regions between the Atlantic and Pacific oceans: for this animal not being able to endure the warm waters of the equator, could not pass from one ocean to the other unless by way of the Arctic regions.

The investigations connected with these animals have also pointed out to us the great currents of warm water which keep up the ocean circulation of the Pacific—it might be said of the globe; for as we study their habits, these dumb creatures teach us by their instincts that there are continuous currents in the sea between places the most remote.

With the aid of what the whales have taught us, in connection with what we have learned from other sources, we can now *almost* prove the existence of a continuous current of water from the borders of the Red sea into the English Channel. The current, which has its genesis partly in the Red sea, and partly in the Indian ocean and its contiguous bays, is bifurcated off the African coast by a cold current from the South. And were it possible to throw into the Red sea two bottles properly marked and labelled, which would not be drifted out of the current, but which would separate at the forks of the stream, these two bottles would, or might pass, one around Cape Horn, the other around the Cape of Good Hope; and, meeting again in the tropical regions of the Atlantic ocean, it would, theoretically, be possible for them to drift into the Caribbean sea;—thence through the Gulf of Mexico;—and by the Gulf Stream out again into the Atlantic ocean; and by its waters to be cast up together on the shores of the British Islands, as the drift of the Gulf Stream is often cast.

There is an under current from the Red sea, and the course of the supposed bottles would be with that under current out into the Gulf of Aden; thence, rising to the surface in the Arabian sea—an immense cauldron without any escape, as from our Gulf of Mexico, for its heated waters to the North,—they would be drifted to the South in the currents from this sea: arrived near the Cape of Good Hope, this current is bifurcated by a cold one from the South going to replace the waters which it has conveyed from the North.

Here the bottles would separate, one following the Lagullas current around the Cape of Good Hope into the Atlantic.

The other taking the other branch of the stream, would be drifted to the southward of New Holland, and be carried into the Antarctic regions near Victoria land. Here the current being cooled down and deflected, it would commence its flow towards the North in the ice-bearing current which flows into the Atlantic around Cape Horn,—the icebergs of which I have encountered in latitude 37° South. Bottles that have been thrown overboard off Cape Horn, have been picked up on the shores of Ireland.

However, without pursuing just now this system of currents pointed out by the bottles and the whales, I propose at another time a still further investigation and account of these beautiful and interesting facts which the Whale Charts are developing.

After Lieut. Herndon was called away, the investigations for these charts were continued by Lieut. Leigh for a short time. His duties were soon changed, and I remained without force to resume the work, till late in 1850, when Lieut. Fleming reported for duty. He was set to work upon the "Whale Charts," but before he had made much progress with them, he was detached and ordered on other duty. Passed Midshipman Jackson has it now in hand, and it is hoped that with the great interest he takes in the subject, with the zeal and industry which he brings to bear upon it, the Whale Charts will soon be ready for the press.

They will show in what parts of the ocean the whales "use" in each month, and the knowledge cannot fail to prove of great importance to the whaling interests of the country,—an interest which keeps in continual occupation a fleet of 600 sail, manned by 15,000 American seamen—and which fishes up annually from the depths of the ocean, property, the real value of which far exceeds that of the gold mines of California.

Plate IV exhibits an extract from the Whale Chart.

The object of this chart is to show where the whalemen have hunted, and where they have found their game; consequently, this chart when completed, will enable us to designate those parts of the ocean where the whales "use," and those parts where they never go—and to tell where in each month this animal is most likely to be found.

The three horizontal lines, Plate IX, marked D. R. S., in the middle column, repeated from parallel to parallel, stand: D. for days; R. and S. for the number of days, each, in which whales, right and sperm, have been seen. The days of search are expressed in figures; the days on which whales are seen are expressed by the system of "fives and tallies," as already explained with regard to the winds.

It will be observed, that from 60° North, to 60° South, between the meridians of 125° and 130° W., right whales, except in one instance, have never been reported by any of the vessels whose Logs have been examined. That sperm whales, except a straggler or two, have never been seen between these meridians, below 5° S.; between which parallels and the equator they are most abundant. That they are seen between 35° and 50° N., between the equator and 10° N., but not between 10° and 35° N.; and the inference is drawn from the fact of their appearing so frequently between the parallels of 35° and 50° N., that warm water is found there.

The investigations for this chart are so conducted as to show the years in which the whales have been searched for, and seen in the various districts of the ocean. These results are the embodied experience of several hundred whalemen as to the best fishing grounds.

A chart, incomplete and imperfect it is true, but of some value to the whaling interest nevertheless, because it gives the results as far as they have been obtained, is in press, and will be speedily published. In the mean time, the work for one, more complete, is carried on with vigor.

Besides the practical advantages which it is conjectured will inure to the whaling interest from these investigations, much information of a highly interesting character will probably be elicited by them for the naturalist and geologist.

Scenes and information how interesting so ever to the world at large they may be, yet by often recurring, lose their novelty to classes; they become familiar, cease to strike, and are at best apt to be thought not worth speaking or writing about. This is particularly the case with regard to the whalemen and their calling. With the view of reminding them how little is known by the world generally, with regard to the habits of the whale, it may be remarked that the information conveyed in the communications from them, which are now published, and which information has been obtained from them by accident or chance as it were, will be read with much interest by men of science.

The gentlemen who were kind enough to furnish this information, had, I am sure, no idea of its publication; but I hope they will excuse the liberty for the sake of the motive.

These papers will, it is hoped, be the means of calling forth much additional information of a kindred nature.

Letters from Whalemen.

Capt. Daniel McKenzie to Lieut. Maury—dated, New Bedford, June 8th, 1849.

Herewith I forward some additional knowledge of the *sperm whale*, their *history*, *habits*, *food*, *age*, &c.; also the laws that govern their migratory movements, with such other thoughts as may occur to memory as I write.

The sperm whale, though found in every sea and clime, yet their great nursery is in the great Pacific; their haunts are found there from coast to coast; their limits that of the ocean itself. The males are more frequently found in high latitudes, the other sex in milder climates; a tropical region seems to suit them best; they seek bays in islands and coral beds and reefs in vast shoals to bring forth their young. The period of gestation I do not know. Perhaps no animal found in the sea are more timid and easier frightened; they always group by themselves, and seem to shun the society of other tribes of the ocean.

Their powers of vision are exceedingly limited, they cannot see directly ahead of them; hence they often, when alarmed, run foul of each other, and foul of other objects. I have seen them run against a whale boat, and the concussion so alarm them as to create the most convulsive phrensy; and I think they are as unconscious of the approach of the harpooner from that direction as when he follows after them. Their exquisite sense of hearing, however, is most extraordinary; not unfrequently in large shoals covering miles of space, the instant one is attacked, the whole school for miles around spring, shoot out their heads above water, and listen for a moment, and if the attack is made on a female (or cow) they will all rush with great speed to their wounded companion, as if to extend their sympathy, if nothing more, unconscious of their own danger. The bold whaler avails himself of their approach, lays off a short distance from his bleeding victim, and takes them as they come; and if he is clever at the deadly game, he will mortally wound several, ere they discover the tragic act he is playing; but if the first one attacked happens to be a male, nine times in ten the shoal will run off with such rapidity as soon to be out of sight. The cows are found in shoals from 25 to a hundred in number, not only at their usual haunts while feeding, but also in their migratory movements in search of food, accompanied generally by one large bull, who seems to reign over all as king, whose head is always found covered with scars and wounds, the result, as we always thought, of battles fought with other bulls in defending his gallantry for the other sex. The principal article of food (and indeed the only one as far as I know) is squid; the smaller kind they eat is found near the surface, and is from two to three feet in length; the larger kind, which probably have their haunts deep in the sea, must be of immense size—the flesh soft and of gelatinous substance. I have seen very large junks floating on the surface entirely shapeless. The cows on an average will yield fifteen barrels of oil; the males, (or bulls, as whalers call them,) are much larger, will yield from fifty to one hundred barrels of oil. At this stage, he is a noble animal, moving through the water so graceful, and with such majesty, and with such astonishing velocity; and that too, without apparent muscular action, is sublime; and when attacked, such perfect command over his locomotion as to entirely change his position as quick as thought. I have seen them lay motionless fifty feet off, and in an instant swing their huge flukes under us, and at one blow send the boats in splinters, men and all, ten feet in the air.

Large whales are seldom seen in groups; frequently four or five are found within as many miles of each other, but more frequently alone. In their several stages of growth, the males will be found in shoals all very nearly of a size; some shoals will yield 20, some 30, some 40, and sometimes 50 barrels, each whale. The males when very young, frequently accompany the other sex, as boys and girls go to school together, and as they approach a more mature stage, they separate.

I have never been able to approach any satisfactory result in relation to the time a sperm whale lives; the general opinion is that they live forty or fifty years. I once extracted the barbed end or head of a harpoon from the back of a large whale, enclosed nicely in the oily blubber, and the wound entirely healed where it had been lodged fourteen years. This was satisfactorily proved after we got home, by the initials of the blacksmith who made it on the one side, and the initials of the captain on the other. I remember the whale yielded about fifty barrels of oil; there was nothing in the appearance of the whale indicating old age. I have often noticed their teeth rotten and decayed down to the jaw, and others worn down level with the gum by mastication, and covered with wrinkles and furrows, having a way-worn appearance, evident marks of slow but progressive deterioration.

The ship Balena, of this port, Capt. E. Gardner, while at anchor at Karkakua bay in Owhyhee, took a large sperm whale off the bay, that yielded them one hundred and two barrels of oil, whose teeth were worn down level with the gum, evidently by masticating his soft food. This noble animal had no other appearances of extreme age, but seemed to have enjoyed full vigor of health and life; who then can tell the length of life they reach, ere it terminates by the ordinary process of nature! may it not as probably reach a hundred years, as close at forty?

I have said that the cows seek bays and still water to bring forth their young; they never visit shallow water; they go to such bays only where the water is blue and deep, and under the lee of islands and reefs—the bays at the great island of Albemarle, of the Gallapagos group, is often visited by large shoals of cows for that purpose—the water in those bays is of great depth, and as blue as the Gulf Stream.

I have said that squid is the only article of their food. I am aware that others think differently; that they do eat other fish. I can only judge from what I have seen. After a sperm whale is mortally wounded, and is in his last struggle, he not unfrequently throws up the contents of his stomach; which in the hundreds of instances I have seen, I have never discovered anything but parts of squid. In cutting them up, also, I have often opened the stomach, and never noticed anything but squid; hence I infer, that squid is their only food.

Their great object of migrating from place to place is no doubt in search of food; they are often seen in large bodies moving quickly, all in one direction; by getting their course as they pass, and following on after them, in a few days, again meet them brought to, feeding and laying quite still, and headed in different directions. In this case, the whaler often succeeds in getting a large share of oil before they are so harrassed and cut up as to compel them to abandon the ground.

I have often thought that currents had much to do with the movements of sperm whales; and as they are most always found heading it where it is strong, I have thought it was to meet the bate brought down with the current, particularly near the equator in the Pacific, where a current is always found setting to the westward, which grows stronger as you proceed westward, and the whales generally found stemming it, headed to the eastward.

I have spoken of the timidity of sperm whales. I have known instances near the land, where sperm whales were laying entirely still, a seal to spring in amongst them, and start them to running with great violence. I have also known them started and set running by the approach of porpoises.

It is remarked by many experienced sperm whalers—though I never noticed it very particularly myself, except in large whales—that after rising to the surface from their deep submarine explorations, they would breathe or spout as many times as they will yield barrels of oil. How this rule works with small whales, I never noticed; but I do know that those we rank as large whales, yield from fifty to one hundred barrels—do when undisturbed spout from fifty to one hundred times; as a general rule, they spout from sixty to seventy times, and yield when taken, from sixty to seventy barrels of oil.

Large sperm whales remain submerged in search of food, from an hour to an hour and a half, which I presume is as long as they can hold their breath, for, when they rise (unless disturbed or making a passage) lay quite still as if breathing was the ostensible object.

That sperm whales do perambulate the whole ocean, I have no doubt. Instances are known of their being harpooned on the Japan coast, and disengaging themselves from the boat, have afterwards been taken on the coast of Chili; this was known by the ship's mark on the harpoon. One instance is known where a sperm whale was thus struck on the coast of Peru, and, subsequently, taken off the coast of the United States.

I have often met sperm whales off the Cape of Good Hope, and off Cape Horn, making their passage from sea to sea.

I notice our ships have discovered a new region, new haunts for right whales. They enter the Yellow sea early in the season, and as it advances, they proceed North, through the Straits of Corea into the sea of Japan; thence North up the Gulf of Tartary; thence through the Perouse Strait into the sea of Seghalien; thence up the Ochotsk sea, following the whales as they proceed North.

Others have passed up the sea of Behring or Kamtschatka, North through Behring's Straits into the Arctic sea, where whales are found large and plenty; sea smooth, and weather in the summer months (from the extreme length of the day) favorable for whaling. Several ships have been whaling successfully in those parts. The polar whale (as it is called) yields very rich oil, and the bone is larger and longer than that of the North-west Coast, and fetches a better price in the market.

A free communication by our whalers through those remote seas, will develope the phenomenon of winds and currents there; they will also, in cruising for whales, discover the hidden dangers, (if any,) and thus contribute to assist the Hydrographer in preparing charts to guide future navigators.

Herewith I forward you a history of the sperm whale, by Capt. F. Post, of this city; also the history of Nantucket, the once great whaling nucleus of the world, from which you can find many useful statistics of early whaling. I am now quite idle, hoping soon to receive your instructions to commence copying Logs again, and to attend to any other business you may have this way.

Our whaling fleet are now being fitted away, and I am often called on for your Wind and Current Charts, but having no supply on hand of the kind useful to whalers bound South, they cannot be supplied.

History of the Spermaceti Whale, by Captain Francis Post.

It is a matter of much surprise, that, while the whale has been so long and so extensively an object of commercial pursuit, so little should be generally known of the animal.

There is perhaps scarcely a being in the animal world, at least, not one whose existence has been so long known, the habits, structure and qualities of which are less known to the naturalist than are those of the whale. It is a very prevalent opinion that whales spout water—Morse, in his American Geography, tells us that whales spout water to a great height, and we find many writers have been led into the same error;—but it is well known among whalers that whales never spout *water*, and that their spouts, which are simply dense respirations emitted with some force from their large nostril, never ascend above twelve feet high; and when the whale is unmolested seldom to that height, or to one half of it.

The Spermaceti Whale has but one spiralle through which it respires, this is on the left side of the upper part of the head, and within a few inches of its end; it is about fifteen inches long when closed, and when extended, from five to six wide. The spout shoots obliquely forward and upwards, expanding when it rises like a whiff of tobacco smoke, which it much resembles in form; it is visible but for a moment: is near the same density as fog, and when blown in the face, the same degree of dampness is felt from it. When the air is clear and cool, and a moderate breeze is blowing, so that the sea is not much ruffled, the spout of a large whale may be seen from a ship's masthead the distance of nine miles,—the white spout forming a fine contrast with the blue field above which it rises, and appears at intervals of almost as much exactness as can be measured by a first-rate chronometer. When whales spring out of the sea, the spray produced by their fall is so great as to be seen 15 miles—in one of these playful gambols they are frequently first discovered.

The males of this species are out of all proportion the largest, and they are generally found alone; it is then quite astonishing to see with what exactness they pursue their course. Not unfrequently they are pursued by a ship the space of a whole day together without altering their course a single point of compass. What can enable these inhabitants of the deep to thus pursue an undeviating course for a day, and most likely for as long a period as they choose?

So far as our knowledge extends the inequalities of the earth's surface beneath the sea, are similar to those above, and the conjecture, therefore, is a reasonable one, which supposes that the utmost cavities of the sea, do not exceed the loftiest heights above it. May not then these occupants of the watery world, like those of earth and air, be guided on their way by visible objects? For without such guidance, no animal, man not excepted, can long pursue an unvarying course. Instinct may urge the animal *when* to move, but something discernable must aid its way through the deep with such precision. Nor is it at all unreasonable to suppose that, by a wise provision of nature, their organs of vision are as well adapted for the watery element, as ours are for the ærial one.

These large whales generally spout from fifty to sixty times when to the surface, and the spouts appear at intervals of about fifteen seconds, though when the whale first appears they are rather more hurried than afterwards, this occupies nearly a quarter of a hour, after which they go down, and stop beneath the sea an hour, or an hour and a half, but never exceed this before they return to the surface again for the purpose of respiration. Thus between one-fourth and one-fifth of their time is occupied in sustaining vitality, by breathing atmospheric air. The periods of time passing while the whale is in the depth below are often nicely measured. In one instance the writer was in pursuit of a whale which was going quite fast nearly a day, and all this time he never stopped beneath the surface more than fifty-two minutes, nor less than fifty; he spouted no more than 48 times at a rising, nor less than 46. His other movements were equally uniform.

It is observed that whales suspend their breath longer in some seas than in others, probably because they go deeper for their food. Some idea may be given of the depth to which they go, by stating that when harpooned it is sometimes necessary to connect three or more lines together to prevent them from escaping. Each of these lines is commonly 225 fathoms long, so that if a whale take from boats four of these lines there is attached to it a continued line nearly a statute mile. It would not, however, go this whole depth; but, unless the descent was perpendicular, the whale's course would describe a sort of curve, and from the great length of line out, and pressure of the sea on it, the whale would continue to take line from the boats until it reached the surface, or nearly so; when in this condition the whale appears, it is generally found in an exhausted state, arising principally, it may be supposed, from its fright and struggles to get free, though some conceive it to be produced by the weight of the vast volume of water that must have pressed upon it while in the sea beneath. But this latter hypothesis seems rather untenable, for though the pressure may be great, yet if small fry, such as are caught from an hundred fathoms or so, can bear this pressure, then one bulky whale is not likely to get squeezed beyond endurance in the deepest cavern of the sea.

Spermaceti Whales are rarely, if ever, seen on soundings, though they are often seen and taken near land; but in this case there is always a bold shore and great depth of sea.

It is difficult to assign a reason why these whales are so partial to a deep sea, when all other kinds frequent shallow bays and harbors. Cuttle or squid, supposed to be the only food which sperm whales ever eat, are often found in shoal water; there is however a species of this fish, the exact size of which is not known; but it is presumed to be large, as whales, in the agony of death, frequently eject from their stomachs pieces as large as the bulk of a barrel, and these in large quantities; so that the assertion of the naturalists that, the whale, though the largest of animals, is one of the smallest eaters, is untrue. Large pieces of squid are often seen floating on the sea, which whalers consider indicate good whale ground.

The manner in which they take their food is rather curious, and affords a singular specimen of animal ingenuity. While the whale is making little or no progress through the sea, its capacious mouth is extended, by having the lower jaw dropped down, and the inside being white, the squid dart swiftly in. Whales are often seen in this position, and it is known that squid will spring at white and shining objects in the sea, for in this way are they caught. But for this stratagem, the whale might seek other food than squid: for they are extremely active, and if pursued could, by frequent evolutions, easily evade the pursuit of a whale.

The general color of this species of whale is a dark bluish grey, though some have large and irregular formed spots of white on them. The exterior surface of the animal is a thin tender substance of a glass-like slickness, which is easily broken, and forms what anatomists might call the cuticle; beneath this and upon the blubber is a short, soft, furry substance, that covers the whole whale. The blubber is of various thicknesses upon different parts of the body, and may average about 9 inches, though this depends wholly on the size of the whale. Some of this species have yielded 120 bbls. of oil, and as this comes only from the head and blubber, some notion may be formed of the enormous bulk of a large whale. Such a mass of animation cannot weigh less than sixty tons, and yet this animal, by all odds the largest that now exists, and unquestionably the largest that ever did exist, has, by a love of the marvellous been greatly magnified; when we are told that whales have been found to measure 160 feet in length, we cannot say, that

"*Travellers ne'er did lie.*"

That they are, or ever have been formed of such prodigious length, is wholly improbable; that sword fish and thrashers attack them, is equally so. But lay hyperbole aside, and reduce the size of a whale to flat reality, and it is then certainly a monster to excite our wonder.

The following are the dimensions and an admeasurement of a large sperm whale that yielded 95 bbls. of oil; and it may be asserted without fear of contradiction, that the description of one which makes the dimensions exceed these more than a few feet, is entitled to no credence. The whole length of the whale, from the end of the head to the end of the tail, was 62 feet; circumference at the largest part of the body 32 feet; head 20 feet long; under jaw 16 feet long, and contained two rows of teeth, 22 in each; (the upper jaw has seldom any teeth, and when it does they are very small.) The tail was 6 feet long and 16 broad. The head usually yields about one-third part of the whole quantity of oil produced. The tail of the whale, like that of all the cetaceous tribe, is horizontal to the body; and when wielded as it is by a great number of sinews, some of which are as large as a man's wrist, forces an irresistable blow, to which a cedar whale-boat forms a puny shield. The tail is between a triangle and semi-lunar form, and is the principal organ for impelling the whale along. The two pectoral fins serve rather to guide than to produce its motion. From the head to the hump, the whale approaches to a circular form; from thence the body terminates in an uneven ridge above and below, and diminishes in size, till at the junction of the tail, it is not above 6 feet in circumference; this hinder part of the body measuring much more, vertically than horizontally. The hump is a protuberance on the whale's back about 2 feet high, and when the whale is swimming along the surface this is seen elevated so much above it. The whale has no external ears, but two small apertures for admission of sound; the eyes have moveable lids, and are between three and four inches in diameter.

In comparison with the males, the females are diminutive, a full grown one of the latter, not exceeding in bulk one-fourth of that of the former, and seldom making more than 20 bbls. of oil, often much less. They are found in herds together with their cubs, varying in numbers from fifteen or twenty, to above an hundred; among them are some scarcely ten feet long. The writer had one of these nursling cubs hoisted on deck whole, which measured 14 feet in length, and yielded no more than 20 gallons of oil. This afforded an excellent opportunity of examining the internal structure of the whale, and on an occasion like this, the young whaler is never backwards in doing so, as by observing the position of the seat of life, he is enabled afterward to point his lance with a more deadly aim. Though it be somewhat perilous, an encounter with one of these immense herds is a whaler's delight, since sometimes no less than eight or ten reward the adventurous exertions. It is a singular fact that when one of these whales is harpooned, though the herd, or shoal, as it is commonly called, be separated some miles apart, it is instantly perceived by the whole, and they either rush with great velocity towards the wounded whale, or decamp and leave it to his fate. If the whales surround the wounded one, they of each boat may select one of them for themselves; and when they are killed, to prevent their being lost, (for as they are near the specific gravity of the sea, but a small portion of their bodies remain above it,) a hole is cut in each whale, and a pole some 15 feet long, with a small flag affixed to its upper ends, is placed vertically therein. This done, the boats may go in pursuit of more, as there is now no danger of their being lost, and they may be taken along side the ship at leisure. But it often happens when a whale is "struck" in one of these large bands, that the others all seek safety in flight, and then the whalers must content themselves with *slim fares*.

Either a whale's sense of hearing must be singularly acute, or else its vision is very powerful in a clear aqueous medium, for by one of these senses it is enabled to ascertain a long way off when another whale is attacked. Water it is said, on account of its density, has the quality of propagating sound farther than the rarity of the air will admit it; though it has only been ascertained that sound can be transmitted far *over* water, not *through* it.

When unmolested, the velocity of whales is not often more than three miles per hour, though when alarmed and closely pursued, they are capable of swimming at the rate of ten miles per hour, but they never go long at this pace before it diminishes to four or five. On receiving a wound in the vitals they spout out amazing quantities of blood, so as to color the ocean for many yards around. Instances are common, notwithstanding their mighty strength and size, of whales expiring in a moment after receiving their death wound. Sometimes in apparent fright they use every effort to escape from their merciless assailants, and not unfrequently in plunging into the depths of the sea and drawing all the lines from the boats, succeed in doing so.

When a whale is taking line from a boat, the utmost care is taken that it runs clear, as, should it become entangled and not instantly cut, the boat and all it contains, would at once be drawn beneath the sea. Many fatal accidents have occurred to whalers from being themselves entangled in the line, drawn from the boats and seen no more. In order for the whale to get no more line than is absolutely necessary, a strong piece of wood called a "*logger head*" is firmly fixed near the boat's stern; round this a turn or two of the line is taken, and it flies so swifty round, that its friction would set the logger head on fire, if water were not occasionally thrown on the line.

Whales when attacked are generally passive, suffering the boats to approach, and the harpoons and lances to pierce their huge bodies without making even a show of resistance, though serious accidents often happen, merely from the spontaneous movements of a wounded whale.

Boats in this way are often so badly stoven as to be rendered totally useless, and are abandoned on the sea. But they are not all thus unresisting: occasionally a large warrior whale is encountered, which proves himself a formidable and dangerous antagonist; that with a single blow of his ponderous tail severs the boat from which he is assaulted quite into halves, often to the destruction of part of its crew. But the terrible jaw of such a whale, set with a couple of score of large pointed teeth, constitutes his chief arm of defence, and wo to the thing in the shape of a man or boat with which it comes in contact.

Naturalists in their closets often make ridiculous mistakes in describing animals that are found in regions where they never venture themselves. Thus, of the ——— and whale. "Both want *teeth* for chewing, and are obliged to live on insects." Again, "the whale pursues no other animal; leads an inoffensive life; and is harmless in proportion to his strength to do mischief."—*(Goldsmith's Natural History.)*

Sperm whales are not so gentle; the large males often encounter each other so furiously as to break off many of their teeth when the jaws come in contact: and they have been taken with their jaws broken.

Instead of fleeing, a warrior of this mettle resolutely maintains his ground, and even in turn becomes the assailant, chewing in pieces every boat that approaches him. These desperate whales, after much hard fighting and imminent danger, are sometimes conquered; but so obstinately, and so successfully have they been known to defend themselves, that instances are on record, where all the boats of a ship, save one, to convey the drenched crews back, have been chewed into atoms, and the whales themselves, after defying all the resources of art, and disdaining to flee, have been left in full possession of the field of battle. We have heard of more than one case, where as a *last resort* the ship herself has been run alongside of a whale like this, and while passing by, lances were so skilfully thrown, that he ultimately died of his wounds, and became at last a prey to his captors. But an attack in this way is certainly hazardous, as all will agree who remember the fate of the whale ship Essex.*

The sperm whale is remarkable for yielding the unctuous substance whence comes its name; and it is also remarkable for producing ambergris; the bowels of a sperm whale forming the only situation where this singular fragrant substance is generated. Whether its existence is a cause of, or the effect of disease, is not yet known; it rarely occurs, not perhaps in one whale out of a thousand.

They seem to be more migratory in their habits than other whales, occurring in every parallel of latitude between the two polar seas, down to an equatorial one: though generally preferring the deep blue sea that indicates unfathomable depths.

As they are thus widely scattered, they are searched for in almost every sea, however remote, and hence it often occurs in voyages of 3 or 4 years duration, that ships before completing their cargoes, entirely circumnavigate the globe. They are occasionally seen in the Atlantic and Indian oceans; but are found in greater abundance in the Pacific, where they are seen at times in favorite spots, scattered over the whole extent of this great sea. When half a century ago, our ships first ventured into the Pacific in quest of sperm whales, the coasts of Chili and Peru abounded in them; and our hardy pioneers in this daring occupation were there enabled to fill their ships, without the necessity of penetrating farther. But the whaling fleet increased extensively; the persecuted whales were in a measure killed and driven from their haunts; so that later voyagers to insure success, have been compelled to push their adventures into still farther and comparatively unknown seas. One unexplored track after another has been traversed, until it may now be said that from Chili to New Holland, from California to the Japan Isles, and China sea, with the whole intermediate space—in a word, over a square expanse comprehending above eighty degrees of latitude, and more than one hundred of longitude, there is scarce a spot of any extent but what has been furrowed by the keels of a whaler, and been a place of privation to her enduring crew.

Zoologists have classed these animals, as well as all the spouting tribe, among fishes, distinguishing them by cetaceous order, comprehending a variety of species. But on an examination of their structure and functions, the impropriety of this classification is manifest; and the inspector is at once convinced of their being

*This ship was attacked and sunk by a whale; the mate and part of the crew, who took to their boats, were brought home from the Cape of Good Hope in the U. S. S. Vincennes in 1829, in which ship I was then serving as midshipman.—M.

far removed, or in fact wholly distinct from any species of fish. They have many analogies with the larger land animals, having in common with them, warm, red blood flowing throughout the system, though a certain modern philosopher has asserted to the contrary: Robert D. Owen, in one of his published letters while in America, skeptically comparing his situation in a stage coach to that of Jonah in the whale's belly, asserted that the whale was a "cold blooded animal."

They have a heart, with auricles and ventricles through which this fluid is propelled; they have lungs, together with all the functions for breathing atmospheric air, and they can only suspend this breathing for an hour or two at a time. Being entire tenants of the deep, and having organs for propelling them through it, are the only fish-like qualities they possess. They seem to form a sort of intermediate and connecting link between *absolute beasts*, and their more near submarine neighbors.

It is highly creditable to the spirited and enterprising individuals, who have put forth their capital in ships, destined to traverse the deep in quest of these oily monsters, that they have become so numerous as to form a large and important portion of our navigation; and this, without ever receiving, without ever needing, legislative encouragement. A computation roughly made, shows that we have now whale ships enough, if placed in a direct line, equidistant and just in sight of each other, to form a continued fleet, that might reach more than half way round the globe. The wealth drawn out of the deep and conveyed by them annually to the shores of America is immense. But aside from contributing thus largely towards our national wealth, no small degree of honest pride arises from the knowledge that no nation can rival us in this perilous branch of industry. The English have, it is true, been for many years engaged in it, and with partial success, but the immense amount of bounty paid by their government to encourage the establishment of one branch of whaling alone, shows how reluctantly they have been drawn into it, and fully justifies us in saying, that, in this pursuit as in others that call forth daring energy, Old England must yield the palm to *New England* adventurers.

From the commencement of the whaling career of the English in the northern seas, down to the year 1786, that government had paid bounty therefor, amounting to £1,266,000—a fraction or so of the national debt. To ensure success in their whaling operations in the South seas, the English as well as their neighbors across the channel, have not scrupled to secure for their ships, masters and other chief conducters of whaling voyages from the young country that first led the way beyond the two fellow capes, in this great marine enterprise. So liberal in fact were the inducements held forth, that merchants as well as seamen removed from our own to their countries, invested their funds, and became actively engaged in this venturesome pursuit. So far as we know, a detailed description of the manner of capturing, cutting in, and trying out a whale, has never been given; the following may, therefore, supply the place of a better one.

It may first be mentioned, that when a whale ship leaves her port, a man is stationed in the top-gallant crosstrees of each mast to look out for whales, and the mastheads are kept manned from daylight until sunset, during all weather that admits boats to leave their ship, from the time of her leaving home until her cargo is completed, or the voyage terminates; the ship's company standing watch aloft by turns of two hours each. When the spout of a whale is descried, the discoverer immediately makes it known by the welcome, and—on board of a whaler—the well known exclamation of "There she blows!" which is repeated often, as the spout appears in view; and though it should be so far off as to be but just discernable, yet by its peculiar formation, as well as by the number of times and regularity with which it appears, the experienced eye of a practical whaler can distinguish at once from what species of whale the spout proceeds. If it be a sperm whale, and not to windward, the ship is instantly headed for it, and all sail made in pursuit. After some few preliminary observations, such as noting time by watch, and with a spy-glass tracing the animal's way through the sea, its course and rate of going are ascertained, and it now may be calculated for with tolerable precision.

The ship is usually run within a half mile or so of the spot where the whale is expected to appear, when it rises to the surface, and by having the courses hauled up, and one of the larger topsails hove back, she there remains nearly stationary. The boats are now sent off, and are rowed in different directions, so that if the whale is not going fast, at least one of the boats is nearly sure of being near him when he rises, or should he chance to come up a mile from the boats, they can generally reach him before he has his spoutings out; as this occupies some fifteen minutes, and the boats may be rowed at the rate of six miles an hour, even over quite a rough sea. If the whale be slow in his movements, the boats' crews have nothing to do while waiting for it to appear, but to lay upon their oars; and as the time draws nigh, eager eyes scan all portions of the sea around, to catch the first glimpse of a rising spout. But if there happen to be much swell, from the depressed condition of the boats, being often in a cavity between waves that entirely obstruct the vision, it is difficult to discern a spout from boats beyond a limited distance; in this case, the main dependence is placed on the man at the ship's masthead, who, as soon as he sees the whale, runs up a signal and points out its direction. This creates a scramble among the crews, as there is generally no small share of rivalry existing among them, and all strain every nerve with the view of being the first who approach and have the honor of first implanting their harpoons in the whale; but as the boat which is more favored by chance, or happens to out-row the others, gets within a few yards of him, the contested race is given up, and the sternmost crews cease rowing and silently await the issue of the first conflict. Sometimes boats approach a whale, as their situations chance to be, by rowing up towards the head and get to the pervious part of its body in this way; at other times they proceed direct to its side, but generally the most approved way is to row up from behind, and if necessary, make a circuitous route to do so. The approach of a boat often alarms a whale, when he dives beneath the sea and suffers it to come near him no more; but more commonly and especially on new grounds where they have been but little disturbed, there is no difficulty in placing boats sufficiently near whales as to leave them in the attacker's power. It is probable, however, that boats seldom arrive near whales without their knowledge: such only making efforts to escape as have learned to regard them as enemies by having become acquainted with the missive weapons thrown therefrom. The harpooner rows at his oar until the boat gets nearly "within dart," when he is called up by the officer who steers and controls the boat; and when within a few feet of the whale the progress of the boat is checked as much as possible, by strokes of the oars. The harpooner now darts his two harpoons which pass through the blubber and enter the fleshy mass that encloses the bones of this great animal; and these keen instruments coming in quick succession often give to the affrighted whale the first intimation of impending danger. This is always a moment of peril to the assailants, and therefore one of anxiety to the lookers on; as some fearful accident might proceed from the convulsive motions of the wounded whale, other boats promptly row up to assist the first. The skill and activity of every one are now in requisition, lest the yet slippery and valuable prize should by some means escape before receiving his death wound. If, as often happens, a boat is badly stoven in the first onset, another takes in the immersed crew and tows the stoven boat to the ship, while others make a fresh and combined attack on the whale, which may now be rolling in the ocean foam, that his own struggles have produced, or perhaps rearing its mighty tail in the air, and drawing it down on the sea with such force as to make it resound to a great distance.

Soon as a boat is attached to a whale, the officer in charge exchanges situations with the harpooner or boat steerer, as he is more generally called, the latter now steering the boat while the former goes forward and plies his lance, taking care to poise it well before throwing it, and to aim it always so that some portion of the whale's vitals shall be pierced. Copious emissions of blood then gush from the spout hole, rise up a few feet, and fall into the sea, dyeing it with the crimson fluid wherever the animal pursues its way. Where a whale has fairly received its death wound there is but a small chance for escape, as it seldom lives above an hour or so afterwards. When dead, a hole is cut in the head or tail, through which a rope is rove, and if the ship is to the leeward the boats tow the whale towards her; but if the ship be to the windward, this labor is saved, as she then runs down within a short distance of the whale, where the fore topsail is hove aback, the whale is hauled alongside and a cable of rope or chain put round its tail; preparations are now made for cutting in the blubber and other oily portions of the whale.

This is a laborious process which, for a large sperm whale requires the principal part of a day to complete. The cutting operation is performed from stages suspended over the ship's side; the cutters being provided with sharp instruments for the purpose, called spades, these have a razor-like edge of fine steel, and are affixed to poles of convenient length. To make a beginning, a small hole is cut first in the blubber near the head, and into this is placed a blubber-hook, to which is attached one of the two large tackles employed in hoisting in the blubber, and by means of the windlass a piece of blubber about six feet in width is thus raised up to the ship's side. As this goes aloft the whale rolls over and over, the blubber peeling off rapidly as it rolls; and as the cuts are made not quite circularly round, but in a direction somewhat obliquely towards the tail, the whole blubber comes off the whale in one continued piece, being stripped off in the spiral way from head to tail. With the aid of the windlass, this piece of blubber is heaved some thirty feet above the deck, when the lower block of the tackle meets the upper one, which is suspended from the main masthead; a second tackle then relieves the first, having a strap of the block inserted through, and secured to the blubber near the deck; just above this block the blubber is cut off; the piece separated forming what is termed a "*blanket piece;*" this is lowered into the "*blubber room,*" which is that portion of the ship between decks, directly abreast and beneath the main hatches; another piece goes up to the same height as the first, and is in the same manner cut off and lowered into the blubber room, and so on till all the blubber is taken from the whale, five or six of these pieces commonly taking the whole. The carcass is then abandoned to the ravenous sharks and hungry birds that surround a ship on these occasions. The carcass sometimes floats, but most commonly sinks.

While the whale is being rolled the head is cut off; and it remains alongside secured by a strong rope till the blubber is hoisted in.

Small whales' heads are heaved on deck whole, but the immense weight of a large one renders it impracticable; it is therefore necessary to divide it. Both tackles are firmly hooked to a portion of the head, denominated the junk, and this when cut off requires the united strength of the whole ship's crew at the windlass to heave it high enough to reach the deck, a large one weighing at least between five and six tons.

The last and most remarkable portion of the whale remains yet to be hoisted in. This is what whalers term the "*case;*" it is a body of fluid head matter that often amounts to twelve or fourteen barrels, which when removed from the head, leaves a large tubular cavity that runs longitudinally its whole length. It is enclosed by a cartiligenous substance that yields no oil, and this again has an outer covering which is of an intermediate nature between blubber and a singular part of the whale called "*whitehorse,*" which contains no oily matter, and is impervious to all but the keenest instruments—a cannon ball would hardly penetrate it. This part containing the case is also too unwieldly to be taken in whole, and to subdivide it would cause a loss, as much thin oil would escape; hence it is necessary to raise it with the cutting apparatus perpendicularly up the ship's side, with its lower end remaining in and supported by the sea. A perforation is then made in the upper end with a spade and into this a bucket is placed which requires to be pushed down with a pole in order to tear away the tender membranous filaments that oppose its way; the bucket is then filled with oil, and by means of a pulley is hoisted up and emptied into a receiver. In this way ten or twelve barrels of the oily liquid are obtained from every whale of a large size. It is necessary that this oil should pass through the pots and be heated to prevent its becoming rancid, though it may be mentioned that while fresh it is perfectly sweet, and like other animal fats only becomes rancid through age. While fresh, it may be and is sometimes used on board ship for culinary purposes. A certain species of Yankee food called "*dough-nuts*," fried in fresh oil occasionally adds variety to the homely and too often scanty board of a whaler. Next to the case, the junk contains in proportion to its bulk, the largest quantity of oily matter; much of it yielding its own bulk in oil, and while it is being cut into smaller pieces the oil exudes so copiously that it is necessary to stop up the scuppers, and bail it from time to time off deck. The blubber between decks is cut into small pieces so as to be conveniently transferrable, these are called "*horse pieces*," and in this form the blubber passes through the mincing operation. This is performed by drawing a long knife across or nearly through the pieces, cutting down portions from a half to three quarters of an inch thick; these are not entirely severed, but for the convenience of removal are kept hanging together somewhat after the manner of book leaves.

In this state the blubber is ready for the try pots, into which it is transferred with a fork or pike constructed for the purpose. A hot fire is kept up under the pots, and in an hour or less a pot full of blubber has all the oil fried out; "the scraps," are then skimmed off; more blubber is put into the pots and a sufficient quantity of oil is boiled therefrom.

The oil boiled off is poured into a copper cooler, and from thence it runs through a cock into a second cooler, and from this is bailed into casks which are placed about deck, and when the oil is perfectly cool the casks are coopered and stowed away in the hold.

If the weather is fair and the sea smooth, a large whale may be fried out in about 36 hours, which gives an average of from 2 to 3 barrels an hour; and if the whale be uncommonly fat, the oil can be extracted proportionably faster.

The scraps, it may be stated, form a sufficient quantity of fuel for continuing the frying process; this goes on night and day, the ship's company being divided into two watches who perform duty alternately.

It is somewhat remarkable that in this age of invention, there has been no new method devised for capturing whales; nor any improvement made on the old one nor yet on the simple instruments used against them.

The plain harpoon employed by the early whalers, is still in use, although there have been various modifications of this form; such as, harpoons with one flue, those with joints, others barbed, &c., &c. But these have all had their day, and given way to the plain primitive harpoon.

There have indeed been some curious, but theoretical rather than practical, machines constructed for "*Shooting whales*," and also fanciful contrivances designed to explode in the animal and blow it up. But nothing has yet been fabricated for sending a harpoon, that is at all comparable to a pair of nervous and dexterous arms, more especially if these happen to belong to a stout heart. That, however, a portable piece of mechanism can be put together which will fully answer the end of throwing the missive weapon and destroying the whale with less risk of human life than the means now employed, is undoubtedly within the bounds of possibility. The chief difficulty, however, seems to be that of constructing an engine of this sort which shall possess sufficient projectile force to enable the *shooter* to remain secure in the distance, and yet be of diminished size and weight, so as not to occupy much space nor add materially to the weight of a boat.

Whale boats are necessarily nutshells of fabrics, there being not a board in one, from the keel to the gunwale, that measures one half inch in thickness, and this of the lightest material.

New Bedford, *June* 8, 1849.

Sir:—Having perused the foregoing reminiscences of my friend Capt. Post, who is an intelligent sailor, and has commanded a whale ship on several successful voyages, I have no hesitation in saying they entirely agree with my views and experience; hope, therefore, they may be found useful to you.

Having copied several of Capt. Post's sea journals for you, in one of which found the foregoing, (written out probably at sea,) and being much in detail, possibly may assist you in your great work; have therefore taken the liberty to forward them.

Very respectfully sir,

Your obedient servant,

DANIEL McKENZIE.

To Lieut. M. F. Maury,

Superintendent of National Observatory, Washington.

The same to the same—New Bedford, June 18th, 1849.

"Your communication of 13th inst. is received, contents duly noticed. I am most happy to learn that the book and letters I sent you in relation to sperm whales, &c., and also the statement wrote out by Captain Post, will be found useful. Captain P. is now absent, he commands the Barque Pliades of this port, and is on his passage to California on a gold-digging expedition, and has your charts from me; he will probably return you a valuable abstract log of his voyage.

You mention that you 'should not infer from the chart which is devoted to the whales, that the sperm whale has so wide a range across the ocean, as I and Capt P. seem to think, and should say the sperm whale in the Pacific is found almost exclusively within the tropics, or rather within 30° each side of the equator, and that the right whale is as seldom found within that zone as the sperm is found without it.'

Your inference (as a general rule) from the records you have had of the haunts most frequented, and long cruised around, both for right and sperm whales, is correct; that right whales are always found without the tropics is true, with the exception of a very few instances where cows in cruising along a coast seeking a still bay to calve, will enter the tropics, but their home and food is always found in a high latitude, and are sought after between the 30th° and 60th° latitude, generally from 35° to 45°.

The sperm whale has (as you remark) generally been sought after and found within 30° each side of the equator, and as long as they can be found in a friendly clime, where the sea is smooth and weather pleasant, they will be sought after there, and probably they would remain in low latitudes where the sea is smooth and their food abundant, if they were not harrassed, wounded and frightened away. Be this as it may, you may rely upon it, sperm whales are found, and many thousands of barrels of their oil been taken off the S. W. coast of Chiloe and off Gaufor, latitude 44° S.; also off the Chatham Islands, latitude 44° S., and amongst the Eleoutian Islands, (N. Pacific,) latitude 53° N. But after all, the great bulk of the fleet will be found cruising in every sea from the equator to 35° each side.

You ask if 'I or Captain Post, or some one else cannot give a similar chapter on the right whale, and if they and the sperm are ever found together, and if they fight.'

In my letter of the 5th of February, you will notice my description, somewhat in detail, of the habits of the right whale. The right and sperm whales, though sometimes seen near each other, I have no idea they ever mix, mingle, associate or fight; their food being entirely different, they are a different animal, having no affinity with each other, nor have I any knowledge that right whales ever fight each other; they seem to be lonely in their habits, sometimes they go in pairs, and at other times 4 or 5 will be seen together, but when they couple or cohabit together they meet indiscriminately and seem to indulge an indiscriminate intercourse. Shoals of each sex meeting together,—at this interview the bulls particularly are very wild; they bellow and roar like lions, breaching, rolling, and threshing about, lashing the ocean to foam with their huge flukes, and seem more intent on business than pleasure; it is exceedingly dangerous to attack them at this time; this mad phrenzy is soon over, when they separate, and resume their lonely wanderings over the ocean for food.

The charts you sent I will distribute with a special request 'to use the water thermometer freely.' It would give me great pleasure to furnish any additional remarks or thoughts upon whales. I do not know at present anything more I can write; should you wish me to investigate further, you will please inform me, and I will if possible comply."

Extract from W. S. Haven's letter to Geo. Manning—Sag Harbor, Sept. 17th, 1849.

"Your first question is as to the yield of the whale: Answer, Mr. E. says the largest whale taken in the Polar sea in the Superior made 180 *barrels*, the smallest made 120 *barrels* of oil, of a good quality, limpid and equal to the best oil found in the whales taken on the coast of Kamtschatka. Your next query, 'do the whales sound under the ice?' Answer, they saw no ice, therefore cannot tell whether they do or not. Question, 'if he has any bones (so I read it,) should like the loan of them:' Answer, he has none, neither has he any drawings of any kind of whale. The description he gives is as follows: The whales taken in the Polar sea were all of the Right or Black Whale species, of a deep black color, having head much longer than black whale usually has, and more crooked, drooping at the extreme, and without the protuberance near the end technically called the bonnet in other whales; saw a few white flukes or tails as you would call them; the head being longer; the whale bone was found of a corresponding length, being also much longer and smoother but not so thick as N. W. Coast whales; brings a better price in market; comes from the whale clean without the roughness usually found on bone from other whales; their spout holes are much higher than other whales of equal size in other respects; some of them were found with a hump on their backs like the Spermaceti Whale; saw no calves, found none in the cow *whales* in cutting; took a number of cows; their feed was of a different kind from that found in the other *Oceans*—not the red brit, but a paler substance, probably some oceanic animalculæ which causes the water at times to become thick; found the *whales* gentle and plenty; I believe I have answered your questions as fully as I can with the material at hand: if you require anything further I shall be happy to furnish you with any information I can obtain. Mr. Eldredge is not so communicative as some men,—very ready, very willing to tell you all he knows, but is not a talker, but requires a question to draw information from him. I hope you will furnish him with a set of charts, should he require them hereafter. In regard to whales crossing the line, I say with Mr. Eldredge, no! no! no! decidedly. Black whales are sometimes found as low as 18° or 20° from the equator, about the bays, in looking up places for the delivery of their young; but in all my experience I never heard of a whale in the open ocean nearer than 25° of the equator of the black whale species. I am therefore fully of the opinion, after crossing the equator twenty-four times, that black whales never cross the line, in which opinion I have all of our Sag Harbor whalemen agreeing with me."

Walter R. Jones to Lieut. Maury—New York, September 20, 1849.

"Your esteemed favor of 15th is received, and I am pleased to find that you are engaged in ascertaining the habits and the different kinds of whales of the different oceans, in addition to the other scientific and useful researches and discoveries that you are making; and it will give me pleasure to aid you if I have it in my power to do so.

The right whales differ very much, as you are well aware, and are very different in appearance and size in different latitudes. By uniting the observations of seamen, and comparing the dates with the places where whales are seen at different dates, you will contribute in determining the places where they may be expected to be found at different dates in successive years, and thus facilitate the operations of whalemen in taking them.

Our whaling masters tell me that it is a common occurrence to find the right whale in great numbers remaining stationary at their feeding place for a considerable time, when they suddenly start off in a particular direction, when the whalemen by exerting the greatest skill are only able to keep up with them a short time, and very soon they disappear entirely.

I cannot give you much information in relation to the important question you wish to solve as to the northern communication between Behring's straits and Greenland sea and Davis' straits. The whaling in Davis' straits and Greenland is now almost exclusively carried on by English whalemen. Indeed I do not know and never did know of but one American ship engaged in the whaling business to Greenland and Davis' straits; that ship is the McLellan, commanded successively on her three voyages by Jackson, Whipple and Chappell, and is expected to arrive at New London next month; the third mate of her on a former voyage has since been with Capt. Middleton in the ship George and Mary of New London to the Ochotsk sea, and says that the large common whales of Davis' straits and the Ochotsk sea, out of which the ships usually make the chief parts of their cargoes, are exactly alike. Other men who have been in the McLellan, are probably by this time in the whaling business in the vicinity of Behring's straits, who will be able to give more particulars in the course of the ensuing year, when more complete, more certain, and more satisfactory answers may be obtained.

Capt. Thomas B. Roys made a voyage in the ship Superior of Sag Harbor last year, and procured a full cargo to the northward of and inside of Behring's straits. He is probably the first American shipmaster that has entered that sea; he told me that whales commonly taken in the vicinity of the straits are generally large, fat and sluggish; and he also found there several other kinds of whales of smaller size, one of which kinds differed from any he had before seen, having a horn on the end of the head, which this species of whale use for rooting up their food from the bottom, and differs from every species of whale he had seen in other places; and he also spoke particularly of the whales taken in latitude 50° to 60° North being much more active and fierce, and more difficult to approach and more dangerous to take than those in latitude 70° in Behring's straits. He is now in command of the ship Sheffield, chiefly owned by myself and brothers, which vessel left here the 18th August for San Francisco and the Sandwich Islands, where he is to complete his outfits for another whaling voyage, during which Capt. Roys intends again to go through and to the North of Behring's straits. I am also interested in the bark Alice, Capt. A. D. Smith, which vessel sailed the first of this week; and in the ship Huntsville, Capt. Freeman Smith, to sail in the course of the next month. It is expected that these Captains will all pass Behring's straits early in the spring, and either of them will be willing to comply with any requests you may have to make. I can hand to Capt. Freeman Smith any communication you may wish to make to him, and I can send to Capt. Roys by the overland route via Panama to San Francisco any communication you may wish him to have; both of which I will forward with great pleasure. I make this offer, supposing you may have suggestions to make in addition to the one of bringing the scull bones of one of the whales of the West Coast.

Capt. Roys thinks there is land or very shoal water to the North of Behring's straits, as he found the soundings diminished as he sailed North; he also found on his entering the straits in the month of July an insetting current apparently dividing, and the strongest part of it running to the Northeast along Georgia, and another part setting to the Northwest, at a time when it was supposed the melting snows and ice would in the spring force the water outward; instead of which on his outward passage in September he experienced a diminished outward current setting to the South.

Messrs. Perkins and Smith of New London, the chief owners of the McLellan, will probably fit that ship again, in which case I have no doubt of their willingness to do anything in the way suggested that you may wish. Should that ship not go, the only way to procure a scull would be by asking the master of one of the English whalemen from a Scotch port to procure one, as they will have that business exclusively if the McLellan should he withdrawn, which I hope may not be the case."

C. B. Chappell to W. R. Jones, Esq.—New London, October 25th, 1849.

"Having been requested to furnish a description of the Greenland whale and its habits, I comply with pleasure in furnishing what information my experience in the country will afford.

First then I will state, that there are two kinds of whales in the Greenland seas, the first of which is found in latitude from 59° to 62° North, and invariably close to the ice, which at different seasons extends farther to the eastward, sometimes as far as 55° of longitude West; but as the season advances from March, the ice gets broken and squander in April and May. The whales seek their food and protection from rough weather among the ice, and always the heavier ice in preference; towards the land to the westward, and where there is no ice, they are seldom found and never at rest. The currents here set to the S. E. These whales have a long crooked head, perfectly smooth, with a very high crown or spout hole; measure not more than 50 to 52 feet in length, having a small ridge or hump near the flukes, but not like the sperm whales or hump-back. When the ice is gone these whales seek the land and go up the floe which runs far inland towards the West. The whales farther North, in latitude 68° near the island of Disco, have no such hump, but whose habits are the same. From Disco Island, the currents are found to set from the westward, which clears the ice from the land on the East side of Davis' straits, and leaves water for the whales in this vicinity.

The current at the same time presses the ice over to the West side, baring the passage of the whales up Hudson straits in the early part of the season; but after June comes in, the ice becomes more open and the whales can pass through to the West land, where in general there is a strong land ice, in which if there be no cracks or holes, they remain a short time in quiet. In the early part of July, whales are found to be going to the westward very quick, up Lancaster sound, and in large numbers, where it is supposed by all men that I have conversed with on the subject, that if they meet no firm ice across the sound, they continue their passage either through Barrow's straits down to Hudson's bay, or farther to the North and westward through the unexplored regions. Some seasons they have been found, after going up Lancaster sound and being gone for a while, to return to the southward. From this we must suppose that the ice was so strong that the whales could migrate no farther West, and the frost setting in obliged them to seek a passage farther South. When it happens that they come South they keep the land, and generally at the mouth of some deep inlet seek inland again; and finally, when in September, if there is any ice in the straits and any whales, we find them with the ice. We seldom find whales to the northward of Lancaster sound in Baffin's bay. But in former years it has been said they were quite numerous in latitude 76° 35′. Off Pond's inlet in latitude 74° North, longitude 76° 30′ W., we find whales coming from the middle of the straits; and if the land ice permits, they go directly up the inlet; if not, they remain awhile, then make up the sound. In March we find the old whale with their young in latitude 59° to 62°. In August we find many young ones in latitude 74°, yielding from 50 to 60 barrels. The largest one that I have seen taken yielded 175 barrels and 2200 pounds bone. About whales stopping under the ice, I would say that they can at certain seasons stop beneath the water according to their own pleasure, or as nature, according to my own judgment, has created them to lay at bottom dormant for a length of time. I am strengthened in this belief by hearing the Governor of Disco relate the fact that he saw a whale lying at the bottom near the Harbor of Liefly on Disco Isle for seven weeks, and that he visited the spot each morning on the ice beneath which the fish lay for this length of time, and then arose to the surface and was captured. I do not remember at what season of the year this happened. What I have seen of the whales, their average length of stopping down is one hour and fifty minutes, and remain above about twenty-five minutes; but when amongst the ice we seldom see them more than two risings, and many times never see them after going down. When they are irritated by having the harpoon stuck into them, they do not stop down so long as when disentangled; and still I believe I have seen a stuck fish stop down over two hours and come up apparently out of breath; and have seen them when I supposed they had made much exertion to pass under a heavy floe of ice, and that they could not pass it, was obliged to return again completely out of breath. At such times they are captured without a move to get away. I have seen a whale in a hole in the ice lay without going under for four hours, and if not troubled probably would have lain longer. It is my belief that these whales do emigrate to the West, and that there is a passage for them beneath the ice to seas beyond these sounds, or we should meet them oftener going the other way, which we never do. These whales do not require a large hole to breath through; have often been found dead in the vicinity of Lancaster sound, with no mark upon them, in numbers. From what I have heard, believe them to be the same as the Polar or Russian whale, but never saw one."

Captain Roys to Lieut. Maury—Hong Kong, January 19*th*, 1851.

"I received your favor with pleasure, and am very willing to communicate any knowledge I possess, respecting the whaling business. The whale of Behring's straits and Baffin's bay are the same; yet they differ very much from the Kamtschatka or Northwest whale, or the right whale of the South seas. I have known a whale to sound deep enough to take one thousand and fifty fathoms of line from the boats; yet I never knew a whale to remain longer under water than 35 minutes, of the right whale species;

and one hour and 30 minutes for the sperm whale kind. I have never known them to sound under ice, that is, more than 30 feet above the water's surface, which was in the South seas. I have never seen any ice to the northward of Behring's straits more than 30 feet high. The right whale feeds upon a small animal substance, which seems to vegetate and come to maturity every year, and perish like the vegetation upon the land. And it is only in one state when the whale will eat it; consequently, in the northern hemisphere, in the month of January, the food is to be found from 30° to 35° North; and in February it is ripe for the whale; a little farther, in March; still farther, and so on, until August, when it is as far North as the Kamtschatka whales go, which is 60°; while the feed from 35° to 40° becomes dead and unfit to nourish the whale, consequently the whale cannot live at that season in those latitudes, while the humpback and finback take possession and seem to enjoy and revel in the food, after it has passed its stage for the right whale. The polar whale's feed differs a little from the others, and in January, may be found in 50° North, and in August, from 70° to the pole. I am firm in the opinion that the South is the same; but as no one has ever seen yet a right whale the opposite of the Arctic whales, in the Antarctic, the matter still remains in doubt; and it is a lamentable truth, that the ships of war who have visited those seas are not able to tell us for certainty the kinds of whales they saw there. It is not the easiest thing in the world to distinguish the different kinds of whales, even to those who have been in the whaling business, and a ship must be brought close by a whale to tell for certain his kind.

The sperm whale is found in all climates, and in every sea; he feeds upon an inanimate animal substance called a squid, which grows upon the bottom of the sea, and is never seen upon the surface, except when torn up by the whale. I have seen it in large pieces floating upon the surface. I have seen a dying whale vomit it up. I have opened the stomach of a whale and seen it there in pieces: which convinces me the animal is very large, also as well as small; and that the sperm whale almost always, when in want of food, goes to the ocean's bed.

I do not know as I shall be able to procure for you a whale's horn, as they are difficult to take; but if no ill betide me, I will bring you the under and upper jaw of a Russian whale, which will be about 24 feet long by 16 diameter, which will serve to show the magnitude of this animal, and perhaps we may obtain the horn and something more.

I obtained the last season 3,200 barrels of oil, and 40,000 whale-bone, which I shipped from here to England, and try my fortunes another season. I commenced whaling in 1833, at 17 years of age, and it has been the whole study of my life ever since that time; and I am writing a book with all the knowledge I possess, giving a particular description of all kinds of whales, with all my opinions, &c., which I will forward unto you upon my return to the States. I shall sail from here the 10th of February, and expect to be in 60° North on the 20th of March. It would require too much paper to send, by mail, full answers to your enquiries, and I can only say, that I heartily rejoice that we have one man in our Government who will condescend to take notice of a business whose annual income is millions, and at the present time has broken down all competition of other nations, and is supplying the markets of the world with oil. I shall also be able to give you some of my opinions of ocean currents, &c. I have a set of your Wind and Current Charts, which I am happy to say, I consider very useful, and have found them so. When I arrive at home, you will hear from me soon."

Capt. McKenzie to Lieut. Maury—New Bedford, May 22, 1851.

"Your communication of 20th inst. is just received, contents duly noticed; in reply say:

It is both the right and sperm whale that is covered with hair, but not on the *outer* surface. The hair is found between the two skins; the outside skin is thinner than the finest paper, separated from the second or inner skin by a muddy substance covering the whole animal a quarter of an inch thick.

In this muddy substance lays imbedded a thick coat of hair, (as whalemen call it,) nearly half an inch long, resembling the fine *fur* found on a seal after picking off the hair.

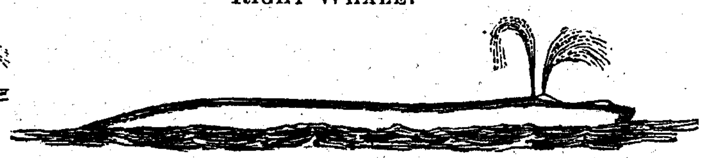
This is known to all who, for once, have witnessed the *cutting* and *boiling* of either of the above species of whale.

I have the promise of several Captains (who are now out) to get for you a small piece of the skin of either right or sperm whale.

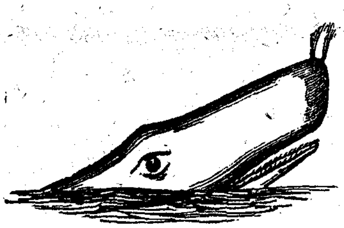
Diagrams.

SPERM WHALE.

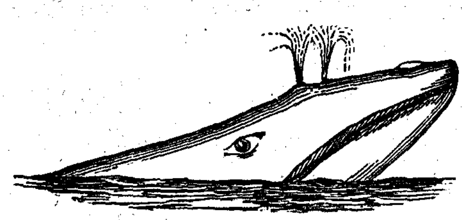
RIGHT WHALE.



SPERM WHALE HEAD.



RIGHT WHALE HEAD.

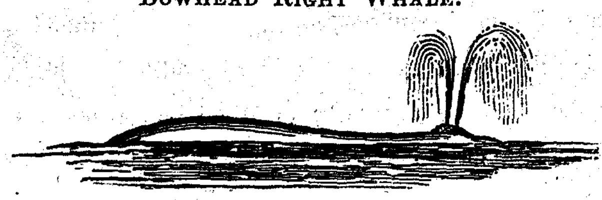


As the *Bowhead Right Whale* differs in form and spouts from all other whales known, I forward a sketch or diagram, showing their appearance as they lay swimming, and the form of the spouts. Also the shape (as developed) of that part which differs from the common kind when dead and on the surface.

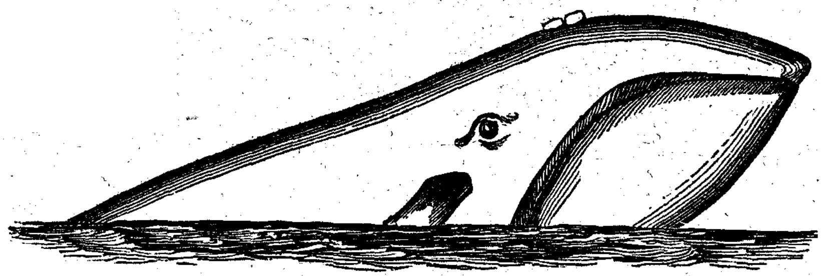
The skin of the bowhead is entirely smooth, of very dark color, with the single exception of two white bunches, each the size of an ostrich egg, forming the spout-hole.

I learn from Captains that the sea around where bowheads are found, is covered with parts of dead fish, and they suppose they were discharged from the whales.

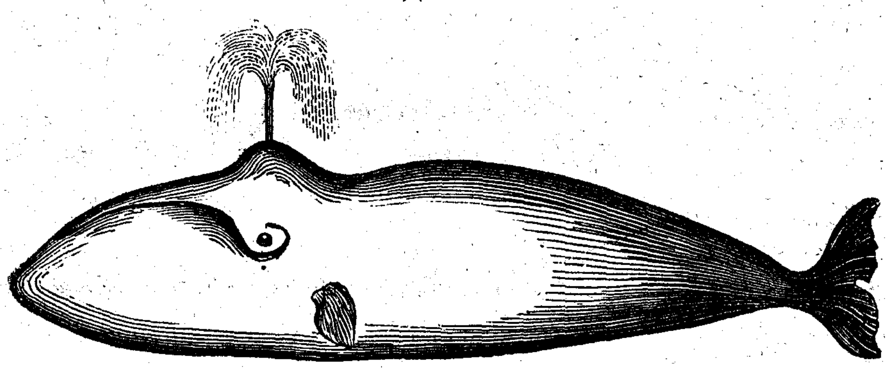
BOWHEAD RIGHT WHALE.



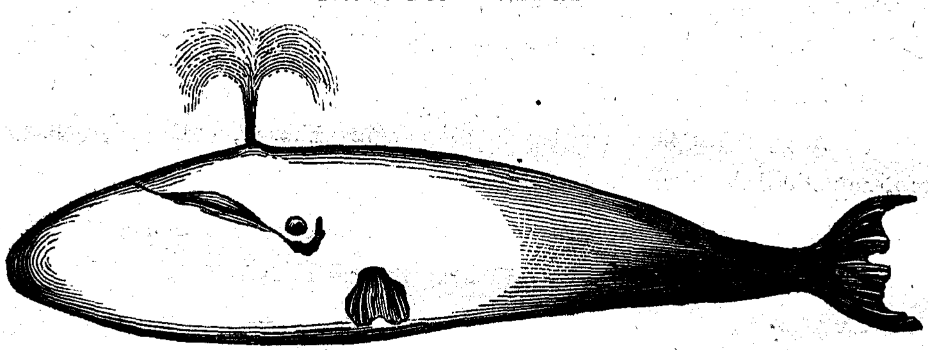
BOWHEAD RIGHT WHALE.



No 1. RUSSIAN WHALE, OR CAMEL-BACKED WHALE.



No. 2. RIGHT WHALE.



Russian whale like No. 1.

White whale.
Horned whale.
Brick colored whale. } Whales of the Polar seen by Captain Roys, North of the Behring Straits.

No. 2. Common right whale found in the North and South Atlantic—also in the South Pacific Ocean; and as far North as the Fox Islands.

The horn whale, or unicorn whale is smaller than the right whale. The horn whale, when full grown, is about 10 feet long; it projects ahead from the upper lip—is of solid bone—appeared as if used by the whale for rooting up food from the bottom of the sea—probably a species of the war whale. Capt. Smith thinks they may prove to be the California Grey Whale. There is a marked difference between the Russian or camel-backed whale and the common right whale. The spout of the former is a perpendicular jet, running high and then branching off in two parts, one part falling over the head, the other continuing upwards until its force is spent, then falls towards the tail. The spout of the right whale is a low, bushy jet, flying in all directions. The Russian whale has a hump on the back from the centre of which he spouts. Immediately behind this hump, the back caves in. His tail is broad and nearly square. The right whale is smoother on the back and has a narrow tail."

From same to same—May 28th, 1851.

"I have received yours of the 26th instant, and duly noticed its contents. In reply: the hair does cover the right and sperm whale 'all over the body;' probably shorter at the extreme ends than on the body of the whale

The right whales taken in *Anadir* and *Arctic* seas is somewhat different in its organization from all other right whales yet found; they are called *Bowheads*, having a curve down with their heads from the spout hole to the nose-end; so much so, as never to show their heads forward of the spout-hole—either when blowing or during their capture.

These whales are very *large*, *black*, and skin entirely smooth; no barnacles or other crustacea adhering.

They appear to be nourished by a different kind of food; their excrement, different; being *moulded* as if *costive*, and most *exceedingly*, *horribly* fetid.

If this be true, and I am told it is, since they are found in shallow water, is it not probable they may feed on other fish, or on vegetable matter found on the bottom?

One of our most intelligent captains told me he struck a right whale in the sea of *Ochotsk*, which went down and remained half an hour, when he succeeded in disengaging himself, and thus escaped. On taking the harpoon on board, he noticed the hitches and searons were covered with mud, he thought the whale had been rolling on the bottom, and worked out the harpoons; the whale descended two hundred fathoms.

I intend calling on some of my friends, on their next voyage, to examine the contents of the Bowheads' stomach.

John T. Conklin, second mate of the ship Huntsville, has been four voyages on the Northwest Coast; two from Cold Spring, and two from Sag Harbor. Has never seen a sperm whale on the Northwest Coast; has seen them in almost all oceans in the Pacific, not higher North than 35°; in south latitude as high as 57°, off the pitch of Cape Horn in a snow storm. 110 barrels is as much oil as he ever knew a sperm whale to make, and so down to five barrels; usual quantity 45 to 50 barrels. The sperm whales keep in warm latitudes, here, or on the equator, or near it.

The Russian whale has been seen as far South as 49°. The first he saw, was with Capt. White in the Tuscarora—was then in the Ochotsk sea in the Huntsville, about Lat. 61° or 63°; Long. 153° East. Land in sight 5 or 6 miles distant.

The quantity of oil from a Russian whale of large size 210 to 220 barrels, and down to about 90 barrels;

usually, 175 barrels from each Russian whale. This is probably the same kind as are taken in Behring's straits. Find the common right whale in abundance here. Also, some call these Japan whales. These whales, Mr. Conklin thinks, are similar to the Greenland whale, but he has never seen the latter.

The right whales keep to the North of 30° North, and South of 30° South—never go near the equator. Has heard of one taken near the Sandwich Islands or the passage, in about Lat. 19°; has taken one.

260 barrels down to 15 barrels, usually about 75 barrels, are taken in all oceans, except from 30° North to 30° South.

California Grey—usually 25 to 30 barrels. Fin-back:—does not chase them;—are not of sufficient value;—may make 15 to 30 barrels; some do not make any. Sulphur whale, about the same;—heard of one that made 60 barrels—are not sought after. Grampus:—are small;—may make a barrel or two;—similar to the Black Fish. Black Fish make about one barrel, and equal to sperm oil, and like the Fin-back and the Sulphur Bottom, are seen in all seas, and in all latitudes;—cross the equator and go elsewhere. Hump-back whale—is found usually on the coast of Chili and Peru, and New Holland, and up and down the coast of California, Lat. 40° South and Lat. 40° North, are plenty;—have been chased in Valparaiso and Sandwich Islands;—hardly worth catching;—the large ones have but 50 barrels—a common whale of the same size, 100 barrels—usually 60 feet, some are 70 feet."

Capt. McKenzie to Lieut. Maury—New Bedford, July 26th, 1851.

"Your favor of the 28th ult. came to hand; contents duly noticed; and in reply, say, I have with pleasure made your 'grateful acknowledgments' to Capt. Howland, of Ship Citizen, for his 'kindness and attention,' as you directed.

Capt. H. says further as regards sperm whales staying for days under water, that in cruising for instance on or near the equator, round the Gallapagos, and westward also on the coast of Japan—these places are cited as celebrated haunts, where hundreds of ships are cruising near each other at the same time,—that not unfrequently no whales are found for several weeks, when all at once, as if by magic, the ground for hundreds of miles, will be found abounding with sperm whales; when the great work of slaughter simultaneously begins. They at last disappear as suddenly and unexpectedly as they came. After the decks are cleared and oil stowed below deck, sail is again crowded on the ship; while cruising they often speak each other, and report the success they have had. It is then known that the whole fleet found whales about the same day, and lost them near the same time. I entirely agree with Capt. H. and others of great experience in their opinion as above; and what is very extraordinary, when the whales are first seen they are slow in their movements, and headed every point of the compass.

The sea elephant has never yet been seen out upon the open sea, either by their pursuers or by whalers; they are first seen crawling up the beach, where they bring forth their young; and at another season to shed their coat.

They therefore must remain for months under the surface, or on the bottom; whether they carry with them a reservoir of compressed air to feed upon, or whether they die and are brought to life again, God only knows, *I do not.* The 'Notice to Whalemen' sent me I have furnished to owners and masters as they have called, still have a small supply on hand; happy to say they were most gratefully received.

The 'long-looked for' Whale Chart (Series F) has at length arrived, (one dozen copies,) they are appreciated very highly by all intelligent men, especially owners and masters. A large supply is now or soon will be wanted for distribution."

In this stage of my investigations into the habits of the whale, I have thought it best to give the foregoing letters without any comments of my own. They possess much interest and have a peculiar value. I quote them, not for the purpose of exciting discussion among naturalists, but for the purpose of eliciting further information from the whalemen themselves; hoping that these last will be induced to go more into detail, and give us all the information which they possess; and among such a number of close observers there is no doubt much that is valuable. I need not add that naturalists would be thankful to any whaleman who will furnish them with a specimen of the *hair* with which we are informed by Captains Post and McKenzie that whales are covered.

It is proper to remark that I *infer* the figures of the whales (Plate X) were drawn by Mr. Conklin, from recollection, and that I have others of the same species drawn by F. H. Smith, which I presume were also drawn from memory, and which resemble these so closely that there is no difficulty in recognizing the pictures of the different kind of whales as drawn by each.

Captain Smith makes this difference, however: His profile of the Russian or Polar whale has a protruberance in which the spout hole is inserted, whereas he represents the right whale as having no such feature.

Let us return now to the whale chart—letter F of the series.

By examining this chart it will, as incomplete as it at present is, serve to satisfy one at a glance that the favorite haunts of the sperm whale are about the equatorial;—of the right, about the polar regions. That near the tropics is a sort of debatable ground, where the pasturage of the one overlaps the pasturage of the other. And that on either hand a straggler from the one herd is occasionally found far over within the borders of the other.

I have to request that whalemen when they come across these stragglers will observe them closely. Do they appear to be lost? what is their bodily condition, fat or lean? and what the contents of their stomach? Are the stragglers generally male or female, and what is there that is peculiar about them?

The preliminary whale chart (series F) which comprises a chart of the world, Mercator's projection of 10 degrees to an inch at the equator, and which extends from Lat. 79° 50′ N. to 68° South, shows three places where the sperm whale is in the habit of leaving the tropical regions and of resorting to higher latitudes. These places are in the South Atlantic where they have been found in large schools between the parallels of 30° and 35°;—in the South Pacific, between the parallels of 35° and 60°;—and in the middle of the North Pacific as high up as 40°.

I account for their presence up in the North Pacific by the "Gulf Stream," which has its genesis in the

Indian ocean, and its exodus in the China seas. It carries, high up into the North Pacific ocean, the warm waters and sea climate of the Tropics. And the sperm whale resorts there to enjoy it.

The sperm whale being found in the South Atlantic has suggested the inquiry as to the temperature of the waters there—can there be a warm current in that part of the ocean? If so, whence does it come?—from the intertropical regions of the Atlantic, or from the Indian ocean? or, is it a branch of the Lagullas current?

If it be the temperature of the water which invites the sperm whale into these extra-tropical regions of the South Atlantic, we may perhaps obtain from these dumb creatures an answer to the question: By what channel do the waters which the Lagullas current, and the ice-bearing current around Cape Horn, and the cold current from Baffin's bay, and the waters which the Mississippi river, the St. Lawrence, and all the great rivers of Europe and Africa bring into the Atlantic ocean—by what channel, do these waters escape and preserve the level of that sea?

These currents bring into the Atlantic water more than enough to supply the waste of evaporation. The brine of the sea is not accumulating or concentrating in this ocean, and we therefore *know* that there must be somewhere in this ocean, either at the surface above or in the depths below, a current of large volume running from it. I have searched for it long and patiently. I have looked for it—feeling as certain of its existence as we do of a thing that has been seen and known to exist, and is lost—but in vain.

The components of sea water like the components of the atmosphere are every where the same. It is true that we find a little more salt in this place, and a little less in that; but this is attributable, not to the want of a general system of aqueous circulation in the terrestrial economy, but rather to local causes, such as an excess of precipitation, or an excess of evaporation, or the discharges of fresh water from rivers in the neighborhood. If the waters of the sea did not pass from one climate to another, and from one ocean to another, it would not be difficult to conceive, why, in process of time, there should not be as great a difference in the waters in different parts of the great oceanic reservoir of the earth as there is in the waters of the Dead sea and of the Mediterranean, or in the waters of any two seas, between which there is no communication.

The chemist analyzes the waters of the Mediterranean and of the Red sea, and detects the same components. Now, unless the waters of those two seas could intermingle,—and I have traced a current from the one to the neighborhood of the other—unless, I repeat, there were an intermingling between the waters of these two seas, what could preserve the same salts in the same quantities in each?

The Red sea, because it is riverless and rainless, receives no salts from the land on its shores: Whereas the rivers which empty into the Mediterranean have for ages been filtering "the salt of the earth", taking it up in solution from the soil, and bringing it down with their drainage into this sea.

Now unless nature had provided some means or process, by which the waters of these two seas should regularly intermingle with the waters of the ocean, and through the ocean, with each other, what would hinder the two seas from salting up their brine with different strength.

No doubt the harmonies of the sea are as beautiful and as sublime as the "music of the spheres." And to what agency therefore, if not to the agency of currents and the mobility of water, must we ascribe the permanent condition of sea water? for perhaps of all parts of creation that are both tangible and visible to us, the waters of the sea are most permanent and stable in their characteristics, proportions and constituents.

If nature had not provided a general system of circulation for the waters of the sea, what would prevent the waters of the Mediterranean for instance from absorbing salts and other constituents through its rivers, and of accumulating them in quantities and proportions, which would possibly make a characteristic difference between sea water from the Mediterranean and sea water from the Red sea?

That the waters of remote seas do not permanently attain different degrees of saltness—that sea water like the air of heaven, come whence it may, is always the same—may of itself be taken as a proof if no other evidence could be had, that there is a regular and constant passage, secret and invisible though it be, of the waters from one oceanic basin to another. At least in the present state of our information upon this subject, we infer that such is the case; and that it is owing to the agency of currents in the depths below and on the surface above, that the waters of one sea are not all brine, of another all fresh, and of another all ice.

Twice, perhaps thrice as much fresh water is discharged by the rivers of Europe, Africa and America, into the Atlantic, as is discharged by all other rivers into the Pacific. Twice, perhaps thrice as much fresh water is taken up from the Pacific as from the Atlantic by evaporation. Now, if the waters of these two oceans were never to intermingle—if the waters of the Pacific never found their way into the Atlantic, and if the Atlantic were never to send its waters to mingle with those of the Pacific ocean in its own basin, what would prevent the great water-sheds that are drained into the Atlantic from filling its basin up in the process of time, with fresh water? What too, would prevent the Pacific, which gives more fresh water to the clouds than they restore to it again, from becoming first, a sea of brine, then, finally a bed of salt?

Studying the habits of nature, so to speak, with regard to the air, and the sea, I have learned to conjecture that every drop of water now in the Pacific, has been at some former period, in the Atlantic; and this conjecture, reason teaches me, is as plausible as is the supposition that every breath of air now in the northern hemisphere, has at some time or other, in following its appointed paths, coursed its round in the general system of circulation through the channels of the southern hemisphere.

Assuming these principles to be in conformity with the designs of nature, I have been induced to search for a current from the Atlantic ocean into the Pacific.

Taking its existence for granted, therefore, as I am disposed to do, it can be readily shown that this current does not have its exodus through the Arctic ocean; for in that case, the precipitation in that ocean being greater than the evaporation, the waters of the great rivers of northern Asia, Europe and America, being added to its own waters, would create a stream of immense volume and frightful rapidity through Behring's straits into the Pacific. Whereas, so far from this being the case, the reverse occurs.

The current through Behring's straits runs generally from, not into the Pacific. I have therefore looked to the South Atlantic;—to the space between the two stormy capes, as the only place in which this ex-Atlantic current could make its exodus. And if, after all this special and minute investigation;—if, after the most accurate and careful, and patient examination that has been made of Log-books here for some evidence of this current;—if, after the attention of navigators has been called to it, and they have exhausted all the means which human ingenuity has devised for detecting and measuring currents at sea, and have failed to discover one here;—if, after all this labor and research, it should so turn out when we go there with the water thermometer, that the sea climate is not an extra-tropical one as its latitude indicates, that it is the inter-tropical temperature of its waters which tempts the sperm whales to gambol there in such multitudes—then the discovery of the fact that the sea water here is a little warmer, and that therefore there is a current running hither from the equator, should be regarded as one which is due to the information which the study of the habits of this animal has given us.

In the sperm whale region off the coast of Chili and Terra del Fuego, we have been taught to believe in the existence of a cold current. Assuming this cold current to be there;—that it is not crossed or divided by a warm current, the resort of the sperm whales there must be regarded as an anomaly in the habits of the creature.

These investigations as to the habits and places of resort of the whales, have taught me to regard sperm whales as much out of place in cold water, as the whalers themselves would regard out of place a wilderness of howling monkeys of the Amazon among the Green Mountains of Vermont.

The Whale Chart (letter F) which is in press, is merely a beginning. It is incomplete and defective in many respects; but incomplete and defective, and unsatisfactory though it be in many respects, I have yielded to the solicitations from the whaling interest, and give it, with all its imperfections, to those engaged in that business, hoping that it will have the effect of exciting on their part a still more active and hearty co-operation.

The following notice from this office to whalemen, has been published in the newspapers of the day.

Notice to Whalemen.

NATIONAL OBSERVATORY,

Washington, May, 1851.

Captain Daniel McKenzie, of New Bedford, and George Manning, of New York, have been engaged for a year or two in collecting materials for this office relating to the habits of the whale, &c.

These materials have been used here by Lieutenants Herndon, Leigh, and Fleming, of the Navy, in making a Chart to show when and where our whalemen have searched for whales, when and where they have found them—with what abundance, and whether in schools or alone.

This Chart divides the ocean into districts of 5° lat. by 5° long.; perpendicularly through each one of which districts, are 12 columns for the 12 months; and horizontally through each one of which districts are three lines: one to show the number of days that have been spent in each month in every district, and the two others to show the number of days on which whales, sperm or right, have been seen. Thus:

A.

Lat.	85° W.		Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	80° W.
5° N.	Days of search.		125	11	2	7	72	90	155	148	183	138	112	94	
	No. of days Whales seen.	Sperm.	18	0	0	1	21	13	20	30	41	37	38	9	
		Right.	0	0	0	N.	0	0	0	0	0	0	0	0	
Equator.	Days of search.		53	81	108	180	138	97	157	179	160	189	139	81	Equator.
	No. of days Whales seen.	Sperm.	5	8	10	17	8	3	23	22	10	14	5	9	
		Right.	0	0	0	M.	0	0	0	0	0	0	0	0	
5° S.	Days of search.		45	111	70	56	56	50	91	125	119	95	94	97	5° S.
	No. of days Whales seen.	Sperm.	3	9	2	1	5	2	6	8	13	10	8	3	
		Right.	0	3	0	P.	0	0	0	0	0	0	0	0	
10° S.															10° S.

B.

Lat.	80° W.		Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	75° W.
40° S.	Days of search.		148	96	39	54	25	5	8	0	26	116	222	255	
	No. of days Whales seen.	Sperm.	2	3	0	16	2	0	0	0	1	4	10	0	
		Right.	27	7	1	Q.	2	0	0	0	7	21	76	105	
45° S.	Days of search.		48	58	16	8	3	0	6	0	0	5	4	22	
	No. of days Whales seen.	Sperm.	5	0	3	R.	0	0	0	0	0	0	0	1	
		Right.	5	1	0	0	0	0	0	0	0	0	0	10	
50° S.	85° W.														

The above is an extract from the Chart, which not being ready for publication, nevertheless affords information that I have thought might prove of some value to the great national interests which attach to the American whaling business.

It will appear from the above sample, that I have had examined the Log-books of whalers who altogether have spent 1,131 days in the district (N) between the equator and 5° N.—80° and 85° W., without ever having seen a right whale. In the district (M) that joins it on the South, sperm whales have been seen in every month of the year, but less frequently in April, May, August, and October. This, too, is a place to which right whales never come; and it appears that the district (P) which joins this one immediately on the South, is much frequented by the sperm whale, but only now and then by a straggling right whale, in January.

If the information afforded by the great number of vessels, whose Logs have chanced to be examined for these districts, be a fair sample of what the whole would show, as it is supposed to be, then it would appear altogether useless to look here for right whales.

In the sample marked B off the west coast of South America, between 40° and 50° South, 75° and 80° West, it appears that the upper district (Q) is not much frequented by the whalers in May, June, and July, nor by the whales in January, February, and March, except sperm, which are most abundant in March, April, and October. Whether it be a place of much resort for either kind in May, June, and July, we have not found Log-books enough to show.

It is almost of as much importance for whalemen to know where whales are not to be found, as to know where they are; for this is a case in which negative information is almost as valuable as that which is positive.

I have, therefore, selected from the Whale Chart those districts of the ocean in which most whales *have been* found in former years. Whether they have changed their places of resort, my information does not enable me to say.

But according to the Chart which is constructed for the whole ocean in the manner already explained, these are the places in which most whales *have been* found, and which it may be supposed now afford the best whaling grounds:

SPERM WHALING GROUND ABOUT THE EQUATOR.		
Months.	Latitude.	Longitude.
May to Nov. inclusive,	0° to 5° N.	80° to 75° W.
April to Dec. "	0 " 5 "	85 " 80 "
Dec. to July, "	5 S." 5 "	90 " 85 "
Dec. to March, "	0 " 5 "	90 " 95 "
February, - - - - -	0 " 5 "	125 " 120 "
All the year, - - - -	0 " 5 S.	170 " 180 E.
All the year, - - - -	0 " 10 "	85 " 80 W.
All the year, - - - -	5 N." 5 "	95 " 90 "
All the year, - - - -	0 " 10 "	110 " 100 "
Aug. to Sept. inclusive,	0 " 5 "	115 " 110 "
Nov. to March, "	0 " 5 "	120 " 115 "
Dec. to April, "	0 " 5 "	125 " 120 "
Jan. to June, "	0 " 5 "	130 " 125 "
Feb. to June, "	0 " 5 "	135 " 130 "
January, - - - - -	0 " 5 "	145 " 140 "
Dec. to Jan. - - - -	0 " 5 "	155 " 150 "
March to May, - - -	0 " 5 "	160 " 155 "
Dec.Jan.Mar.June&Nov.	0 " 5 "	175 " 170 "
Dec. Jan. Feb. - - -	10 S." 15 "	80 " 75 "
July to Nov. inclusive,	10 " 15 "	85 " 80 "
July to Feb. "	10 " 15 "	90 " 85 "
Nov. to June, "	10 " 15 "	85 " 80 "
NORTH PACIFIC.		
May, June, July, - - -	25 to 30 N.	140 to 145 E.
May to Aug. inclusive,	25 " 30 "	170 " 165 W.
April to Oct. "	30 " 35 "	145E "170 "
July to Aug. "	25 " 35 "	140 " 145 E.
June to Oct. "	30 " 35 "	150W.170W.

RIGHT WHALING GROUND SOUTH PACIFIC.		
Months.	Latitude.	Longitude.
Jan. Feb. and March, -	20° to 50° S.	45° to 50° E.
Sept. Oct. Nov. and Dec.,	30 " 40 "	55 " 60 "
Oct. Nov. Dec., - - -	30 " 40 "	60 " 65 "
Oct. Nov. Dec., - - -	30 " 40 "	65 " 80 "
December and January, -	35 " 45 "	90 " 95 "
July to Nov. inclusive, -	35 " 40 "	115 " 120 "
Nov. and Dec., - - -	35 " 45 "	120 " 130 "
January, - - - - -	45 " 50 "	160 " 170 "
Dec.Jan.Feb.Mar.&April.	40 " 50 "	170E."175W.
NORTH PACIFIC.		
April and May, - - -	40 to 45 N.	145 " 150 E
July to Oct. inclusive, -	45 " 50 "	145 " 150 "
April and May, - - -	40 " 50 "	150 " 155 "
May to Sept. inclusive, -	45 " 55 "	155 " 165 "
May to Sept. "	45 " 55 "	165 " 170 "
May to Sept. "	50 " 55 "	160W.165W. and in Behring's Straits.
May to Sept. "	50 " 60 "	155W.130W.
SOUTH ATLANTIC.		
Aug. to Dec. inclusive, -	35 to 40 S.	25 to 20 W.
Aug. to Dec. "	35 " 40 "	20 " 5 "
Sept. to Dec. "	35 " 40 "	5 W."10 E.

As to whether the right whales are to be found in the high northern latitudes in our winter, or in high southern latitudes in our summer, when the whalemen do not visit such latitudes, of course, the Chart does not show. Thus, between 50° and 60° N., 130° and 155° W., we only know that right whales are abundant from May to September, inclusive ; we know not as to the other months, because the night and cold there drive the whalemen from this part of the ocean, and we cannot say anything as to the numbers in which the fish resort there then. The Charts are, therefore, silent on the subject.

It is the same at the South, in its seasons: that is, when it is winter there the whalemen abandon the high latitudes, and seek their game in more genial climates.

But seeing the abundance of whales in the Greenland and Arctic seas in our summer season, and seeing that they have not been sought for in similar latitudes South, I invite the attention of whalemen to the subject of southern whaling in south summer time.

Below the parallel of 50° S :—indeed, with here and there an exception, I might say, that below the parallel of 45° S. the Whale Chart is a blank. It is very seldom that vessels go beyond the parallel of 55° S. The indications of the Chart are, that somewhere to the south of the parallels, and between the meridians as given below, whales are probably to be found in considerable numbers, if not in great quantities, viz:

Below	40°	S.	from	25°	West	to	10° East.	A
"	50°	S.	"	45°	East	"	60° "	B
"	45°	S.	"	110°	"	"	140° "	C*
"	50°	S.	"	160°	"	"	150° West.	D

In view of all the information before me, I would suggest the following as a very inviting route or cruise for a vessel that finds herself on the Whāling Ground of the South Atlantic in our fall months.

She can cruise in the region A, of the last mentioned table; and from that, but still keeping well down to the South, pass rapidly on, unless she finds whales, to the region B.

A week or two here will satisfy her as to the prospect for whales. She may then enter the region C, where time might be spent in the search, crossing different parallels, and taking care to keep well to the South.

After having cruised and tried sufficiently in region C, the favorite region, the vessel may then "crack on" for region D; and when this region is explored, the season at the South will probably be over.

The N. W. are the prevailing winds of these latitudes, and therefore the programme of the route would be easy. Ending the search for right whales at the South, and leaving the region D, for the equatorial cruising grounds, and entering these between 175° E. and 150° W., the route westward, and between 5° S. and 10° S., will be through good Sperm Whale grounds. These grounds commence between the meridians of 180° and 170° West, after crossing the parallel of 35° South, for just here, Sperm Whales resort in great numbers. Continue North between these meridians till you cross 10° South, for there is good sperm fishing all the way.

From 170° E. to 165° W., between the Line and 10° S., is capital sperm ground.

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* *This region is particularly attractive.*

The vessel, therefore, reaching this ground between the meridians of 170° E. and 180° W., may tarry in it, tending westward as long as she has luck, taking care not to look North of the Line here for whales, for they are not to be found except as stragglers, or in occasional schools.

After crossing these grounds, which reach westward as far as 170° E., and East to America, she should carry on without stopping to look for whales until she crosses 20° N., between 165° W. and 175° E., which is again fine Sperm Ground. After passing west of 175° E., she will find good Sperm Ground between the parallels of 20° N. and 30° N., as far as 140° E.

Passing from these grounds, excellent right whale fishing will be found above the parallels of 50° N., between 135° W. and 160° W.; above 45° N., between 145° E. and 170° E.; above 35° N., between 145° E. and 155° E., and up through into Behring's straits. There is good fishing upon these last mentioned right whale grounds from May to September, inclusive; I have not yet found the Log-book of any whaler that has cruised here at any other season of the year, and therefore my information as to the rest of the year is negative.

But there is reason afforded by the Chart for the opinion, for the belief, that the right whales of the North Pacific ocean, seldom come to the South of the parallels named, and that, therefore, as a general rule they remain somewhere to the North of the parallel of 35° all the year.

If this indication of the Chart be correct, and I see no reason to question it, it appears that this animal must have supplies of food all the year round, above 35° N.

I have reason to believe that temperature of the sea has much to do with the whale or the growth of its food: that the sperm whale delights in warm water, and the right whale in cold; and those whalemen who co-operate with me in collecting materials for the Wind and Current Charts, and the Whale Chart belongs to the series, will therefore understand and appreciate the importance of keeping a *daily* record as to the temperature of air and water.

There is another point also to which I would call their attention, because by regarding it, it may prove of value to them, and that point is *deep sea soundings*.

It is conjectured that the sperm whale goes to the bottom of the sea for its food. What is the greatest depth to which it can go for this purpose, and are its places of resort *confined* to parts of the ocean that come within those depths?

Now, if owners would provide their ships, each with a few thousand fathoms of twine, and scraps of old iron or lead to serve as sounding weights, I am sure that the whalemen from the great degree of philosophical interest, which many of them manifest with regard to my researches, would, in calms, get deep-sea soundings for me. If the ocean were very deep, and the time could not be spared to haul up the line, it might, the length out being known by what is left, be cut; and as the line and sinker would cost but little, the expense to each ship would be but a trifle.

I take this occasion to say, because some of the whalemen have supposed it unnecessary to continue the abstracts when in sight of land, that it is important to have a complete abstract for every day they are at sea, that we may know whether they find fish or not, how plentifully, the force and direction of winds and currents, the temperature of air and water, and that we may glean information as to all other phenomena, which they are requested to note in the Abstract Log.

More about the Red Sea Currents.

The remarks which I submitted to the American Association at its meeting in Charleston, pp. 38–9, and which, since the commencement of these investigations, have been made from time to time concerning the currents of the Red sea; were based upon the suggestions derived from studying the operations of those agents which nature employs to keep up the oceanic circulation. Those remarks were based on theoretical deductions elaborated out of the fact, that there is a surface current known to be setting through the Straits of Babelmandeb into the Red sea. Other observations, I had none.

I have attempted on divers occasions to show theoretically, how the surface of the Red sea must in consequence of evaporation, be higher at the Straits of Babelmandeb than at the Isthmus of Suez; how it presents an inclined plane to the northwest; how the water in this sea, after it has supplied the demands for vapor (which is fresh, not salt,) is salter, and therefore heavier than that which is just entering to meet those demands; and how therefore the heavier and salter water must escape as an under current through the Straits of Babelmandeb.

I have within a few days past received volume IX, Transactions of the Bombay Geographical Society, from May, 1849, to August, 1850. From it, I learn that the excellent society of which it is the organ, has especially included in its field of researches, "the determination of the saltness of the ocean, and of the arms and gulfs of the sea."

At p. 38 et seq., of that vol., is a paper by Dr. Buist on the "saltness of the Red sea." That paper fully sustains the position which has already been advanced during these investigations. It contains so much that is valuable upon the subject, being for the most part the result of actual observation, that I take the liberty of extracting from it.

"Mr. Morris, Chief Engineer of the Ajdaha, had some time ago taken the more certain method of filling a succession of bottles full of water all the way from Suez to Bombay, and these having been placed in the hands of Dr. Giraud, whose assistance, valuable at all times, became doubly valuable from the promptitude, cheerfulness and alacrity, with which it was rendered, had found the following to be the results: they were unexpected, but there was no reason to doubt their accuracy:—

		Lat. °	Long. °	Sp. Gr.	Saline contents. 1000 parts.
No. 1.	Sea at Suez	—	—	1027	41.0
No. 2.	Gulf of Suez	27.49	33.44	1026	40.0
No. 3.	Red sea	24.29	36.	1024	39.2
No. 4.	do.	20.55	38.18	1026	40.5
No. 5.	do.	20.43	40.03	1024	39.8
No. 6.	do.	14.34	42.43	1024	39.9
No. 7.	do.	12.39	44.45	1023	39.2

"Dr. Giraud gives the following note of the saltness of the sea, from a variety of other localities. From this it will be seen, that the Mediterranean at Marseilles is of the same saltness as the Red sea at Suez, while the Atlantic in the latitude of the Canaries is $\frac{4}{1000}$ more salt:—

Baltic - - - - - - - -	grs. 20.0 in 1000.
Firth of Forth - - - - - - -	" 30.0 "
Boulogne - - - - - - -	" 32.0 "
Havre - - - - - - - -	" 36.0 "
Bayonne - - - - - - -	" 38.0 "
Marseilles - - - - - -	" 41.0 "
Atlantic, (Canaries) - - - - -	" 44.0 "

"Following the sinuosities of the coast, the Red sea shore is more than 4000 miles in extent from the Straits of Babelmandeb round. Not one drop of water flows in from any of the countries on its shores, and the nearest river to the Red sea is the Nile, which approaches it at Suez to within eighty miles, but retires on the southward to four or five times this distance; so that on the average there seems to be not less than 500 miles of the African side depending on the Red sea for a supply of vapor. On the Arabian side, the arid expanse is of similarly ample dimensions; and in both cases, when a little rain does fall, the interval of years, it is nearly saturated with salt before it reaches the sea. The temperature of the air betwixt Suez and Aden, often rises to 90°, and probably averages little less than 75° day and night, all the year round. The surface of the sea varies in heat from 65° to 85°, and the difference betwixt the wet and dry bulb thermometers often amount to 25°—in the kamsin or desert winds, to from 30° to 40°; the average evaporation at Aden is about eight feet for the year, though the air on the Arabian promontory is, from April to August, nearly as damp as at Bombay during the open periods of the monsoon.

"Assuming the evaporation of the Red sea to be no greater than that of Aden, a sheet of water eight feet thick, equal in area to the whole expanse of the sea, will be carried off annually in vapor; or assuming the Red sea to be 800 feet in depth at an average—and this most assuredly is more than double the fact—the whole of it would be dried up were no water to enter from the ocean, in 100 years. The waters of the Red sea, throughout, contain some four per cent. of salt by weight—or as salt is a half heavier than water, some 2.7 per cent. in bulk—or, in round numbers, say three per cent. In the course of 3000 years, on the assumptions just made, the Red sea ought to have been one mass of solid salt."

The annual evaporation at Aden in the Red sea is quoted by Dr. Buist at 8 feet. According to the observations of Mr. Laidley, quoted in the same valuable transactions, the annual evaporation at Calcutta is 15 feet. Between the Cape and Calcutta it amounts to 3 feet 9 inches for October and November; and in the Bay of Bengal it was found to exceed an inch a day, or at the rate of 30 feet and upwards the year.

Dr. Buist also tells us that the dew point of the winds which blow over the Red sea is frequently not less than 30 or 40 degrees below the temperature of its water.

The evaporation therefore which goes on night and day, and all the year, from its waters near Suez, is probably much more than 8 feet the year. It is probably not less than 18 feet; and if, therefore, it took the waters which enter that sea through the Straits of Babelmandeb a year to flow up to the Isthmus of Suez, it is evident that the level of this sea at the isthmus would be 18 feet below its level at the straits; for by the supposition, 18 feet have been taken up into the clouds by evaporation from the surface, and borne away by the winds. And now if we suppose merely for the convenience of illustration, the waters to be 36 feet deep at the straits, the bottom of the sea to be a perfect level thence to Suez, it would require no lead and line nor chemist to tell us that the depths of the Red sea at its head was just 18 feet, and that the water here had just twice as much salt in it as the water at the straits has. Now the water at the straits could not balance this brine. The brine is the heavier, and out it must flow as an under current, as exemplified by the illustration with regard to the water and oil in a trough, p. 39.

It probably does not take the water more than 60 days on the average to reach the head of the Red sea after first entering it. In that case, the annual evaporation being 18 feet, the difference of level would be 3 feet, and this estimate is probably not far wrong.

Thus the conditions with regard to the Red sea, viz: higher level, and an under current at the Straits of Babelmandeb, are theoretically established with just as much certainty as we might expect to find salt at the bottom of it, were the mouth to be closed and all the water now in it to be evaporated.

With regard to the under current from the Mediterranean, and which under current is caused by similar agencies, an early idea as to its existence was owing to the following circumstances, as given in a paper "of the currents at the straits-mouth," by Captain———, communicated by Dr. Hudson to the Philosophical Society, 1724.

"It is very remarkable," continues that remarkable paper, "that in the year 1712, Mons. du L'Aigle, that fortunate and generous commander of the privateer called the Phœnix of Marseilles, giving chase near Ceuta Point to a Dutch ship bound to Holland, he came up with her in the middle of the gut between Tariffa and Tangier, and there gave her one broadside which directly sank her, all her men being saved by Mons. du L'Aigle; and a few days after, the Dutch ship with her cargo of brandy and oil, arose on the shore near Tangier, which is at least 4 leagues to the westward of the place where she sunk, and directly against the strength of the current; which has persuaded many men, that there is a recurrency in the deep water in the middle of the gut that sets outward to the grand ocean, which this accident very much demonstrates; and possibly a great part of the water which runs into the straits returns that way, and along the two coasts before mentioned; otherwise this ship must of course have been driven towards Ceuta, and so upwards. The water in the gut must be very deep; several of the commanders of our ships of war having attempted to sound it with the longest lines they could contrive, but could never find any bottom."

In 1828, Dr. Wollaston, in a paper before the Philosophical Society, stated that he found the specific gravity of a specimen of sea water from a depth of 670 fathoms, 50 miles within the straits, to have a "density exceeding that of distilled water by more than 4 times the usual excess, and accordingly leaves upon evaporation more than 4 times the usual quantity of saline residuum. Hence it is clear, that an under current outward of such denser water, if of equal breadth and depth with the current inward near the surface, would carry out as much salt below as is brought in above, although it moved with less than one-fourth part of the velocity, and would thus prevent a perpetual increase of saltness in the Mediterranean sea, beyond that existing in the Atlantic."

The Doctor obtained this specimen of sea water from a captain in the English navy, who had collected it for Doctor Marcet. Dr. Marcet died before receiving it, and it had remained in the captain's hands some time before it came into those of Wollaston.

It may therefore have lost something by evaporation, for it is difficult to conceive that all the river water and three-fourths of the sea water which runs into the Mediterranean is evaporated from it, leaving a brine for the under current, having four times as much salt as the water at the surface of the sea usually contains. Very recently, M. Coupvent des Bois, has shown by actual observation, the existence of an outer and under current from the Mediterranean.

These facts, and the statements of the Secretary of the Geographical Society of Bombay, seem to leave no room to doubt as to the existence of an under current from the Red sea, and as to the cause of the surface current which flows into it.

Sailing Directions.

Lieut. Maury to the Secretary of the Navy.

I have the honor to report to you, for the benefit of navigation, the accompanying "Notice to Mariners," which is derived from the "Wind and Current Charts," in process of construction at this office.

I would recommend that all vessels, whether public or private, bound hence in the months named, to ports in the Pacific, Indian, or South Atlantic Oceans, should try these routes, because they are derived from the results of many thousand voyages, and are, in fact, the combined experience of thousands of navigators.

These routes therefore are not dependant upon any theory; they are the results of actual observation. If the navigators who have furnished me with copies and abstracts of their logs have (and they doubtless have) reported correctly the direction of the winds encountered by them, then there is no doubt as to the practicability of these routes. The advantages which they offer are of commercial and national importance.

A vessel that pursues them, instead of the old or usual route hence to the equator, will save from one thousand to fifteen hundred miles in distance, and gain on the average from a week to ten days in the passage to the ports of India, China, South America, California and all the markets of the Pacific Ocean.

Careless navigators in slow sailing vessels, may try these routes, fall to leeward, and bring them into disrepute. To prevent this, it is a matter of great importance that their practicability should be tested by fair sailers, under skilful navigators.

You will therefore perhaps encourage the hope that the Department will, at an early day, find it convenient to avail itself of the authority granted by Congress, and detail two suitable vessels of the Navy for the purpose of trying these routes, and of co-operating with the "Taney" in making those other observations which are required to assist me in the construction of these charts, and which are necessary to perfect them.

NATIONAL OBSERVATORY, *Dec.* 14, 1849.

NOTICE TO MARINERS.

It is well known that the route to every port in the Pacific, Indian, and South Atlantic Oceans, is the same as far as the equator; and indeed until Cape St. Roque, in Brazil, be cleared.

It is also well known that this common part of the route varies according to the season of the year.

Since the first publication of the "Wind and Current Charts," the materials for improving them have increased with great rapidity. These materials have been so discussed and arranged by the officers at the Observatory that, with the aid of the "Pilot Chart," the navigator may now calculate and project the path of his ship on an intended voyage, very much in the same way that the astronomer determines the path of a comet through the heavens. There is this difference, however: the chart with its data shows the navigator that, in pursuing his path on the ocean, head winds and calms are to be encountered, which will turn him aside or retard him on his way; and that therefore he cannot predict with certainty the place of his ship on a given day. He, therefore, in calculating his path through the ocean, has to go into the doctrine of chances, and to determine thereby the degree of probability as to the frequency and extent with which he may anticipate adverse winds and calms by the way.

Thus in the 5 degrees square of the ocean, between latitude 35° and 40° N., longitude 70° and 75° W., the log books of 4,387 vessels, or the records of vessels for 4,387 days, in this square, have been examined; 323 of which were there in the month of February of different years.

Now supposing (and there is no reason to suppose otherwise) that these observations give a fair average as to the prevalence of calms, and the direction of the winds: we are led to the conclusion that if one of these vessels had attempted to sail through this square one hundred times on an E. S. E. course, in the month of February for a series of years, she would have had 6.2 calms, fair winds 85.5, and 1.3 wind *dead ahead* or at E. S. E.; that she would have been headed off on the larboard tack, or by "slant" winds from the northward and eastward 7.3 times; and on the starboard tack, or by "slant" winds from the southward, 5.9 times.

From this, the navigator will see also that, along this part of the February route, the northern side is rather the windward side; and that, therefore, when winds are *free*, it is better to keep, along this part of the route, somewhat to the North of the projected track.

After crossing latitude 20° N., longitude 40° W., he will likewise see that he is there still liable to be headed off by winds from the northward and eastward, and that, consequently, when the wind comes out *dead* ahead, he should stand off on the starboard tack; and that, when the winds are fair, he should keep the projected track to the southward and westward of him, say generally 40 or 50 miles.

He is recommended to steer straight from *d* to *d* when the winds are fair; and when he gets thrown off his course, instead of turning out of his way to get back to the projected track, he should be guided by the "Pilot Chart," and run parallel to this track, or otherwise, according to the "Pilot Chart."

Similar tables, with complete sailing directions, are in the course of preparation for every month, and all the principal routes across the ocean.

These present tables from that publication are given for the information of those navigators who are on the eve of sailing on voyages beyond the equator.

Those who desire to try these routes should project the route for the month on the chart as far as the equator; arrived there, let a line be drawn from the point of *actual* crossing to Cape St. Augustine; and then aim to keep this line under the *lee*, so as to have it at least 20 or 30 miles to the westward when the ship crosses the parallel of 6° or 7° South.

After that, the winds haul more to the eastward, and there will be no difficulty in laying up S. S. W. or even as high as South.

If the ship be headed off to the west of her course or to the west of said line to St. Augustine, she should take advantage of the first "slant," tack, stand east, and make short and long legs until she can clear the land.

This part of the route is the turning point of the passage. By studying the charts as well as the tables, navigators will see, that with attention and management between the equator and 6° South, they will have no difficulty in either making a S. S. W. course good on one tack, or an east course on the other; and when they find it necessary to stand to the eastward, they should never stand farther, unless they can make southing also, than to bring 20 or 30 miles to leeward of them, a straight line drawn from 31° on the equator just so as to clear the land about Cape St. Augustine. In this part of the route more than in all others, the navigator should study the *slants*, and take advantage of all of them.

I recommend these routes, it should be understood, only to vessels which can sail within six points of the wind. I would not advise any vessel that cannot do this, to attempt them, for she will be apt to fall to leeward, and then she will find it difficult and tedious to get up again.

There are other parts of the routes in which it is also necessary to study the "slants." For instance: take that part of the February route which lies between the parallels of 20° and 15° N. It will be observed that though but one of the 25 observations from which this part of the route is determined, gives the wind *directly ahead*, yet that 8 per cent. of them are "slant" winds from the eastward, which will prevent a vessel 8 times in 100 from lying S. S. E., the course prescribed.

After crossing 15° it will be seen that the navigator will have—if the observations consulted give a fair average as to the direction of the wind—neither head winds nor "slants"—until he gets to 5° N. Thence to the equator he is liable to be headed off to the westward 14.7 times in 100. He should therefore aim, if the winds allow, to keep this part of the route under the lee, so as to cross 5° N. to the east of 31°.

By "*slants*" I mean winds, that though not *dead* ahead, will nevertheless head a ship off her course—thus, for a vessel that wishes to head E., a wind at N. N. E. or N. E. would be what here is called a *slant* wind.

The route for each month is computed according to the doctrine of chances; the number of observations from which each part of the route is calculated is stated in the last column, "Total number of observations."

It will, therefore, be perceived that some parts of each route are entitled to more weight than others. Thus the per centage of fair and adverse winds for the first course on the December track is derived from 364 observations, whereas that for the fifth course is derived from only 26. All will admit that 364 give a better average than do only 26 observations.

It must be further presumed and admitted that vessels may expect, in following any one of these routes, *sometimes* to encounter head winds and calms, and have long passages.

But, taking the average length of passage by these routes, the data of the charts lead us to the conclusion that a fair sailer, under good management, will run in December from 31 to 36 days from the Atlantic ports to the equator; in January from 30 to 35 days; and in February and March from 19 to 27 days, against 41 days by the old or usual route.

Navigators who are disposed to try these routes should have the "Pilot Charts" on board; which "Pilot Charts" will be furnished to them on application, either at the National Observatory, at Washington; or to George Manning, No. 90, Wall-street, New York; provided the applicant will agree to furnish this office an abstract of his log according to the form with which he will also be gratuitously supplied, and which form may be found in another part of these directions.

Vessels bound around Cape Horn, are recommended to pass between the Falkland Islands and the main; and to double the "Horn" as close as the winds will allow.

In this passage it should be remembered that the prevailing winds about, and to the South of the Cape, are westwardly winds; that outward bound vessels want to get to the West; and that, therefore, they should manage when they reach the parallel of the Cape, to be as far to the West as possible. For this reason, it is better to make westing, north of the Falklands, in good weather, than to keep outside of these Islands and have the westing to make where the weather is more severe—and where it is more difficult to get to the West.

Vessels bound to California without touching, should, after clearing Cape Horn, aim to cross the parallel of 25° or 30° N., about 130° W. They will sometimes be compelled to cross this parallel as far as 140° W. Those that touch should cross the equator from 100 to 115°, according to the season of the year—then stand on with "a good rap-full," not pretending to lay up for their port, until they lose the N. E. trades, which they may expect to do in 25° or 30° N.

Vessels so bound should not go too near to the coast of Central America and Tehauntepec, on account of the baffling winds, storms and calms which prevail in with the land along that coast.

Vessels from other ports of the United States, besides New York, are recommended to make the best of their way to the track from New York. They should generally be governed by the winds they happen to meet, as to where they will intercept this track. If vessels from southern ports aim to intercept it to the S. of 33° N., they will be liable to encounter the calms of the "Horse Latitudes."

NATIONAL OBSERVATORY, *Washington, December* 14, 1849.

Best average routes from New York to clear Cape St. Roque in Brazil.

DECEMBER.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd. or E'd.	SLANTS FROM S'd. or W'd.	Fair.	Calms.	Total No. observ'ns
From 40°27′ N.	74°00′ to										
39 12	70 00	E. S. E.	200	7.0	214	2.1	7.2	4.5	86.2	3.0	364
39 12	65 00 *d*	E.	233	6.4	248	2.0	5.0	7.0	86.0	1.5	195
35 12	60 00	S. E.	338	7.2	363	0.8	8.8	8.8	81.6	0.8	119
35 00	59 24	E. S. E.	31	10.9	34	4.0	7.0	7.0	82.0	1.0	100
33 29	55 00	E. S. E.	237	6.4	252	4.0	0.0	0.0	96.0	0.0	26
33 29	50 00 *d*	E.	350	3.7	259	0.0	0.0	*w* 9.2	90.8	0.0	44
31 44	45 00 *d*	E. S. E.	275	9.3	300	3.9	7.8	6.5	81.8	7.5*e*	75
30 00	43 00	S. E.	147	24.8	183	6.4	16.8	*w* 26.4	50.4	2.4	121
25 00	43 00	S.	300	9.6	329	2.0	12.0	12.0	74.0	6.0	48
22 16	40 00	S. E.	232	9.0	253	3.4	*w* 13.6	0.0	83.0	3.4	29
20 00	37 34 *d*	S. E.	192	7.5	206	0.0	*w* 19.5	6.5	74.0	1.3	79
15 00	35 24	S. S. E.	325	4.3	339	0.0	*w* 7.2	4.8	88.0	2.4	42
14 37	35 00 *d*	S. E.	33	22.9	41	11.1	*w* 14.3	0.0	74.1	0.0	27
10 00	35 00	S.	277	1.4	281	0.0	*w* 6.0	0.0	87.0	0.0	25
5 00	30 00 *d*	S. E.	424	13.1	479	2.0	*w* 26.0	14.0	58.0	10.7*e*	50
Equator	32 04	S. S. W.	324	3.0	334	1.4	4.2	0.0	94.4	4.0	71

Shortest distance to the equator by this route, 3,918 miles; average distance to be sailed, on account of adverse winds, 4,115. Ship Bothnia, Capt. Avery, in Dec. 1850, accomplished it in 29 days, and 4,077 miles per log.

It is only about in the proportion of 1 to 2 that a vessel in this part of the ocean can make a S. E. course from 10° to 5° N. Therefore vessels going the December route should always aim to cross 10° N. to the East of 35° W.

ROUTE TO RIO—JANUARY.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average.	WINDS; PER CENT. Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	Total No. observ'ns.
From 40°27′ N.	74°00′ to										
40 27	70 00	E.	182	6.2	193	2.0	6.0	5.0	87.0	2.1	97
38 52	65 00	E. S. E.	248	7.4	266	2.4	5.6	5.6	86.4	0.8	118
38 52	60 00 *d*	E.	233	6.7	249	0.9	3.6	*w* 11.7	83.8	3.4	113
37 14	55 00	E. S. E.	255	7.5	274	2.4	3.2	*w* 8.8	85.6	0.0	128
35 35	50 00	E. S. E.	260	8.3	283	3.0	7.0	8.0	82.0	4.5	105
35 00	48 17 *d*	E. S. E.	92	11.4	103	4.4	6.6	*w* 13.2	75.8	0.0	91
30 00	45 49	S. S. E.	324	12.1	362	1.9	15.2	*w* 19.0	63.9	10.0	54

ROUTE TO RIO—JANUARY—CONTINUED.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Cent.	Average.	Head.	SLANTS FROM		Fair.	Calms.	
							Nd. or Ed.	Sd. or Wd.			
29°44′ N.	45°00′ N.	E. S. E.	42	25.7	53	8.4	*w* 25.2	11.8	49.8	4.2	24
25 20	40 00	S. E.	374	13.6	425	3.3	*w* 16.4	8.2	72.1	1.6	61
25 00	39 38 *d*	S. E.	34	28.0	43	13.2	8.7	*w* 11.0	67.0	3.3	88
20 00	37 16	S. S. E.	324	6.4	344	2.5	5.5	5.5	87.5	0.0	80
15 00	35 00	S. S. E.	324	7.7	348	0.0	*w* 15.8	10.5	73.7	0.0	19
10 00	32 53	S. S. E.	324	0.4	325	0.0	*w* 3.0	0.0	97.0	0.0	33
5 00	30 48 *d*	S. S. E.	324	1.6	329	0.0	*w* 8.0	0.0	92.0	0.0	25
Equator.	30 48 *d*	S.	300	0.7	302	0.0	*w* 6.6	0.0	93.4	0.0	88
1 00 S.	31 13	S. S. W.	65	3.7	67	0.0	*w* 15.0	0.0	85.0	0.3	294
2 54	32 00	S. S. W.	123	6.1	130	0.0	*w* 23.9	0.0	76.1	0.0	46
5 00	32 52 *d*	S. S. W.	137	5.8	145	0.0	*w* 28.6	0.0	71.4	0.0	21
5 08	33 00	S. W.	12	0.0	12	0.0	0.0	0.0	100.0	0.0	29
7 00	34 00	S.S.W.½W.	136	5.1	143	0.0	*w* 14.4	0.0	85.6	0.0	28
9 00	34 50	S. S. W.	130	5.3	137	2.9	2.9	0.0	97.1	8.0	34

Shortest distance to the equator by this route, 3,640 miles. Average distance to be sailed on account of adverse winds, 3,899 miles. The "Surprise" in January, 1851, accomplished it in 24 days, and 3,852 miles per log.

The courses from 35° N. to 30° N., and from 7° S. to 9° S., run through a part of the ocean that is liable to calms. In the adjacent wind-roses, to the East of these (see Pilot Charts,) there is less liability to calms. From New York to the parallel of 25° N., in this month, the South is generally the windward side. Thence to the line it is to leeward. Prefer, therefore, in this month, to cross 25° N. to the E. of 40°, and 7° S., to the E. of 34° West Long.

ROUTE TO RIO—FEBRUARY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Cent.	Average.	Head.	SLANTS FROM		Fair.	Calms.	
							Nd. or Ed.	Sd. or Wd.			
From 40°27′ N.	74°00′ W.	to									
39 11	70 00	E. S. E.	199	5.1	209	1.3	7.3	5.9	85.5	6.2	303
37 33	65 00	E. S. E.	256	2.7	263	0.0	5.7	2.3	92.0	4.5	87
35 53	60 00	E. S. E.	263	1.2	280	7.0	9.0	6.0	84.0	1.0	100
35 53	55 00 *d*	E.	243	7.2	260	3.0	5.0	4.0	88.0	1.0	100
35 00	53 12	E. S. E.	144	5.7	151	1.3	12.2	14.8	78.4	4.0	74
33 21	50 00	S. E.	225	0.0	225	0.0	0.0	0.0	100.0	3.5	28
32 54	48 13	E. S. E.	98	2.1	100	0.0	5.5	5.5	88.9	0.0	18
30 00	45 00	S. E.	240	3.8	249	0.0	5.5	*w* 11.1	83.4	0.0	18
25 38	40 00 *d*	S. E.	372	0.0	372	0.0	0.0	0.0	100.0	0.0	20
25 00	40 00	S.	38	11.5	42	3.7	*w* 14.8	7.4	74.1	18.2*e*	27
20 00	37 45	S. S. E.	324	9.3	354	4.8	1.6	3.2	90.3	3.1	62
15 00	35 35	S. S. E.	324	1.6	329	0.0	*w* 8.0	0.0	92.0	0.0	25
10 00	33 28	S. S. E.	324	0.0	324	0.0	0.0	0.0	100.0	0.0	31
5 00	31 23 *d*	S. S. E.	324	0.0	324	0.0	0.0	0.0	100.0	5.3*e*	18

ROUTE TO RIO—FEBRUARY—Continued.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	Total No. observ'ns.
Equator.	31°23′ *d*	S.	300	3.7	311	0.0	*w* 14.7	0.0	85.3	2.7	108
1°00′ S.	32 00	S.S.W.¾W.	72	5.1	76	0.0	*w* 19.0	0.0	81.0	1.7	289
3 00	32 50	S. S. W.	130	6.5	138	0.0	*w* 21.6	0.0	78.4	0.0	28
3 24	33 00	S. S. W.	26	0.0	26	0.0		0.0	100.0	0.0	9
5 00	33 40	S. S. W.	104	3.0	107	0.0	*w* 25.0	0.0	75.0	0.0	12
7 00	33 40 *d*	S.	120	0.0	110	0.0	0.0	0.0	100.0	0.0	11
7 48	34 00	S. S. W.	52	0.0	52	0.0	0.0	0.0	100.0	0.0	22
9 00	34 30	S. S. W.	78	5.2	82	0.0	*w* 13.0	0.0	87.0	0.0	23

Shortest distance to the equator by this route, 3,674 miles. Average distance to be sailed on account of adverse winds, 3,793.

The route for this month is the most favorable. In no part of it is the average of winds that are entirely fair less than 74 in 100; and generally the northern or larboard side is the windward side. The passage to the Line has been frequently made by vessels that have followed this route, in 19 and in 20 days.

ROUTE TO RIO—MARCH.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	Total No. observ'ns.
From 40°27′ N.	74°00′ to										
39 11	70 00	E. S. E.	199	9.6	218	2.2	*w* 10.7	7.5	79.7	2.0	448
37 43	65 00	E. S. E.	256	7.0	274	1.4	7.8	7.0	83.9	2.0	353
36 03	60 00	E. S. E.	261	6.7	278	2.4	6.6	3.0	88.0	6.7	181
36 03	55 00 *d*	E.	243	6.5	259	2.1	6.3	4.9	86.7	4.7	142
35 00	53 43	S. E.	89	6.1	94	0.9	1.8	*w* 14.4	82.9	4.2	113
31 53	50 00	S. E.	265	12.6	298	6.0	4.5	3.0	86.5	0.0	65
30 05	45 00 *d*	E. S. E.	284	12.2	318	5.1	6.8	6.8	81.3	0.0	60
25 00	45 00	S.	305	8.8	331	0.0	*w* 15.5	12.4	72.1	8.6	32
20 23	40 00	S. E.	399	10.5	441	0.0	*w* 22.5	15.0	62.5	0.0	40
20 00	39 35	S. E.	33	4.5	34	0.0	6.0	*w* 12.0	82.0	2.0	45
15 36	35 00	S. E.	370	3.7	484	0.0	*w* 14.8	0.0	85.2	0.0	27
15 00	34 23 *d*	S. E.	51	10.1	56	3.6	7.2	7.2	82.0	0.0	56
10 00	32 16	S. S. E.	324	1.0	327	0.0	*w* 5.1	0.0	94.9	0.0	60
5 00	30 10 *d*	S. S. E.	324	9.8	355	3.9	*w* 11.7	1.3	83.1	3.7	78
Equator	30 10 *d*	S.	300	3.0	309	1.4	*w* 2.8	0.0	95.8	2.0	143
1 00	30 35	S. S. W.	65	2.1	66	0.0	*w* 7.4	0.0	92.6	4.8	299
1 25	31 00	S. W.	35	4.0	37	0.0	*w* 13.4	0.0	86.6	0.0	15
3 00	31 40	S. S. W.	103	0.0	103	0.0	0.0	0.0	100.0	0.0	6

ROUTE TO RIO—MARCH—Continued.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Ct.	Average.	Head.	SLANTS FROM		Fair.	Calms.	
							Nd. or Ed.	Sd. or Wd.			
S. 3°48′	32°00′ to	S. S. W.	52	8.8	56	0.0	*w* 22.2	0.0	77.8	0.0	9
5 00	32 30	S. S. W.	78	0.0	78	0.0	0.0	0.0	100	0.0	10
6 12	33 00	S. S. W.	78	0.0	78	0.0	0.0	0.0	100	0.0	15
7 00	33 20	S. S. W.	52	0.0	52	0.0	0.0	0.0	100	40.	25
8 36	34 00	S. S. W.	104	4.5	109	0.0	*w* 14.0	0.0	86.0	0.0	49
9 00	34 10	S. S. W.	26	3.2	27	0.0	*w* 9.8	0.0	90.2	0.0	82

Shortest distance to the Equator by this route, 3,703 miles. Average distance to be sailed on account of adverse winds, 3,976 miles.

This and the February route are the most favorable. After crossing 5° N. if you can lay up S. S. E., to the Line, *do so*. *For full explanations of these tables, see Explanations in another place.*

ROUTE TO RIO—APRIL.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total.
			True.	Per Ct.	Average.	Head.	SLANTS FROM		Fair.	Calms.	
							N. & E.	S. & W.			
From	S. Hook to										
39°10′	70°00′	E. S. E.	200	10.7	221	3.6	*w* 11.1	5.3	80.0	4.0	523
39 10	65 00	E.	233	9.8	256	3.7	*w* 9.3	6.2	80.8	4.5	320
37 33	60 00	E. S. E.	254	6.2	274	2.0	*w* 6.6	4.0	87.4	3.2	151
35 54	55 00	E. S. E.	260	6.4	276	0.7	8.0	8.8	82.5	4.9	136
35 54	50 00	E.	243	6.1	258	0.0	*w* 12.2	7.2	81.6	8.1	125
35 54	45 00	E.	243	5.8	257	0.0	*w* 12.3	3.7	84.0	5.8	81
35 00	42 21	E. S. E.	141	7.7	152	1.5	6.2	*w* 10.8	81.5	0.0	65
30 00	40 00	E. S. E.	312	17.4	366	6.3	6.2	*w* 32.5	55.0	1.0	95
25 00	37 40	S. S. E.	325	13.8	369	3.0	17.0	*w* 19.0	61.0	3.0	97
20 00	35 26	S. S. E.	325	2.6	333	0.0	5.4	*w* 7.2	87.4	5.1	56
15 00	33 16	S. S. E.	325	2.0	331	2.0	0.0	0.0	98.0	0.0	49
10 00	31 09	S. S. E.	325	0.0	325	0.0	0.0	0.0	100.0	4.4	43
5 00	29 04	S. S. E.	325	0.6	327	0.0	1.7	0.0	98.3	0.0	59
Equator.	29 04	S.	300	2.1	306	0.0	*w* 5.9	1.3	92.8	6.8	152
			3811		4051						
S. 1 00	29 29	S. S. W.	65	4.4	68	0.0	*w* 17.7	0.9	81.4	5.5	344
1 31	30 00	S. W.	44	3.3	45	0.0	*w* 16.7	0.0	83.3	0.0	12
2 31	31 00	S. W.	85	2.4	87	0.0	*w* 8.4	0.0	91.6	0.0	12
3 00	31 12	S. S. W.	31	2.4	32	0.0	*w* 12.0	0.0	88.0	15.0	17
5 00	32 02	S. S. W.	130	4.0	135	0.0	*w* 20.0	0.0	80.0	12.5	15
7 19	33 00	S. S. W.	150	2.7	154	0.0	*w* 13.3	0.0	86.7	0.0	15
9 00	33 42	S. S. W.	109	3.2	112	0.0	*w* 10.8	0.0	89.2	0.0	55

Observe that between the meridians of 55° and 60°, the calms of the Horse Latitudes most prevail between the parallels of 21° and 27° N.; and between the parallels of 28° and 32°, between the meridians 40° and 45°.

The equatorial calms in April, between 25° and 30° W., prevail from 5° S. to 3° N., being most prevalent between 1° S. and 1° N. Between 30° and 35° W., they prevail from 3° N. to 3° S., being most prevalent between 2° N. and the Line.

Observe also how the winds in this month hang from the southward, in latitude 35° to 30° N., and between the meridians of 40° and 45° West.

ROUTE TO RIO—MAY.

Latitude.	Longitude.	Course.	DISTANCE. True.	DISTANCE. Per Ct.	DISTANCE. Average.	WINDS; PER CENT. Head.	Slants from N. & E.	Slants from S. & W.	Fair.	Calms.	Total.
From	port to										
39°11′	70°00′	E. S. E.	199	9.8	218	2.5	10.8	8.3	78.4	2.1	599
39 11	65 00	E.	238	11.5	264	6.4	12.8	11.2	69.6	2.8	315
37 34	60 00	E. S. E.	254	9.1	277	2.8	6.6	8.8	81.8	1.6	181
35 55	55 00	E. S. E.	259	10.2	285	1.8	9.1	*w* 15.2	73.9	3.6	163
35 55	50 00	E.	243	9.9	267	0.7	15.2	12.4	17.7	2.7	145
35 00	47 17	E. S. E.	144	5.5	152	0.9	0.0	*w* 16.9	82.2	1.7	112
33 06	45 00	S. E.	194	9.1	211	3.3	0.0	*w* 11.5	85.2	1.6	61
30 00	41 23	S. E.	263	14.7	301	3.3	13.9	*w* 19.1	63.7	5.6	151
27 00	40 00	S. S. E.	194	6.5	206	2.6	*w* 10.4	0.0	87.0	2.5	39
25 00	40 00	S.	120	9.4	131	3.4	5.1	5.1	86.4	0.0	60
20 00	37 46	S. S. E.	325	0.3	326	0.0	1.8	0.0	98.2	0.0	54
15 00	35 36	S. S. E.	325	0.8	327	0.0	*w* 4.4	0.0	95.6	0.0	23
10 00	33 29	S. S. E.	325	0.0	325	0.0	0.0	0.0	100.0	0.0	54
5 00	31 24	S. S. E.	325	0.5	325	0.0	*w* 4.8	0.0	95.2	0.0	42
Equator.	31 24	S. S. E.	300	0.6	302	0.0	*w* 5.2	1.7	93.1	3.4	115
			3708		3917						
S. 1 00	31 49	S. S. W.	65	2.1	66	0.0	*w* 9.9	0.4	89.7	0.0	264
1 27	22 00	S. S. W.	29	0.0	29	0.0	0.0	0.0	100.0	6.2	15
3 00	32 39	S. S. W.	101	3.3	104	0.0	*w* 16.7	0.0	83.3	0.0	12
3 51	33 00	S. S. W.	55	0.0	55	0.0	0.0	0.0	100.0	0.0	21
5 00	33 28	S. S. W.	75	0.0	75	0.0	0.0	0.0	100.0	0.0	6
6 24	34 00	S. S. W.	84	0.0	84	0.0	0.0	0.0	100.0	0.0	9
7 00	34 15	S. S. W.	39	14.2	45	0.0	*w* 48.9	2.4	48.7	0.0	41
7 00	33 30	E.	44	3.2	45	0.0	0.0	*w* 11.8	88.2	0.0	23
8 13	34 00	S. S. W.	79	32.0	104	13.0	*w* 52.2	0.0	34.8	0.0	23

In this month, and near this route, the calms of the "Horse Latitudes" are most prevalent between the meridians 40° and 45° and the parallels of 32° and 33° N. Between the meridians 25° and 30° the equatorial calms are most prevalent from 5° North to the Line, the greatest prevalence of calms being between 3° and 4° North. Between the meridians of 30° and 35° the equatorial calms prevail most between 3° and 5° N. Here they extend also a little to the South of the Line. In the main, the equatorial calms prevail more as you go to the East. When you cross the Line to the West of 29°, draw a line from the point of crossing to St. Augustine, and aim to keep to the eastward of it, and for this purpose take advantage of all slants.* This direction applies to every month. You should aim generally to make easting, when easting becomes necessary after crossing the Line, before crossing 7° South.

If you can cross 7° S. to the East of 34°, there will probably be no necessity of steering the East course as by the table. Observe that calms are seldom or never found along this route in this month, south of 1° S.

* Vide p. 217

ROUTE TO RIO—JUNE.

Latitude.	Longitude.	Course.	DISTANCE. True.	DISTANCE. Per Ct.	DISTANCE. Average.	WINDS; PER CENT. Head.	Slants from N. & E.	Slants from S. & W.	Fair.	Calms.	Total.
From	New York to										
39°11′	70°00′	E. S. E.	199	10.1	219	2.6	7.8	*w* 11.4	78.2	3.1	349
37 34	65 00	E. S. E.	254	13.4	287	5.3	*w* 10.7	4.0	80.0	1.3	300
35 55	60 00	E. S. E.	259	5.9	272	2.0	2.8	*w* 6.2	89.0	1.2	245
35 00	57 17	E. S. E.	144	8.8	157	2.2	6.3	*w* 10.9	80.6	0.9	233
34 13	55 00	E. S. E.	123	2.0	125	0.0	*w* 10.0	0.0	90.0	20.0	20
32 30	50 00	E. S. E.	271	6.1	287	0.0	10.0	10.0	80.0	0.0	30
30 45	45 00	E. S. E.	276	5.8	292	1.1	2.1	*w* 17.0	79.7	19.7	94
30 00	42 54	E. S. E.	118	19.3	140	6.7	17.4	16.0	59.9	9.7	149
27 28	40 00	S. E.	215	15.0	247	3.3	*w* 22.9	6.6	67.2	4.2	67
25 00	37 15	S. E.	209	16.2	242	6.0	*w* 13.0	9.0	72.0	4.8	100
20 00	35 00	S. S. E.	325	2.6	333	0.0	*w* 9.0	0.0	91.0	1.8	56
15 00	32 50	S. S. E.	325	0.3	326	0.0	0.7	0.9	99.1	0.8	116
10 00	30 43	S. S. E.	325	2.0	331	0.0	*w* 7.5	1.5	91.0	0.0	66
5 00	28 37	S. S. E.	325	17.6	381	5.3	13.2	13.8	67.7	16.0	152
Equator.	30 41	S. S. W.	325	8.8	353	2.8	*w* 16.1	2.8	78.3	0.0	106
			3693		3992						
S. 1 00	31 06	S. S. W.	65	3.0	67	0.0	*w* 12.0	0.0	88.0	0.0	171
3 00	31 56	S. S. W.	130	5.8	138	0.0	28.5	0.0	71.5	0.0	21
5 00	32 46	S. S. W.	130	10.0	143	0.0	50.0	0.0	50.0	0.0	12
5 34	33 00	S. S. W.	37	10.0	41	0.0	50.0	0.0	50.0	0.0	12
7 00	33 36	S. S. W.	93	7.7	100	0.0	33.4	0.0	66.6	0.0	21
7 58	34 00	S. S. W.	63	6.6	67	0.0	27.0	0.0	73.0	0.0	37
9 00	34 26	S. S. W.	67	6.4	71	0.0	24.0	2.0	74.0	0.0	50

If the wind should, as it probably will, head you off, after crossing the Line to the West of 30°, so as to force you to leeward of 33° before crossing 5° 30′ S., stand East for a few leagues, or until the wind hauls so as to let you lay up.

Aim to cross the equator near 29°; and do not, if it can be avoided, go to the east of 28° 30′ after crossing 10° N. The farther you go East there, the more prevalent are the calms.—Endeavor to cross 30° N. in about 40° W., so you may get to 25° N. by a South course. It is difficult to get to the S. E. between those two parallels. Southwest winds are not uncommon here. Between 10° and the equator, calms are much more frequent E. of 30° than to the West of 30°, and they increase as you go East. Between 25° and 30° W. from 3° to 5° N. are the calm latitudes. See the Charts, Pilot and Track.

Vessels should aim never to get to leeward of the track here laid down after crossing the Line. The winds hang obstinately to the southward in June. Therefore take advantage of all slants for making easting in south latitude, until you get to 9° S. Don't consider yourself too far eastward, if in this month you cross this parallel in 31° W. No calms obtain in June, south of the Line, and between 29° W. and the coast. Among 1000 observations examined in this part of the ocean, for this month, not one calm is recorded.

Between 65° and 70° W., 30° and 33° N., is a great place for calms—also from 25° to 28° N., between 60° and 65°. On the average you will carry the N. E. trades to 8° or 9° N.—Equatorial calms are most prevalent between 6° and 10° N., and 25° and 30° W. But between 30° and 35° W., the calms are most prevalent between 5° and 7° N.

Between 30° and 35° W., you sometimes get the S.W. monsoons, and you are liable to them from 9° to 1° N.

ROUTE No. 1, TO RIO IN JULY—(FOR FAST VESSELS.)

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Ct.	Average.	Head.	SLANTS FROM N'd.orE'd.	SLANTS FROM S'd.orW'd.	Fair.	Calms.	
From	Sandy Hook to										
39°11′	70°00′	E. S. E.	199	11.4	222	2.2	11.8	10.8	75.2	4.0	310
37 33	65 00	E. S. E.	256	5.4	269	0.2	8.2	6.5	85.1	10.7	411
35 54	60 00	E. S. E.	259	7.7	278	2.6	4.7	6.9	85.8	7.5	234
35 00	57 21	E. S. E.	141	5.3	148	0.4	4.7	*w* 7.9	87.9	3.4	256
34 12	55 00	E. S. E.	126	19.2	150	6.2	*w* 18.5	10.8	64.5	12.2	65
32 28	50 00	E. S. E.	272	20.6	297	7.2	9.6	*w* 22.8	60.2	0.0	84
30 00	50 00	S.	148	14.4	173	1.7	*w* 19.9	17.4	61.0	1.7	116
25 00	50 00	S.	300	10.6	352	5.3	*w* 10.5	0.0	84.2	5.0	19
20 24	45 00	S. E.	390	3.5	402	0.0	*w* 0.0	17.4	82.6	0.0	23
20 00	44 34	S. E.	34	5.1	36	0.0	*w* 18.0	0.0	82.0	0.0	28
15 40	40 00	S. E.	368	5.8	389	0.0	*w* 28.7	0.0	71.3	0.0	28
15 00	39 10	S. E.	57	11.5	57	0.0	*w* 1.4	0.0	98.6	0.0	72
10 48	35 00	S. E.	356	5.9	377	0.0	*w* 25.0	0.0	75.0	7.2	64
10 00	34 40	S. S. E.	52	6.4	55	1.0	*w* 8.2	1.0	89.8	5.8	98
8 06	30 00	E. S. E.	299	11.7	334	1.0	*w* 18.6	15.5	61.9	13.4	97
6 03	25 00	E. S. E.	322	14.2	367	2.4	15.6	*w* 18.0	64.0 }	10.7	167
5 00	25 26	S. S. W.	68	29.8	88	8.4	*w* 35.4	12.6	44.6 }		
Equator.	27 30	S. S. W.	325	7.4	348	1.3	*w* 21.9	0.0	76.8	0.0	78
			3972		4322						
S. 3 36	29 00	S. S. W.	234	6.9	348	2.0	*w* 21.0	2.0	75.0	0.0	401
4 36	30 00	S. W.	85	0.0	85	0.0	*w* 39.8	0.0	69.2	0.0	35
5 00	30 10	S. S. W.	26	2.9	27	0.0	14.2	0.0	85.8	0.0	21
5 50	31 00	S. W.	70	0.0	70	0.0	0.0	0.0	100.0	0.0	33
7 00	31 30	S. S. W.	76	5 0	80	0.0	24.9	0.0	75.1	0.0	12
7 30	32 00	S. W.	42	0.6	42	0.0	3.4	0.0	96.6	0.0	29
8 29	33 00	S. W.	84	2.9	86	0.0	14.4	0.0	85.6	0.0	21
9 00	33 51	S. W.	44	1.9	45	0.0	9.6	0.0	90.4	0.0	42
10 14	34 00	S. S. W.	80	7.2	86	0.0	26.0	0.0	74.0	5.0	39
11 00	34 19	S. S. W.	50	4.2	52	0.0	23.4	0.0	76.6	0.0	39

JULY TRACK TO RIO—No. 1.

The difficulties for this month consist in calms and baffling winds in certain regions which it is necessary to avoid. I have therefore given two tracks for this month, viz: One for bold navigators and fast sailing vessels that can lay up within six points of the wind; and the other for dull sailers, that cannot do well close-hauled. Both tracks avoid the calms of the Horse Latitudes.

There is not much difference between them as they are here given, in point of *average* sailing distance.—The difference consists in better working breezes by this route than the other, and I now confine myself to this route, viz: No. 1.

In taking this route, if you keep much to the East of the track, say between the parallels of 35° and 30° N., you will get into the calms of the Horse Latitudes—see by the Trade Wind Charts where these calms most prevail along this route, and at this season.

After reaching the meridian of 50° W., South is given as the course which a vessel will make on the *average* thence to the parallel of 25°.

It should be recollected that the tracks given in these directions, and which every navigator who intends to be guided by them, is recommended to project on his chart, are in no case the track which the vessel herself is expected actually to make. But suppose a large number of vessels at different times should take this route as their guide, the mean of all their tracks would be represented by the route which I recommend. Though perhaps it would not represent the track of a single vessel taken separately. Some would be on one side, some on another. Some would cross it in one place and some in another.

It is difficult to get navigators to comprehend this. Many of them think that to go the routes recommended by me, they must actually run on the lines which I have drawn to serve merely as guides for them, and for the purpose of my own convenience in illustration.

Vessels that attempt to follow these routes will sometimes find themselves hundreds of miles on one side or the other of the track as projected, and when they find themselves so driven off from the track as laid down in the books, they should not attempt to get back upon the line itself as though it were a channel way, but taking the direction in which it lies as a guide, and consulting the charts with which they are supplied, they should shape their course and be governed accordingly.

Every track that I have drawn shows that head winds may be expected along it, and when these head winds are encountered, the vessel so encountering must expect to be turned aside, and whether she should beat or not, or stand off altogether upon this or that tack, the master must decide, and he should be governed in his decision by the sailing directions and the charts themselves.

With this general explanation for *all* the routes, navigators who try this July route will perceive that I do not recommend that they should, after reaching the meridian of 50° W., actually stretch away due South for 500 miles until they reach the parallel of 25° N., where the wind will allow them to lay up to the southward and eastward.

Suppose that a vessel on this route should, on reaching the meridian of 50° near Lat. 32° 28′, have the wind to come out from S. E.—as she will find it to do on the average 12 times in 100—she should not in this case stand to the northward and eastward, because she would then run up into a part of the ocean where the calms and light airs of the Horse Latitudes are most vexatious. If she could not lie south, she should stand down to the southward and westward until the wind hauls, or until she should reach the parallel of 31°, and then go about, taking care not to recross the parallel of 32° to the west of 45°.

After crossing 30° N., strive not to fall to the westward of the projected track. Consider yourself in the best possible position if you can cross the parallel of 25° N. between 40° and 45°, or the parallel of 20° between 35° and 40°. From either of these positions you will have no difficulty in reaching the meridian of 30° or 31° between the parallels of 9° and 12° N., where you will lose the N. E. trades. You will then take the equatorial calms, and they may hang on to you obstinately, *if you go much to the East;* but you will seldom or never carry them with you below 6° N. Cross 6° N. by the shortest possible course. Losing these calms, you will generally get the S. E. trades, for to the west of 30° the S. W. monsoons seldom blow—though they do sometimes; to the east of 30° they blow quite constantly in July. To the east of 30°, the equatorial calms prevail from 15° N. to 8° N.; and you will be liable to the S. W. monsoons from 11° to 2° N. Hence you will observe that it is important you should, if the winds will allow you, cross the equatorial "doldrums" about 30° W., and not go further east than 27° if you can possibly avoid it.

After crossing the Line and getting the S. E. trades, if you should find yourself unable to clear the land, stand on boldly to the southward, unless the wind should slant so as to allow you to lay well up to the eastward on the other tack, until you cross 5° S. west of 33°. Between this parallel and 9° S. you can make either a south or an east course good on the average twice out of three, and in some regions three times in four, or even, when you get near the land, four times in five. It is better to take the chances of these slants than it is to attempt to make your easting in the "doldrums" north of the Line. If a vessel strike these calms to the east of 27° west, she may consider herself lucky if she gets clear of them in less than a week or ten days. Don't fear to pass west of Fernando de Noronha.

July is an unfavorable month for quick passages, let a vessel take what route she will.

ROUTE NO. 2, TO RIO FOR JULY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	SLANTS FROM N. or E.	SLANTS FROM S. or W.	Fair.	Calms.	
From	Sandy Hook to										
39°11′	70°00′	E. S. E.	199	11.4	222	2.2	11.8	10.8	75.2	4.0	310
37 33	65 00	E. S. E.	256	5.4	269	0.2	8.2	6.5	85.1	10.7	411
37 33	60 00	E.	238	9.0	259	3.4	*w* 8.6	5.2	82.8	7.5	234
37 33	55 00	E.	238	9.0	259	4.3	3.5	*w* 6.3	85.0	3.4	256
37 33	50 00	E.	238	6.7	254	1.1	4.9	*w* 9.0	84.1	5.8	262
37 33	45 00	E.	238	8.2	257	2.9	1.2	*w* 10.2	85.7	2.8	243
35 54	40 00	E. S. E.	259	5.9	274	1.6	2.0	*w* 11.1	85.3	3.3	244
35 00	38 54	S. E.	77	14.9	88	3.6	9.0	*w* 19.5	67.9	5.5	329
31 41	35 00	S. E.	274	9.6	300	1.0	*w* 16.0	10.0	73.0	3.8	100
30 00	34 09	S. S. E.	115	6.2	122	0.0	*w* 17.6	11.0	71.4	8.3	46
25 00	31 49	S. S. E.	325	8.5	352	3.0	7.0	8.0	82.0	3.0	98
21 00	30 00	S. S. E.	260	0.3	261	0.0	1.5	0.0	98.5	0.0	130
20 00	29 34	S. S. E.	65	0.3	65	0.0	0.0	*w* 2.1	97.9	1.4	142
15 00	27 24	S. S. E.	325	0.5	327	0.0	2.5	0.0	97.5	1.8	163
10 00	25 17	S. S. E.	325	4.3	339	0.6	*w* 8.2	5.2	86.0	9.2	158
	Thence	S.orS.S.E.	to inter	section	of track	No. 1.					

This route is intended for dull sailers and timid navigators. Do not cross 35° N. west of 45°, nor 33° N. west of 40°. After crossing 30° N. in about 33°, you have, as the track shows, all the chances nearly of fair winds in your favor, until you get between 13° and 8° N. between which parallels, if you be between the meridians of 25° and 30°, you may expect to loose the N. E. trades, and then to contend with southerly winds, light airs and calms, (if between these two meridians,) till you get between 5° and 2° N. where the S.E. trades will be found. The getting from the N. E. into the S. E. trades is the difficult part of the passage, and the farther you go east, the more difficult this is. In July you can carry the N. E. trades two or three degrees farther down, by keeping between the meridians of 30° and 35°, than you are liable to do between the meridians of 25° and 30°. In like manner you will get the S. E. trades further to the north, between the two former, than you will between the two latter meridians. And in this fact is the great secret of the advantage to be gained by keeping to the west.

ROUTE TO RIO FOR AUGUST.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	
From	Sandy Hook										
39°11′	70°00′	E. S. E.	199	12.3	223	3.0	13.2	11.4	72.4	5.4	366
37 33	65 00	E. S. E.	256	9.8	281	3.2	5.0	*w* 10.3	81.5	3.5	221
35 54	60 00	E. S. E.	259	8.0	280	2.2	5.4	*w* 9.7	82.7	4.1	185
35 00	57 20	E. S. E.	141	10.9	156	4.6	3.9	*w* 7.8	83.7	7.2	154
33 04	55 00	S. E.	165	8.5	178	1.9	*w* 11.4	3.8	82.9	3.6	53
31 19	50 00	E. S. E.	275	9.6	302	2.6	10.4	*w* 13.0	74.0	0.0	76
30 00	46 17	E. S. E.	207	15.2	238	4.6	9.2	*w* 25.3	60.9	6.5	43
29 32	45 00	E. S. E.	72	39.2	100	8.0	*w* 48.0	28.0	16.0	7.4	25
25 00	42 54	S. S. E.	294	6.4	312	1.5	*w* 19.1	0.0	79.4	2.9	68
22 21	40 09	S. E.	225	7.7	242	0.0	*w* 16.8	7.2	77.0	6.7	42
20 00	38 57	S. S. E.	153	4.8	160	2.0	*w* 8.0	0.0	90.0	0.0	49
15 00	36 47	S. S. E.	325	7.0	347	3.7	*w* 5.5	0.0	90.8	0.0	54
10 50	35 00	S. S. E.	271	8.5	294	2.8	*w* 8.6	4.7	83.9	7.1	105
10 00	34 38	S. S. E.	54	11.5	60	3.4	*w* 11.1	6.6	78.9	9.0	90
8 06	30 00	E. S. E.	297	8.0	320	0.0	8.8	*w* 15.8	75.4	8.1	57
5 00	26 53	S. E.	263	4.6	275	0.0	4.4	*w* 15.9	79.7	7.4	114
Equator.	28 57	S. S. W.	325	10.1	358	1.3	*w* 35.1	0.0	63.6	1.2	78
			3781		4126						
1 00 S.	29 22	S. S. W.	65	1.4	66	0.2	4.5	0.3	95.0	0.0	402
2 32	30 00	S. S. W.	99	5.7	105	0.0	28.5	0.0	71.5	0.0	21
3 00	30 12	S. S. W.	30	13.3	34	0.0	66.6	0.0	33.4	0.0	9
5 00	31 00	S. S. W.	130	6.7	139	0.0	33.3	0.0	66.7	0.0	18
7 00	31 50	S. S. W.	130	0.0	130	0.0	0.0	0.0	0.0	0.0	18
Thence	*ad lib.*										

The only precaution to give with regard to this route—for in August the passage is liable to be tedious by any route—is not to cross the meridian of 50° W. to the North of 31° or to the South of 29° N.

After reaching the meridian of 35° between the parallels of 11° and 10° N., stand straight as the winds will allow for the equator in about 29° or 30°, not caring if you fall upon the Line as far as 30° W. After getting the S. E. trades in this month, there is no difficulty in making stretches to the East; for the S. E. trades frequently at this season of the year blow from S. S. E., and if navigators will bear this fact in mind they should not be discouraged if the wind should force them to cross the equator as far West as 35°: some have even crossed in 41°, and made good passages by taking advantage of slants South of the Line to make easting with. But of course no navigator would willingly cross so far to the westward as longitude 40°.

Vessels from ports South of the Capes of Virginia, that intend to try this route should run up to 34° and continue between the parallels of 34° and 35° until they fall in with the route as projected, which they will do somewhere between the meridians of 55° and 60°. This they are recommended to do on account of the calms of the "Horse Latitudes," with which, by keeping South of 34° in this season and part of the ocean, they are liable to be bothered.

In August, if between the meridians of 30° and 35°, expect to lose the N. E. trades from 14° to 10° N.; to have the equatorial calms from 13° to 9° N., and the S. W. monsoons occasionally *only* from 12° to 5° N.

Between the meridians of 25° and 30° W. the N. E. trades are sometimes lost in 17° N., generally in 12°, though they are occasionally carried to 9°; seldom below. The calms prevail from 15° to 8° N., and the S. W. moonsoons with considerable regularity from 14° N. to the equator. That is, you are liable to get them somewhere between 14° N. and the equator, as you are liable to encounter the calms and to lose the N. E. trades between the parallels above stated.

ROUTE TO RIO FOR SEPTEMBER.

Latitude.	Longitude.	Course.	Distances. Direct.	Distances. Per Ct.	Distances. Average	Winds; per cent. Head.	Slants from Nd. or Ed.	Slants from Sd. or W.d.	Fair.	Calms.	Total No. observ'ns.
40°27′	70°00′	E.	186	13.0	210	2.5	*w* 17.0	*w* 14.0	66.5	3.4	200
38 52	65 00	E. S. E.	249	9.9	274	2.2	*w* 12.4	7.5	77.9	5.1	184
37 14	60 00	E. S. E.	256	7.4	275	0.7	*w* 12.6	7.7	79.0	3.3	147
35 34	55 00	E. S. E.	260	7.4	279	1.6	8.8	7.2	82.4	4.0	123
35 00	54 18	S. E.	48	25.3	60	9.4	13.7	*w* 16.6	60.3	3.5	139
33 31	50 00	E. S. E.	232	15.0	267	3.0	3.0	*w* 42.0	52.0	0.0	34
31 47	45 00	E. S. E.	272	15.4	313	6.0	4.0	*w* 22.0	68.0	5.7	50
30 00	42 55	S. E.	151	15.0	174	2.9	11.5	*w* 21.7	63.9	4.2	69
27 27	40 00	S. E.	217	17.9	255	2.8	11.2	*w* 25.2	60.8	2.7	36
25 00	37 16	S. E.	208	16.8	243	3.4	17.9	16.8	61.9	1.1	89
20 00	37 16	S.	300	4.2	313	4.2	*w* 10.5	0.0	85.3	2.6	38
15 00	35 06	S. S. E.	325	0.0	325	0.0	0.0	0.0	100.0	0.0	23
10 00	32 58	S. S. E.	325	7.8	349	1.6	*w* 11.3	9.8	77.1	6.1	61
8 47	30 00	E. S. E.	191	16.8	223	2.8	3.6	*w* 30.8	60.8	4.0	73
5 00	27 11	S. E.	321	18.4	380	5.8	9.6	*w* 23.0	61.6	7.1	104
*Equator.	29 15	S. S. W.	325	14.1	370	6.2	*w* 34.3	1.4	58.1	0.0	70
			3866		4310						
1 58	30 00	S. S. W.	118	17.4	138	4.4	*w* 13.3	5.7	58.6	0.0	297
3 00	31 02	S. W.	88	9.6	96	0.0	*w* 48.2	0.0	51.8	0.0	27
5 00	31 52	S. S. W.	130	12.5	145	0.0	*w* 62.5	0.0	37.5	0.0	24
5 19	32 00	S. S. W.	21	3.4	22	0.0	*w* 16.7	0.0	83.3	0.0	12
7 00	32 42	S. S. W.	108	7.2	115	0.0	*w* 35.7	0.0	64.3	0.0	14
7 43	33 00	S. S. W.	47	1.3	48	0.0	*w* 6.0	0.0	94.0	0.0	17
9 00	33 32	S. S. W.	83	8.0	91	0.0	*w* 36.6	0.0	63.4	0.0	30

It may be said that the N. E. trade winds prevail in this month only to the east of longitude 50°, and then only between the parallels of 15° and 25° N. They sometimes blow in other parts of the ocean, but it cannot be said that they *prevail*.

*The best routes for October and November do not differ materially from those for September and December. See Pilot Chart.

Endeavor to cross the meridian of 50° between 30° and 33°, and do not consider yourself hopelessly to leeward, if you be *forced* to cross the parallel of 20° N., as far west as longitude 45°, or the parallel of 10° N., as far as 36° or 37° W.

The S. E. trades may be calculated on with certainty between 7° N. and 13° N., between 35° and 40° W. Occasionally the S. W. monsoons are found between the same parallels. The S. E. trades, when taken in the northern hemisphere in this month, are frequently at S. S. E.; and therefore it is not difficult for vessels that find themselves as far West as longitude 37° in latitude 10° N., to get to the eastward before crossing the Line.

Between Long. 30° and 35°, the equatorial calms are found from 4° to 12° N., and between Long. 25° and 30° they, and the S. W. monsoons, are found from 12° to the equator; and as a general rule they are found more and more vexatious as you go east.

If, after getting within these latitudes, *i. e.*, those in which the calms are mentioned as prevailing, and the wind should come out at S. E., prefer the port tack; for before you make the land, you are almost sure to have the wind out from S. S. E., where you can make your easting within the regions of perpetual S. E. trades.

After getting the S. E. trades, and finding himself a little pinched for easting to clear the land, the skilful navigator will see that by standing on with the wind at S. E., all the chances are in his favor. If the wind haul to S. S. E., he can go about and make easting. If it veers to E. S. E., or further, he can lay up and clear the land; for whether you go this or that side of Fernando da Noronha in this or any other month, is a matter of no sort of consequence, excepting only so far as the difference of longitude is concerned. If you can weather it, do so, but do not waste time simply that you may pass to the eastward of it.

Good passages are sometimes made in September, but, as a general rule, the most tedious seasons of the year, are the summer and fall months for passages.

After losing the N. E. trades, the navigator may consider himself fortunate if he is not baffled about for more than a week before he gets the S. E. trades.

General Remarks on the passage from the United States to Ports beyond the Equator.

(Submitted in 1849.)

It has now [Dec. 1849] been about two years since I first proposed a new and shorter route hence to the equator, for all vessels, whether bound around the Cape of Good Hope, Cape Horn, to Rio, or to any of the ports of South America. The track of all such is the same until Cape St. Roque be cleared.

The W. H. D. C. Wright, (Jackson) of Baltimore, was the first vessel to try the new route. In 24 days from Hampton Roads, she crossed the Line in 31° W., and had a passage of 13 days thence to Rio. This was in February, 1848.

In May, she went out again, had 33 days to the Line, which she crossed in 33° 41′ W. In 3 days after she cleared St. Roque. On this passage she was delayed 6 days by calms between 8° 30′ and 5° N. But she had no difficulty in weathering Cape St. Roque.

whence, in three days, she again cleared Cape St. Roque. This trip, it took her 11 days to clear the equatorial calms, which she found between 9° N. and 3° N. In the spring of 1849, she went out again. She had 32 days to the Line in 28°, after having been delayed 9 days by calms between 5° N. and the Line. The average therefore of Captain Jackson's passages to the Line, by the New Route, was 30 days, against 41 by the Old Route.

The Chicora, the Helena, and the Midas, tried this route about the same time, and all with equal success; their average to the Line being 26 days only.

These practical demonstrations of the advantages of the route which I had pointed out were not wanting to satisfy me of their value, for I had consulted many thousand records as to the winds encountered in this part of the ocean by different vessels on different occasions. These records showed the number of times on which the winds had been found to blow from each point of the compass in different parts of the ocean. And knowing the prevailing winds for each 5 degrees square, the navigator could tell what course it was practicable for a vessel to steer through these squares, as well before, as after, the trial had actually been made.

For instance, in a certain square of 5 degrees, I obtained the records of 700 vessels during the month of August in different years. Vessels bound South by the old route, were in the habit of passing through this square, always aiming to make a S. S. W. or south course through it. And of these 700 records as to the wind, 600 gave the wind directly ahead for a South or S. S. W. course. To convince any one, then, who believed in the records examined, that a vessel in this part of the route to Rio would *generally* find the winds ahead, did not require that a vessel should be sent there actually to try it, for here was the experience of 700 vessels, 600 of which had found the winds adverse for a southerly course.

But certain navigators were not disposed to look upon my investigations in this light. Forgetting that they were the results of actual observations, these persons were disposed to consider those results thus announced, as theories, or matters of opinion of my own; whereas they are no more matters of opinion than is the fact that the trade winds blow is a matter of opinion. They are nothing more nor less than the sum of the experience of some thousands of navigators, as to winds and calms.

The effect has been, that though many ship-masters have at once perceived the bearing of these results, and the correctness of the conclusions derived from them, and have readily adopted them, still others have rejected them altogether, or only partially adopted them.

It has not unfrequently happened, as I perceive by the Log-books returned to me, that a navigator will put to sea and stand boldly out for the new route. But after awhile, the wind comes out ahead. He then gets frightened, abandons it, has a long passage, and lays the blame to the new route.

I have never claimed for any of these routes an exemption from liability to head winds. On the contrary, I expressly show that a vessel by any of the routes proposed by me is liable both to head winds and calms; and not only so, I have shown the chances of both against her.

I may here remark that I have never yet heard of a navigator complaining of the new route and a long passage by it, but what, when his Abstract Log came to be examined, it did not appear that the fault was quite as much with him as with the route. For instance, I have drawn certain lines or tracks to show the route recommended. These lines are intended to show the route that vessels should take, not the *track* that they should make. Vessels taking such routes, should be guided by these lines as to the general direction which they ought to pursue. It was never intended that, with fair winds, they should make the zig-zags of these lines. But some navigators have inferred that there was virtue in these lines themselves; that they must be followed as rigidly and as closely as though they marked out a channel-way, on either side of which if a vessel should fall, she would find herself in difficulty. Accordingly, abstracts that have been returned to me show frequent instances wherein vessels, after having been headed off from the projected track, have had the winds perfectly fair for pursuing their straight course onward, yet they have nevertheless proceeded to make a head wind of such, and to beat back out there on the open sea, for the purpose of getting back on the track projected.

Suppose that ship A, makes an uncommonly quick run to a given port, and that she gives her track to B; B attempts it, but is headed off. Now B from this new position will not attempt to go out of his way to get actually in the wake made by A; but B will shape his course by that of A and run by it; and consider that he is following it, when he is near it. This is what I wish vessels to do with regard to the routes that I have projected for them. Do not go out of your way to get on those tracks, but consider yourself, unless especially directed otherwise, to be in good position when you are within one or two hundred miles of the projected track according to the quantity of sea-room.

Therefore, when you are *near* the projected track, consider yourself in as good a position as though you were actually on it.

For the purpose of affording navigators and ship owners an opportunity of comparing the new and the old routes together, and of drawing their own conclusions as to the advantages of the routes recommended by me, Professor Flye has taken at random, and just as they came to hand, a number of tracks by each route, and has stated those for the several months in the tables below.

It should be borne in mind that this showing, though greatly in favor of the new routes, is not as much so as it will probably be after navigators shall come to understand them better, and to have more confidence in them.

Several vessels are put down under the new route, which pursued it to the equatorial calms, became fearful of falling to leeward, abandoned it and ran over to the eastward to fall in with the old beaten track; and had long passages. The cases of such will be mentioned under the head of remarks for the several months. Though there is reason to believe that their passages were considerably prolonged in consequence of thus abandoning the new route, yet they are counted as among the vessels that have tried it, because of my desire not to *overstate* the advantages of the new route. I prefer to err, if at all, on the safe side.

COMPARISON OF PASSAGES BY THE NEW AND BY THE OLD ROUTE TO THE LINE.

FOR JANUARY.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Ship Chicora	1848	Jan.21	Boston to Canton	26	27°00′W	29
Schr. Boston	1849	27	Boston to California	32	30 00	35
Ship Montreal	"	27	Boston to Sand'ch Isld's	24	30 20	27
Brig New Castle	"	5	Boston to California	38	26 40	44
Bark Ocean Bird	"	5	New York to California	38	25 30	44
Ship Aurora	"	9	Nantucket to California	35	24 00	41
Pilot Boat Anonyma	"	18	Boston	25	29 40	28
Bark Isabelita Hyne	1850	27	N. York to Pernambuco	27	30 00	29
U. S. Store Ship Supply	"	3	New York to Rio	35	33 00	40
Bark Agnes	"	2	New York to Rio	32	27 00	34
				312	283.10	351
			Mean	31.2	28.31	35.1

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Don Juan	1843	Jan.16	Boston to China	33	22°31′W	37
New Jersey	"	18	Salem to Manilla	31	22 30	36
Recovery	1802	15	Salem to Sumatra	27	23 07	31
New Jersey	1842	26	Boston to Calcutta	26	17 33	31
Tyber	1839	25	Boston to New Holland	38	22 36	43
Clifford Wayne	1835	22	Boston to Rio	25	20 36	35
Elizabeth	1841	13	Salem to South Sea	41	21 00	44
				221	149.43	257
			Mean	31.6	21.23	36.7

There is less difference between the two routes in this month than at any other season—still there is a decided gain. The mean longitude in which the vessels crossed the equator, was, by the new route, 28° 31; by the old, 21° 23′. But the time thence to clear Cape St. Roque, is by the new route 3.9 days, against 5.1 by the old, or a total gain of one day and a half by the new route.

Three of those vessels by the new route departed from instructions when they got near the equatorial calms, and went to the east of Long. 27°. These vessels were the New Castle, the Ocean Bird, and the Aurora. They had, severally, to the Line, 38, 38 and 35 days. Now, if we exclude these as vessels which, according to their log, did not stick closely to the new route, the average January passage would be brought down to 28.7 days to the Line, and 31.7 to clear Cape St. Roque, which would show a gain of 5 days in favor of the new route, for this month. And this gain I expect will be realized.

FOR FEBRUARY.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Ship Helena	1848	Feb15	New York to Canton	23	27°58′W	26
U. S. Ship Marion	1850	27	Boston to Rio	28	30 00	31
W. H. D. C. Wright	1848	9	Baltimore to Rio	24	31 03	27
				75	89.01	84
			Mean	25	29.40	28

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Toulon	1845	Feb 11	New York to Valparaiso	37	21°19′W	39
Essex	1802	19	Salem to Calcutta	44	19 39	51
Coriolanus	1844	17	Boston to Buenos Ayres	35	23 09	41
Metamora	1840	12	Boston to Buenos Ayres	33	25 00	37
Cadet	"	20	Boston to Montevideo	34	22 30	38
				183	111 57	206
			Mean	36.6	22.23	41.2

The mean longitude in which these vessels crossed the equator, is 29°40′ for the new, and 22°23′ for the old route. The average time required to clear Cape St. Roque after crossing the Line, is 4.6 days by the old, and 3 days by the new route. Thus exhibiting a mean gain of 13.2 days in favor of the new route, in this month, and no difficulty as to clearing the land from a point as far as 30° W. on the equator.

February is one of the best months for short passages.

FOR MARCH.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Schooner Midas . . .	1848	Mh. 10	Savannah to Rio . . .	28	28°05′W	32
U. S. Ship Savannah .	1849	2	Boston to Rio	23	29 50	31
Bark Kirkland . . .	"	7	Baltimore to Rio . . .	21	34 28	29
Ship Helena	"	11	New York to Rio . . .	19	41 30	26
Bark Mason Barrey . .	"	20	N. York to Buenos Ayres	37	29 30	39
Bark W. H. Shailer . .	"	18	Boston to Tahiti . . .	37	28 15	40
				165		197
			Mean	27.5		32.8

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Sarah	1846	Mh. 18	Boston to Madras . . .	46	18°43′W	49
Medora	1845	31	Boston to Manilla . .	43	23 00	45
Dawn	1825	4	Eastport to Brazil . .	40	20 00	44
Clifford Wayne . . .	1833	4	Boston to Batavia . .	43	23 18	49
				172		187
			Mean	43		46.7

In March we have six trips by the new, and four by the old route. The mean place of crossing by the former is 31°56′, by the latter 21°15′. Here the new route leads the old 15½ days to the Line.

The Helena fell to leeward, steered North and recrossed the equator in 37° W. From this longitude she was clear of Cape St. Roque in three days, and made the passage from New York to Rio in 34 days.

FOR APRIL.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Isabelita Hyne .	1848	Ap. 29	New York to Rio . .	27	29°17′W	29
Bark Chalcedony . .	"	22	New York to B. Ayres .	60	31 59	64
Ship Deucalion . . .	"	7	Boston to Callao . . .	23	33 25	34
Ship Horsburg	"	5	Boston to Hong Kong .	24	29 30	26
Brig R. de Taldo . . .	1849	19	Richmond to Bahia . .	38	27 00	40
Bark Hazard	"	4	Boston to Batavia . .	22	25 39	24
Ship Washington Allston	1848	21	Boston to Calcutta . .	29	28 00	32
Ship Houqua	1849	6	New York to Canton .	20	25 00	22
Ship Horsburg	1850	13	New York to Canton .	28	30 00	34
Ship Tartar	1849	3	New York to China . .	23	25 00	25
Ship Memnon	"	11	New York to California	19	28 45	21
				315		351
			Mean	28.6		31.8

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Sirene	1845	Ap. 12	Philadelphia to B. Ayres	30	27°00′W	33
Mary Chilton . . .	1839	17	New York to Rio . .	36	27 00	38
Tusculoosa	1829	22	Baltimore to Montevideo	35	25 36	38
Potomac	1838	3	Newburyport to Batavia	35	22 00	37
Telemachus	1802	21	*Salem to Arabia* . . .	43	24 12	46
Metamora	1841	7	Boston to B. Ayres . .	45	24 11	50
				224		242
				37.3		40.3

In April, we have for comparison six tracks by the old and eleven by the new route, with an average saving of more than a week in favor of the latter; notwithstanding the bad luck of the "Chalcedony." That vessel, when she got to the equatorial calms, committed the mistake of going too far East. She went as far as 24°, and was 32 days in the "doldrums," between latitude 2° and 6° N. This is the longest passage, of which I have received any account, by the new route. It might be rejected because of the departure from this route in going so far to the eastward, but this is a mistake which navigators, I find, are liable to make; and, therefore, I have preferred to count it. On the other hand, if extraordinary long passages by the old route had been sought for, they might have been found of more than 100 days in length.

So, too, with the Brig R. de Taldo. She was becalmed for 13 days in the "Horse Latitudes," between latitude 34° and 36° N., and 5 days in the equatorial calms, between 4° N. and the Line; also, the "Washington Allston." She went as far as 22° W., and was seven days becalmed in the equatorial "doldrums," between 5° N. and the Line.

Now, if these vessels, with the light southerly winds, which they met after losing the N. E. trades, had not been afraid of falling to leeward, so as not to weather Cape St. Roque, they no doubt would have done much better.

Instead of running obliquely, say an E. or an E. S. E. course along the equatorial calms, they should have endeavored to beat due South across the Line, so as to get clear of them in the least time possible. By fanning along to the eastward, they get into that part of the ocean where these calms are most obstinate.

If, therefore, we omit these three vessels from the count, as not coming justly within the rule, we shall have a difference of 13 days in favor of the new route for this month. But retaining them, there is still a difference of more than a week in favor of the new route for April.

☞The new route is much less liable to calms than the old.

FOR MAY.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Schooner Wilmington .	1848	My. 23	Baltimore to Bahia . .	45	27°54′ W	48
Bark W. H. D. C. Wright	"	27	Baltimore to Rio . . .	33	33 41	36
Ship J. Q. Adams . .	"	30	Boston to China . . .	28	29 00	31
Ship Tonquin	"	11	Boston to Madras . . .	36	30 00	39
Brig Smyrna	1849	14	Boston to Cape Town .	50	21 00	53
Ship Tzar	"	12	Boston to Honolulu . .	33	24 00	36
Ship Montauk	"	12	N. Y. to Van Diem's L'd	27	29 00	29
Ship Milton	"	22	Boston to Madras . . .	31	31 10	33
Ship Siam	"	2	Boston to Manilla . .	27	29 00	29
Ship Oneida	"	24	New York to Canton .	31	29 16	33
				341		367
			Mean	34.1		36.7

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Unicorn	1843	My. 13	Boston to Manilla . .	39	25°00′ W	41
St. Paul	1840	29	Salem to Manilla . . .	39	25 00	41
Albion	1838	26	New York to China . .	43	23 50	46
Albion	1839	10	New York to China . .	40	25 00	42
Chalcedony	1835	7	Boston to Cape G'd Hope	34	24 51	36
Abigail	1842	23	Boston to Pacific . . .	40	22 00	43
Harriet	1822	21	Baltimore to Lima . .	51	27 50	54
Ann	1823	21	Salem to Sumatra . .	54	26 06	57
				340		360
				42.5		45.

For this month, we have the means of ten tracks for the average for the new, and eight by the old routes.

I have nothing to say about the schooner "Wilmington," except that she appears to have had bad luck, as vessels by every route will occasionally have. She was becalmed 9 days between the parallels of 5° and 7° North.

The brig "Smyrna," after getting down to the region of equatorial calms, departed from the new route, and went as far as 17° 30′ W. where she was fighting with calms and baffling airs for 13 days, for that is the time it took her to get from 9° to 2° North.

Yet notwithstanding all this, the average of all their passages by the new route, counting the "Smyrna," which went part of the way only by the new route, is 8.4 days less than by the old.

If we exclude the "Smyrna" from both, the new route would show a gain on the average of 10 days for May.

FOR JUNE.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Ann Hood . . .	1848	Jun.22	New York to Rio . .	37	32°00′W	40
Ship Samuel Russell .	"	2	New York to Canton .	22	24 27	24
Ship Charleston . . .	"	3	New York to Callao . .	36	27 17	38
Bark Saxonville . . .	"	4	Boston to Calcutta . .	35	23 25	37
Ship Prince de Joinville	"	18	New York to China . .	39	23 15	42
Bark Channing . . .	"	4	New York to Rio . . .	37	28 30	40
Ship Vancouver . . .	"	23	Boston to Canton . . .	28	27 47	30
Bark W. H. D. C. Wright	1849	23	Baltimore to Pernambuco	32	28 00	34
Cleora	1848	11	Boston to Rio	30	28 48	33
France	"	4	New York to Rio . . .	38	28 34	40
				334		358
			Mean	33.4		35.8

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Niantick	1844	Jun. 5	Sag Harbor to Pacific .	46	19°00′W	49
Sartelle	1847	7	New York to China . .	57	24 00	60
Ronaldson	1844	7	New York to Canton .	35	27 00	37
Oscar	1842	19	New York to China . .	34	23 00	37
Oscar	1843	11	New York to China . .	36	24 00	38
Emerald	1827	7	Boston to Calcutta . .	37	20 30	40
Mars	1829	16	Boston to Calcutta . .	39	24 00	42
Carolina	1844	2	Salem to India . . .	45	24 04	48
Jessone	1835	6	Boston to Batavia . .	45	28 00	47
				374		398
			Mean	41.5		44.2

In the month of June, vessels are recommended to go, under certain circumstances, as far East as 28°, and to cross the equator in about 30° W. See the route for Rio for that month, p. 224.

The mean crossing place of these ten vessels whose tracks are given, is in Long. 28° 50′ W. on the equator. By the old route it is, for the mean of 9, in 23° 44′, or 5° farther East.

The shortest way generally of clearing the equatorial calms, is to go straight across them by a North or South course. In their belt, the light airs that blow are *really* baffling winds which, for the most part, are from the southward. As you go East, this belt of calms grows wider, and therefore the more difficult is it to be crossed.

As a general rule, when a vessel gets into this region of light airs and calms she should always prefer that tack on which she can make the most southing. It is evident from the direction in which this calm belt lies, that a vessel that attempts to fan along to the eastward in it, is not only making no progress in crossing it, but that she is running along its length, and therefore prolonging her stay in it.

Vessels bound to South America and attempting the new route in June, are recommended not to go farther East in the calm belt, if it can be avoided, than Long. 28° W.

The vessels whose passages are longest for June, followed the new route till they lost the N. E. trades; and then for fear of falling to leeward, abandoned it, and went running along to the Eastward in the belt of equatorial calms—whereby they no doubt considerably prolonged their passages. Thus the "Ann Hood," the "Charleston" and the "Channing," went as far as 23° W., and they were delayed, severally, 16, 10 and 8 days in crossing the calm belt. The "Saxonville" and "Prince de Joinville" went as far as 16° W., and were delayed, the former 11, and the latter 8 days, in consequence of prolonged calms and baffling winds.

Yet notwithstanding the bad luck which thus prolonged the sum total of these passages 53 days, the average of the 10 by the new route to the Line is less, by 8 days and a little over, than the average for the same month by the old route.

FOR JULY.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Brig Cohansey . . .	1848	July 14	N. York to Rio Grande .	41	27°00′W	44
Bark Mary Ellen . . .	"	20	New York to Rio . . .	39	20 05	43
Bark Mindoro	"	6	Boston to Rio	50	23 00	53
Ship Candace	"	12	New York to Canton .	32	28 00	35
Bark Mason Barney . .	"	21	N. York to Buenos Ayres	53	30 39	56
Ship Sartelle	"	23	New York to Mauritius	48	23 30	51
Ship Thos. Perkins . .	1849	19	New York to California	34	21 00	37
Brig Joseph Butler . .	"	2	Nantucket to California	34	31 00	37
Ship Carrington . . .	"	4	New York to Canton .	27	30 20	29
				358		385
			Mean	39.8		42.8

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
George	1827	July 4	Salem to Calcutta . .	41	18°38′W	43
Thom	1832	20	Sag Harbor, (whaling) .	44	18 00	46
Erie	1836	28	N. York to Buenos Ayres	42	23 40	45
Henry	1803	19	Salem to Batavia . . .	63	19 28	69
Brookline	1839	27	Salem to Manilla . . .	50	21 13	54
				240		257
				48.		51.4

July is another difficult month for short passages, because of the breadth of the belt of equatorial calms, and the prevalence of the S. W. monsoons. When you get east of 28° W. these winds are found to prevail in the summer and fall, from S. S. E. to S. W. almost constantly, and they are liable to be encountered anywhere between 1° N. and 13° N. To the west of 28° they do not blow so regularly, nor do they cover so broad a belt.

FOR AUGUST.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Gallego . . .	1848	Aug. 6	Richmond to Rio . . .	42	29°17′W	45
Bark Kathleen . . .	"	24	Richmond to Bahia . .	52	26 45	54
Bark E. Korning . . .	"	19	Baltimore to Rio . . .	35	27 38	37
Bark Brazillero . . .	"	29	Richmond to Rio . . .	34	29 00	36
Bark Kirkland	"	1	Richmond to Rio . . .	42	31 25	45
Brig Independence . .	"	16	New York to Rio . . .	45	32 34	48
Ship Esther May . . .	"	3	Boston to Rio	36	33 13	40
Bark Rover	"	4	New York to Rio . . .	37	27 32	39
Ship Malabar	"	4	New York to Callao . .	46	27 40	49
				369		393
			Mean	41		43.7

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Central America . .	1831	Aug. 3	Baltimore to Pacific . .	35	23°44′W	38
Catharine	1843	12	Baltimore to Montevideo	50	26 36	53
Brutus	1845	7	Boston to Calcutta . .	43	25 00	46
Phœnix	1821	27	Boston to Sumatra . .	40	24 00	44
Cadet	1840	12	Boston to Montevideo .	45	23 00	48
				213		229
			Mean	42.6		45.8

August is another bad, and the worst month. Here, also, we have the tracks of 9 vessels by the new route. But the mean of them shows an average gain of only 1.6 days to the equator, and of 2.1 to clear Cape St. Roque.

The mean longitude of crossing the equator in this month is 29°30′ by the new route, and 24°30′ by the old. From the former it requires only 2.4 on the average to clear Cape St. Roque; whereas from the latter 3.2 days are required. In this fact, navigators will see that there is no difficulty in crossing as far to the West as recommended by me for this month. Fourteen days is the average of the time required by those 9 vessels to cross the belt of equatorial calms and monsoons; and every vessel, except 3, went further to the eastward than is recommended by the route, and the average of these three in crossing this belt is 14 days.

The "Kathleen" went as far as 24° West, and was 27 days becalmed in crossing this belt. The Independence went, as was recommended, and was becalmed 18 days. Two others, 12 days each. The passage for this month, when the new route shall be properly followed, will be considerably shortened.

FOR SEPTEMBER.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark *W. H. D. C. Wright*	1848	Sep 19	Baltimore to Rio . . .	33	29°48′W	36
Brig R. de Taldo . . .	"	2	Baltimore to Rio . . .	45	29 00	48
Bark Palmetto. . . .	"	1	New York to Rio . . .	32	24 30	35
Brig Imperial	"	2	Norfolk to Rio	53	32 54	57
Brig Lion	1849	17	Boston to Rio	37	29 00	40
Ship Oriental	"	11	New York to Canton .	35	30 30	37
				235		253
			Mean	39.1		42.1

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Washington	1833	Sept.5	New York to Batavia .	43	21°45′W	46
Coromando	1842	23	Boston to Manilla . .	42	26 00	44
Brewster	1847	14	New York to Concagua	52	26 14	54
St. Paul	1841	11	Salem to Manilla . . .	35	24 00	38
Eliza Ann	1833	15	Boston to Montevideo .	41	27 46	44
Carolina	1843	17	Salem to Rio	45	24 14	47
Potomac	1835	5	Newburyport to India .	42	17 01	46
				300		319
			Mean	42.9		45.6

In September the average passage, as shown by the mean of six voyages by the new route, is 3.8 days less than the average as shown by the mean of 7 per old route.

By the old route the vessels go, on the average, as far as 19° 30′ W., and cross the equator in 23° 50′.

By the new route they are recommended to go as far as 27°, and to cross in 29°; but they have gone, on the average, as far as 26° 30′, and have crossed in 29°; and the average of the time required to cross the belt of equatorial calms is 14 days; so that it does not appear that there is much hope of materially and still further shortening the September passage. The vessels that have tried the new route for this month, appear to have followed it well.

FOR OCTOBER.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Lucia Maria . .	1848	Oct.15	Boston to Zanzibar . .	34	30°00′W	37
Brig A. Hammond . .	"	11	N. York to Rio Grande .	44	34 53	47
Brig Eshcol	1849	6	Boston to Pernambuco .	34	35 00	37
				112		121
			Mean	37.3		40.3

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Lotus	1833	Oct.19	Salem to India . . .	41	25°48′W	45
Great Britain	1845	20	New York to China . .	35	24 23	38
America	1835	25	New Bedford (whaling)	48	28 00	53
				124		136
			Mean	41.3		45.3

In October the new route shows a practical saving of 3.7 days to the Line, and of 5 days to the latitude of Cape St. Roque. The average crossing place by the old route being in longitude 26° W., and by the new in 33° 20′.

Capt. J. C. Harding, of the "Eshcol," who crossed in 35° W., writes, "I think favorably of your route, as laid down on your Charts of Winds and Currents, to the equator. When bound to the east coast of Brazil, I shall never think of crossing the equator East of longitude 31°." The intersection of the meridian of 35° with the equator, is too far West to cross willingly.

It took the "A. Hammond" 22 days to cross "Horse Latitudes," on the passage quoted above. Through that part of the ocean, the two routes are generally the same. Therefore liability to calms here, is not peculiar to the new route.

FOR NOVEMBER.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Brig Marshall	1848	Nov. 7	Richmond to Rio Grande	41	27°00′W	44
Bark Cleora	"	21	Richmond to Rio . . .	35	36 18	47
Ship Amity	"	15	Boston to Penang . .	30	28 00	32
Bark Whiton	"	23	New York to California	35	28 04	37
Ship Kensington . . .	"	27	New York to Batavia .	29	30 00	33
Bark Agnes	"	22	Cape Henry to Rio . .	27	30 00	29
				197		222
			Mean	32.8		37

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Rosanna	1830	Nov. 5	New York to St. Helena	56	23°00′W	58
Cornelia	"	11	Baltimore to B. Ayres .	52	28 40	55
Whiton	1846	28	New York to California	35	25 20	37
Barbara	1844	1	Sag Harbor, (whaling) .	39	23 00	42
Rajah	"	15	Boston to China . . .	45	34 00	47
Roman	"	2	New Bedford to Pacific	35	25 07	37
Sarah Parker	1841	14	Boston to Batavia . .	34	27 09	37
Alasco	1836	3	New York to Batavia .	37	25 00	40
Cuba	1843	19	Boston to Montevideo .	43	22 12	45
Emerald	1833	24	Salem to New Zealand	50	25 56	53
				426		451
			Mean	42.6		45.1

The mean of the November passages gives 9.8 days in favor of the new route to the Line. The mean crossing place is in 30° West. The "Cleora" fell to leeward, crossed in 36°, and had twelve days thence to the latitude of Cape St. Roque. But the "Rajah," by the old route, and before the charts were published, crossed in 34° W. She had 45 days to the Line, and only 2 days thence to St. Roque, total 47 days—which is the passage of the "Cleora" after falling to leeward by the new route.

FOR DECEMBER.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Brig Andrew M. Jones .	1848	Dec. 1	Richmond to Pernambuco	32	34°32′W	40
Bark R. H. Douglass .	1849	26	Richmond to Rio . . .	38	29 55	42
Ship Virginian . . .	1848	27	New York to China . .	32	25 00	35
Ship Aldebarran . . .	1849	27	Boston to Batavia . .	35	27 00	37
Ship Florence	1848	18	New York to California	40	27 50	44
Schooner Rochester . .	1849	14	New York to California	36	30 00	39
Ship Gosco	1848	12	Boston to India . . .	23	29 20	26
				236		263
			Mean	33.7		37.6

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Derby	1825	Dc. 13	Salem to Batavia . .	31	24°31′W	34
Brazil	1841	8	Boston to Sumatra . .	43	21 30	47
Gulliver	1806	22	Boston to Calcutta . .	39	22 10	43
Active	1801	12	Salem to China . . .	41	20 00	44
				154		168
			Mean	38.5		42

In December, the "Andrew M. Jones," when attempting the new route, fell to leeward, crossed the equator in 34° 30′, and yet cleared Cape St. Roque 2 days sooner than vessels by the old route usually do. In this month, the calms are generally between the equator and 4° N., and it takes a vessel 6 days on the average to cross them.

I have thus taken the trouble to quote a number of passages for every month of the year and by each route, that navigators may the better judge for themselves as to the merits of the two routes.

It will be observed that the length of the passages by both routes, depends very much upon the season: July and the old route giving the greatest average, which is 48 days; the most tedious month by the new route is August, which gives 41 days as the average.

In January there is but little difference between the two routes according to the passages quoted, though according to my investigations, the average passage by the new January route should be less than 30 days; and when it comes to be tried *fairly*, such, I expect, will be the result.

February and March are famous months for quick passages. The new route saves about two weeks on the average for each of these months.

When a vessel finds herself pinched for room, she should never hesitate to pass inside of Fernando do Noronha; and vessels bound around the Cape of Good Hope, will find it to their convenience to cross the equator further to the East than they would if bound to South America or around the "Horn."

I have heard complaints of the new route from but two vessels that have returned me abstracts of their logs, so that I might judge whether their complaints were well grounded. These two vessels were the "Oceanus," in 1848, and the "Clarissa Perkins," in 1849. And it is but just to remark that the complaint, as to the "Perkins," comes from others, and not from her master.

I do not claim for vessels on the new route an exemption either from head-winds, baffling airs, or calms. On the contrary, I expressly show that vessels on the new route are liable to all these. Nor do I claim for the new route short passages *invariably*. I only claim that the average of the passages by the new route will be shorter than the average of the passages by the old. I could name a fine sailing frigate, that had a passage to Rio of 100 days by the old route. I could cite the case of other public vessels, that have had like passages, and of merchant vessels that have had 150 days by the old route. But these are the exceptions and not the rule. So doubtless, too, there may be occasionally long passages by the new route.

But to show that it is not the fault of the new route that the "Oceanus" had a passage of 117 days to Rio, and the "Clarissa Perkins" 83, I quote abstracts of their logs, by which it will appear that there is every reason to believe that both vessels would have had fair passages to Rio, if they had stuck to the new route.

Letters and Log of Captain W. A. Sullivan, of the Brig "Oceanus."

"I have crossed the equator to the East Indies eight times to Canton—twice to Calcutta; have generally crossed in 28° W., and twice have had to tack to the eastward in 4° 30′ South, in the months of April and June; and this passage I have met with less wind and stronger current than it has been my fortune ever to have met with before.

Abstract Log of the Brig "Oceanus," W. A. Sullivan, from Boston to Rio, 1848.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A.M.		Winds.
						Air.	Water.	
Mar. 13	No obse'n.	No obse'n.				40	42	N.W. cloudy.
14	" "	" "				45	52	W. "
15	" "	" "				42	68	S.W. and variable.
16	37°12′	64°10′	N. 65° E. 0.9			45	68	S. to W.
17	36 44	60 06	" " 0.9			50	58	Variable from W.
18	35 55	57 53	" " 1.0			62	68	" "
19	34 35	57 10	S. 65° W. 0.3			71	66	S.W.
20	32 55	55 58	None.			66	64	"
21	30 38	53 49	S. 45° W. 0.3			66	72	N.W. by W.
22	28 39	52 06	3 Whale.			68	66	W.S.W.
23	26 24	49 26	4 Whale.			74	66	S.W.
24	24 32	47 22	"			74	69	S.W. by W.
25	23 02	47 55	"			74	70	S.W. fresh breeze.
26	22 14	47 25	"			78	70	S.E. " "
27	20 44	48 27	"			69	70	S.E. " "
28	20 29	47 24	South 0.4 per h.			74	69	Latter part calm. 12 to 12 A. M. S.E., easterly heavy gale.
29	18 46	47 10	S.S.W. 0.4 "			74	69	S.W., westerly brisk.
30	19 03	46 02	None.			74	71	S.E., easterly fresh breeze.
31	16 31	46 42	"			73	71	S.E. " "
April 1	16 39	45 02	"			74	69	S.S.E. " " and squalls.
2	16 30	42 34	"			73	69	S.S.E. and E.S.E. moderate.
3	14 31	41 18	"			73	69	S.E. and E.S.E. squalls and calms.
4	13 29	38 56	"			72	70	S.S.E. to S. moderate.
5	13 40	37 55	"			71	70	S.S.E. to S. squalls and rain.
6	11 03	36 40	W. ¼N. 0.4 tenths.			74	69	S.S.W.&N.byE. " "
7	8 42	35 23	" 0.4 "			73	69	N.N.E. pleasant and brisk.
8	6 42	33 20	" 0.5 "			71	69	N.E. very fresh.
9	3 57	31 17	" 0.8 "			75	70	N.E. and E.N.E. strong first part, moderate latter.
10	2 00	31 22	W.N.W. 0.8 "			75	70	E. very fresh.
11	1 39	31 37	7			76	72	E.S.E. very fresh.
12	0 44 N.	31 38	West, 5 tenths.			76	72	E. moderate.
13	1 39 S.	31 50	W. 1.0 "			76	72	E. " strong tide rips.
14	2 10	30 59	W.10°N. 1.0 "			81	76	N.N.E. light winds.
15	3 05	32 50	W. 1.5 "			84	81	E.S.E. " "
16	3 57	35 10	W. by N. 2.5 "			84	78	E.S.E. " "
17	3 40	34 12	" 2.5 "			84	78	E.S.E. " "
* 18	2 00	37 15	" 2.5 "			81	76	N.E. and E. squalls and rain.
19	1 56 S.	39 40	" 1.8 "			81	70	N.E. and E. " "
20	1 20	39 12	" 1.5 "			76	65	Variable from N.
21	0 44 S.	40 20	W.N.W. 1.9 "			76	70	Variable and light airs.
22	0 10 S.	41 01	" 1.9 "			76	70	Moderate squalls from E.
23	0 15 S.	40 59	" 1.02"			76	70	" " "
24	0 20 S.	41 20	" 2.00"			76	70	Calm.
25	0 15 S.	42 00	" 1.5 "			76	72	Light airs from E.
26	No obse'n	No obse'n				76	72	Light airs from E. and cloudy.

* This is the strange proceeding. With the wind from E. S. E. to N. E., and wanting to go South, he runs off to the northward and westward.—M.

Abstract Log of the Brig "Oceanus."—Continued.

Date.		Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 A.M. Air.	THER. 9 A.M. Water.	Winds.
				In 2 days.					
April	27	1°00′ N.	43°00′	" 50 miles.			76	70	During this week I had the wind from E. by N. and E. by S., light airs, and a strong west set, steering N.; wind enough to move the brig 2 and 3 knots.
	28	1 40	43 50	W. N. W. 1.2			76	70	
	29	2 30	45 12	" 1.5			76	72	
	30	3 28	46 45	W. by N. 1.2			78	74	
May	1	5 50	47 30	W.N.W. 1.3			68	70	
	2	4 15	47 50	" 1.3			68	70	
	3	5 21	48 20	" 1.5			68	70	
	4	6 15	49 11	" 1.5			68	70	E.N.E. good breeze, moderate.
	5	7 12	50 10	" 1.5			68	70	E. good breeze, moderate.
	6	9 40	50 20	" 2.2			64	68	S.S.E. " "
	7	10 56	50 27	" 1.9			74	78	Variable and light airs from eastward.
	8	11 31	52 00	" 1.0			80	77	Variable and light airs from eastward.
	9	10 12	52 48	" 1.0			80	80	Variable and light airs from eastward.
	10	9 13	52 11	" 1.5			87	88	E.N.E. squalls and rain.
	11	8 43	51 39	" 1.0			88	87	Light airs and calms from E.
	12	9 49	52 00	" 1.0			80	80	" " "
	13	11 27	52 12	1.0			88	78	E.N.E. moderate breeze.
	14	11 19	51 42	1.2			78	80	E.N.E. light airs and calms.
	15	10 47	51 11	1.2			78	80	E., & E. by N., squalls and rain.
	16	10 01	50 21	1.5			78	80	Variable from E. and squalls.
	17	10 00	50 19	N.W. 0.4			80	80	Light airs and pleasant. From 12 to 1 no current,—set in at 3 in a tide rip.
	18	9 32	49 03	W.N.W. 1.3			80	80	E. current stronger in afternoon than morning.
	19	9 55	49 05	W. 1.0			79	81	E. heavy squalls and rain.
	20	8 55	48 08	" 0.6			80	81	E. " "
	21	7 59	46 05	" 1.7			80	79	E.N.E. light squalls and rain.
	22	6 58	46 05	" 1.0			75	80	N.E. rain squalls; no wind.
	23	5 29	45 23	" 0.5			80	80	E. and E.S.E. squalls, light air and rain.
	24	4 17	43 50	" 0.5			80	81	N. E. by E. moderate squalls and rain.
	25	4 02	43 40	" 0.5			79	81	E.N.E. light squalls & calms.
	26	3 16	43 14	" 0.5			79	82	Var. from N.E. to S.S.E. light squalls of rain.
	27	None.	None.	—			80	81	Calm, heavy rain.
			Lun. 42 55						
	28	4 26	Cro: 42 47	2 days 0.4 N.N.W.			80	82	Light airs and calms.
	29	5 24	42 21	0.7 W.N.W.			80	81	Squalls, light airs N.N.E.
	30	5 52	41 58	0.7 "			80	79	Light baffling airs and squalls from S.E.
	31	6 18	41 32	0.9 W.S.W.			80	81	Fresh squalls and rain variable from E.
June	1	6 29	40 32	1.2 "			80	81	" "
	2	5 55	40 30	1.2 "			80	82	" "
	3	5 45	40 09	0.5 S.S.W.			80	81	Light air and calms from E.

Abstract Log of the Brig "Oceanus."—Continued.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A.M. Air.	THER. 9 A.M. Water.	Winds.
June 4	5°26′ N.	39°45′	0.7 W.N.W			80	79	Moderate breezes from E.
5	5 22	39 15	1.5 N.N.W.			80	81	" "
6	4 40	38 40	0.4 W.			79	82	Variable from E.S.E. to S.S. E., squalls and rain.
7	4 40	37 50	0.4N.87°W.			79	82	E. squalls and rain.
8	4 11	37 44	0.5 W.N.W.			79	81	Moderate calms and rain; heavy tide rips.
9	4 16	36 01	0.5N.W.byW.			80	81	S.E.& S.byW. heavy tide rips.
10	5 24	35 32	1.0N.25°W.			79	80	Rain and cloudy; good breeze.
	No obs'n.	No obs'n.		*				
11	D.R.5°42′ N.	D.R.34°42′	—			78	80	S.S.E., good breeze & cloudy.
12	D.R.5 15	D.R.33 55	—			76	78	S.S.W., " "
13	D.R.4 17	D.R.33 05	—			79	78	S.W., " "
	D.R.3 03	D.R.32 14	In 4 days.					
14	ob.c.4 41	ob.c.32 14	N. 42 E. 2°42′			79	78	S.W., " "
15	4 01	28 51	N. 64 E. 1 00			78	80	S.S.E., rain.
16	2 57	29 48	No current.			79	80	S.S.E., moderate & pleasant.
17	1 40 N.	30 53	0.8 per h. W.			79	79	" " "
18	0 22 N.	32 57	1.8 " "			78	80	S.E. by S., squalls & moderate.
19	0 19 N.	32 15	1.8 " "			78	79	" " "
20	1 01 N.	31 52	0.7 " "			78	81	S.E. " "
21	0 13 S.	31 52	0.8 " "			78	80	S.E.byE.&E.S.E., moderate.
22	2 13 S.	32 01	0.8 " "			78	79	S.E., stiff breeze.
23	2 00	31 34	1.0 " "			78	79	" "
24	4 07	32 41	1.0 " "			79	80	E.S.E., "
25	5 24	33 35	1.0 " W.N.W.			80	79	S.E. & E.S.E., heavy squalls of 4 h. duration, double reefed.
26	7 01	34 19	N. 22° W. 1.2			79	79	E., fresh breeze and pleasant.
26	7 09	33 55	W. N. W. 0.8			79	79	S.S.E., moderate "
28	8 07	34 49	N. N. W. 0.9			80	78	S.E., moderate; at 7 A. M. Olinda S.W. by S. 7 miles; at noon Pernambuco abeam and St. Augustine S.W. by S. ½ S.
29	9 30	34 56	" 0.2			79	77	E.S.E. & E.N.E., moderate.
30	11 35	35 03	None.			79	77	E.N.E., moderate.
July 1	13 42	35 15	"			78	77	" "
2	15 29	35 32	"			78	77	Brisk from E.N.E.
3	16 44	36. 05	0.2 S.			79	76	W. and N.N.E., moderate.
4	18 12	36 45	No current.			79	78	Variable from W. to S.S.E.
5	19 03	37 17	"			78	78	W.N.W. & N.N.E., moderate.
6	20 15	38 30	"			78	77	N.N.E. & N., strong breeze.
7	22 20	39 52	"			77	78	N., very fresh; saw 5 sperm whales.
8	23 15	41 52	20 miles in 24 h.	Made Cape Frio at 12 noon, N. W. by W. 12 miles.				

* NOTE.—These four days, after taking five observations, convinced me of a set to East northerly, of great force. Hardly believed by myself, and probably will be doubted by you. Every token of a strong current—and after throwing my log with a heavy weight, I found such was the case. I have always known such exist northward between 7 and 10, east of the 30° of West Longitude. It is the first easterly current I experienced.—As I have before mentioned, I have never experienced so much and steady current save in China seas, Straits of Bally, and about the Islands. The ship Heber, spoken 36 days from New York, satisfied me, as the Captain stated the same easterly current had been felt by him. I took several Lunar observations, but finding them agree so nearly to chronometer, have not, but in one instance, taken note of them.

Capt. Sullivan to Lieut. Maury.

"You will see by this abstract from my experience that an ordinary vessel in point of sailing stands but little chance to cross the line in over 30° W. in the months of April, May, and first part of June. In any other months I should think differently.

I have had light airs, and could not have had better opportunity to judge of currents to which I have devoted my attention.

If this prove any benefit to you I shall be partially repaid for the long and tedious voyage.

With respect, I remain, your most obedient servant."

It will be observed that Captain Sullivan followed the new route faithfully to the line, which he crossed, after a passage of 30 days, in Long. 31°42′, with the wind at East. That from the 15th to the 16th of April, with the wind at E. S. E., and wishing to steer *South*, he made a course and distance good of 150 miles W. N. W.; and that from the 17th to the 20th, with the wind from the *northward* and *eastward*, and as fair as he could have it to blow for his course to Rio, he ran off away to the northward and westward instead of to the southward and eastward, until he brought up in the mouth of the Amazon! Surely this is neither the fault of the charts nor of the route. The brig then beat about to the north of the line, and at the end of 78 days returned to it again, and on the 21st of June succeeded in re-crossing it in 31° 52′; that is within 10 miles of where she had crossed it in April the first time.

With the winds now at S. E., less favorable than they were the first time, she had no difficulty in clearing St. Roque in 4 days from the line, and in getting to Rio in 13 days afterward. This "mysterious hanging of the brig about the line" is certainly in nowise connected with the new route.

In justice to Captain Goodrich of the "Clarissa Perkins," it should be observed that he does not charge his passage of 83 days to Rio to the new route. On the contrary, he distinctly shows that the fault was not with the charts nor with the route, but with his passengers; and with a candor that is in the highest degree commendable, he himself admits his mistake in steering to the westward after crossing the parallel of 32° N.; see his abstract, page 246, his winds and courses from February 16th to March 8th, and the remarks in brackets, ( ), which are my own.

Captain G.'s log and remarks are of much value, and I take this occasion to express my thanks to him for the information afforded by them.

Letter and Log of Capt. Goodrich, of the "Clarissa Perkins," to Lieut. Maury.

REALIJO, *March 22d*, 1850.

"A few days since I sent you by private conveyance my journal of the ship 'Clarissa Perkins,' under my command, from New York to San Francisco, from thence to this port. I preferred to send the journal, that you might see more fully than I could express in abstract form.

You will perceive I fell to leeward of Cape St. Roque, yet I would again pursue your route, for I still have confidence in the same. There were at the same time several other vessels much farther West than myself, yet they made a fair passage into Rio de Janeiro. And I there heard of the shortest passage being made by a vessel that made land several degrees West of that Cape.

It was my misfortune to have 140 passengers on board, my vessel only 240 tons, and to them I do in a great measure attribute my not getting round sooner. They interfered much with my duty; protested or remonstrated against my coasting along the shore. And often to prevent some dissatisfaction I stood seaward out of sight of land, and consequently experienced a strong current.

Of my passage from San Francisco to this port I have nothing to say, as you have the journal.

The diversity of opinion is such that no one pretends to give information or instructions for navigating this coast. The prevailing opinion, however, is to coast along in sight of land at all seasons, if bound southerly. And bound up the coast about as many vessels follow the coast along as there are of those that stand well off the coast. It astonishes me, and also many others of my profession, to see how little is known of the winds and currents in the North Pacific ocean.

In contrast with my long passage, I forward herewith the extracts of some other vessels whose journals or log books have fallen under my notice. I shall leave this port in about 7 days on my return passage to San Francisco, and I there shall be most happy to hear from you, acknowledging the receipt of this and also the journal. Should you write, please direct "Care of E. E. Dunbar, Esq., San Francisco, California."

ABSTRACT LOG OF THE SHIP "CLARISSA PERKINS," JAMES W. GOODRICH, COMMANDER, BOUND FROM NEW YORK TO SAN FRANCISCO.

Date.	D. R. Latitude, at noon.	Observed Latitude, at noon.	Longitude at noon. D. R.	Longitude at noon. Observed.	Ther. 9 A.M. Air.	Ther. 9 A.M. Water	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1849										
Feb. 7	39°44′ N.	—	71°36′W.	—	—	—	N.E. to E.S.E.	W.N.W. to S.W.	WSW.to WNW.	Sailed.
8	38 21	—	67 50	—	—	—	W.N.W.	N.W. by W.	N.W. by W.	Strong gales, and squally.
9	37 40	—	64 27	—	56	79	N.W. to W.	W.S.W.	W.S.W. to N.W.	" " "
10	35 40	36°40′	61 20	63°01′W.	50	61	N.W. by W.	N.W.	N.W.	" " "
11	35 09	35 07	58 58	—	59	66	N.W.to W.N.W.	W.S.W.	S.W. to S.S.E.	Strong gales, and squally. Latter part moderate and calm.
12	35 00	35 01	56 36	—	61	65	S. by W. to S.	S.S.W.	S.W.	First part moderate—latter part gales. Ship under close-reefed topsails.
13	34 52	—	53 39	—	61	—	S.S.W. to S.	S.	S.W. to W.	Strong gales, and squally.
14	32 54	34 25	52 16	55 22	61	61	W.	N.W.	N.W.	Moderate breezes.
15	32 43	32 35	51 04	54 32	67	—	N.W.	N.W. to N. by W.	N.by W.&baffling	Pleasant.
16	32 45	—	49 37	—	69	69	S.E. var. S.W.	S. by E.	S. by E.	Light winds. (Stood W. N. W. 5 hours, 19 miles, with wind S. W.)
17	32 32	—	47 03	—	73	66	S.	S.	S.	Pleasant.
18	32 16	—	44 27	—	72	68	S.S.E.	S.S.E.to S.by W.	S. by W.	Unpleasant and squally.
19	31 14	32 39	43 29	—	70	66	S.by W.to S.S.E.	S.E. by S.	E.S.E. to S.S.E.	Pleasant.(StoodS.W.4 h.,20miles,windS.SE.)
20	31 27	31 27	44 48	47 58	71	68	S.S.E.	S. to S. by W.	S. by W.	Pleasant. (Course all day from W. by S. to S. W. ½ S., 104 miles.)
21	30 39	30 46	48 06	48 36	72	68	"	S.W. & variable	N.W. & variable	Light winds. (Stood S.W. 9 hours, 30 miles, wind S.S.E.)
22	28 47	28 55	47 46	47 02	72	68	N.	N.E.	E. to E. by S.	Pleasant. (Think there is a mistake in longitude by chronometer.)
23	27 02	27 25	47 16	47 04	69	71	E.	E.	S.E. to S. by W.	Moderate breezes.
24	26 31	26 52	46 04	45 38	71	72	S.W.	S.W. to S. E.	SSW,NW,SbyW	Light and variable.
25	24 56	25 26	43 49	43 38	71	72	S.S.W.	S.W.	S.W. by S.	Fresh and squally.
26	24 02	24 21	41 47	41 28	72	73	S.W. to S.S.W.	S.S.W.	SWbyWtoSSW.	" "
27	23 38	23 51	40 35	39 41	74	72	S.S.W.toS.byW.	SbyWtoSW.byS.	S.W.by W. to S.	Moderate breezes. (Stands W.S.W. 3 hours, 4 miles, wind S.)
28	22 46	23 21	40 08	39 58	73	74	S. by E.	S.	S.W. & S.	Light breezes.
Mar. 1	22 37	22 53	39 45	38 58	76	72	S.	S.	S.	Pleasant. (Stood W.S.W. 8 hours, 40 miles, wind S.—and W. by S. ½ S. 4 hours, 20 miles, wind S.)
2	22 19	22 31	40 13	—	74	73	S.	S.	S.	Pleasant. (W.S.W. 12 hours, 49 miles—W. S. W. 4 hours, 13 miles, 62 miles.)
3	21 33	21 47	41 11	40 24	76	75	S.	S.E. by S.	S.E. by S. & S.	Pleasant. (Stands to southward and westward all day, 83 miles by log.)
4	20 07	20 20	41 30	40 26	78	76	S.E.	S.E.	S.E. by E.	Pleasant.
5	18 45	18 52	41 30	40 31	76	75	S.E. by E.	E.S.E.	E. to S.E.	"
6	18 27	18 50	40 50	40 04	76	74	S.	S.	S. & S. by E.	Moderate.(StandsW.SW.8h.,32miles,windS.)
7	17 49	17 39	42 16	42 15	78	—	S. by E.	S. by E.	S. by W. & S.	Moderate. (Stands to southward and westward 23 hours, 103 miles.)

Mar. 8	16°55′ N.	17°02′ N.	43°12′W.	43°22′W.	77°	76°	S.	S.byW.	Calm.	Light. (Stands to southward and westward 17 h., 63 miles.) "This and the preceding day is another great error—my not standing to the eastward on the starboard tack."
9	16 35	16 40	43 40	43 32	85	78	Calm.	S.	S.S.E.	Light airs. (Stands to southward and westward all day—40 miles by log.)
10	15 33	15 42	44 21	44 00	82	78	S.S.E.	S.S.E., S.E. ½ E.	"	Light breezes. (Stands to southward & westward all day—81 miles by the log.)
11	13 51	13 46	44 51	44 41	83	78	S.E.	S.E.	S.E., S.E. by E.	Pleasant.
12	11 56	11 51	44 44	44 16	81	79	S.E. by E.	E.S.E.	E. by S.	Moderate breezes.
13	10 05	9 50	43 29	43 20	81	81	E.	E., E.N.E.	E.N.E. by E.	Mod. breezes and squally—took N.E. trades.
14	7 02	7 35	41 54	41 19	82	81	E.N.E.	E.N.E.	E.N.E.,NE.byE.	Fresh breezes.
15	5 53	5 59	40 49	40 28	81	80	E. by N.	E. by N.	E., E. by S.	Moderate breezes.
16	4 29	4 09	39 36	39 42	81	80	N.E. by E.	E. by N., E.	E.N.E. to E.S.E.	Moderate breezes and squally.
17	2 39	—	38 27	—	79	80	E.N.E.	E.N.E. to E.S.E.	E.S.E. to E.byN.	Fresh breezes and squally.
18	1 07	—	36 50	—	81	81	N.E.byE.E.byN.	E.byN.,N.EbyE.	E.N.E.	Good breezes.
19	0 35 S.	1 02 S.	35 20	36 26	86	84	E. by N.	E.N.E.	E. by N.	Good breezes. "At ½ past 7 P. M. the ship is on the equator, in longitude 36° 42′ W. This is 10° W. of the usual route of vessels, crossing the equator, bound S.—and is 7° W. of my most western long. in any previous voyage. This month proved unusually favorable for pursuing Lieut. Maury's route to the equator." "In no instance have I carried the N.E. winds to the equator." "An inspection of my several voyages shows this to be shorter than the average I have made; shortest 31½ days, longest 54 days—but chiefly forty days from N. York."
20	2 46	2 08	35 19	36 32	84	82	S.E.byE.,E.S.E.	E.S.E.	S.E. by E.	Moderate breezes, with showers.
21	3 42	3 24	35 17	37 10	88	84	S.E. by E.	E. by S.	"	Light winds. Current W.N.W.—about 45 miles by log.
22	3 44	3 10	35 02	37 27	85	84	S.S.E. to E.	E.	E.S.E.	Light winds. Stood N.N.E. 8h., 32 miles, wind E.N.E.½N. 4 h. 16 miles,wind E.S.E.
23	3 09	2 45	34 22	37 26	85	84	E. S. E.	E.S.E., E. by S.	E. by S., E.S.E.	Light winds. Strong westerly current.
24	1 44	2 12	33 57	37 55	84	83	E.byS. to E.byN.	E. by N.	" "	Light winds. Strong westerly current. W. 60 miles—N. 23 miles.
25	2 39	2 38	33 15	37 46	84	84	E.S.E. to E.byE.	E.byN. to E.byS.	E. by S.	Light winds. Current W. 27 miles. "During the night my suspicions are awakened that my compasses are greatly erring. In the morning I make comparisons with the azimuth compass—my suspicions are true. The compasses greatly err. An examination takes place, and there is discovered 3 pointed bolts of ⅝ inch size, and about 6 inches long—one was on the front part of compass box, and two directly under the box."

ABSTRACT LOG OF THE SHIP CLARISSA PERKINS.—CONTINUED.

Date.	D. R. Latitude at noon.	Observed Latitude at noon.	Longitude at noon. D. R.	Longitude at noon. Observed.	Ther. 9 A.M. Air.	Ther. 9 A.M. Water	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1849					°	°				
Mar. 26	4°09′ S.	—	32°31′W.	—	83	83	E.S.E.	E.N.E.	E. by S. to E.S.E.	Light breezes.
27	4 10	4°06′	31 34	36°48′	80	83	N.E. by E.	N.N.E., N.W., N.W. by W.	S. baffling, N.W.	Light breezes. Half past 1 P. M. saw land S. W. (Stood N. N. W. 2 hours—5 miles. Wind S.)
28	4 01	3 54	30 12	35 39	80	83	N.W.	N.N.W.	E.byS.toSEbyE.	First and middle parts fresh breezes—latter part light.
29	5 06	4 44	29 25	35 05	79	83	E.S.EtoS.E.byS.	ESE.toS.E.byE.	S. by E. to S.	Good breezes.
30	4 57	4 32	28 59	34 57	83	84	SEbyE.toE.S.E.	E.S.E., E.	E by S., E.S.E.	Light. Would wish to go in shore, and avail himself of the land and sea breezes, but dare not do so, for fear of some of the passengers.
31	5 15	5 16	28 42	34 57	79	83	S.E. by E. to E.	NEbyE.toE.byS.	E. by S., S.E. by E., E.	Light and squally. "Too far off shore to profit by land and sea breezes." Land in sight.
April 1	4 56	4 33	28 01	35 09	80	83	E.	E.S.E. to E. byS.	E. by S. to S.E.	Light breezes. Cur. N. 19 miles, W. 53 miles.
2	4 49	4 34	27 29	34 48	83	83	S.E.	ESE.toS.E.byE.	SEbyE.toE.S.E.	" "
3	4 22	4 05	26 43	34 08	84	83	ES.E.toS.E.byS.	S.E. by S.	S.E. to E.	" "
4	5 06	4 29	25 15	34 41	85	83	S.E. by S.	S.E. by S.	S.E. by S., S.E.	" "
5	5 36	5 02	25 17	35 05	—	—	S.E. to S.S.E.	SEbyStoSEbyE.	S.E., S.S.E.	Mod. breezes. Land about St. Roque in sight.
6	5 17	4 33	24 04	34 25	83	83	S.S.E.	S.S.E.	S.E. by S.	Moderate breezes. Would like to coast along in shore, but dare not.
7	5 10	—	24 00	—	81	82	S.S.E. variable.	S.E. variable.	S. E. variable.	Light breezes. Strong current to N'd. and W'd. yesterday and to-day.
8	5 36	4 56	23 40	35 12	79	84½	S.S.W.toN.N.E.	Calm.	S.E.byS.variable.	Light breezes. 2 days current. N. 40 miles, W. 75 miles.
9	5 25	5 06	23 17	35 09	84	83	S.E., S.E. by S.	S.S.E.toS.E byS.	S.S.E., S.E.by S.	Light breezes. Estimates current N.W.½W. 31 miles per day for 21 days. Stood off shore, although the ship was running along parallel with the land. Cape St. Roque in sight.
10	5 19	5 00	34 33	35 07	83	83	S.E.	S.E. by E.	S.E.	Light winds. Strong current—has advanced only when in shore.
11	5 24	4 54	33 44	34 41	84	83	S.S.E.	S.S.E.	S.E. by S., S.E.	Light winds. Strong current.
12	5 24	5 00	33 16	34 58	83	83	SEbySto SEbyE.	S.E. by E.	S.E. by S. to S.E.	Light winds. Land in sight. Strong current W. 44 miles.
13	5 56	5 36	32 46	34 54	84	83	S.E. by S.	S.E.	S.E.	Light winds. "The further off shore, stronger current." S.W. by W. 50 miles.
14	6 02	5 17	32 30	35 05	83	84	E.S.E.	S.E.byE.to ESE.	S.E.	Light winds. "A ship passes inshore of us."
15	6 04	5 53	32 21	35 07	83	84	SE.byEto E.S.E.	E.S.E.	E.S.E.	Light winds. Stands in shore and finds not so much current.
16	6 32	6 16	31 56	35 05	84	84	E.S.E. to S.E.	S.E. to E.S.E.	E.S.E., E.	Light winds. Land distant 7 miles at noon.
Apr. 17	6°46′	6°35′	31°40′	34°59′	87°	84°	E.S.E.	E.S.E.	E.S.E.	Light winds.
18	7 17	6 52	31 42	34 56	89	84	E.S.E.	E., to E.S.E.	E.S.E.	Light winds. In 9 days set 201 miles N. and 202 miles W.
19	9 00	8 32	33 51	34 12	84	84	E. by S., E.N.E.	N.E. by N.	N.E. by N.	Moderate breezes and pleasant. "As I am now clear of Brazils, I make this solemn protest against certain persons whose mutinous threats have so far intimidated me as to cause my often tacking and otherwise manœuvering my vessel that this passage has been prolonged." "In fact, where I have gained along this coast, it has been through *stealth;* for, to gratify some wishes and desires, I have at close of day gone about, heading off shore, and actually kept standing on for 20 hours *ere* I found occasion to tack. This I mention to show how harrassed has been my situation, and the constant fear I have been under, through threats and declarations of open piracy and mutiny here on board."
20	11°11′ S.	—	33°04′W.	—	85	83	N.E., N.N.E.	N.N.E.	N.N.E.	Good breezes and pleasant.
21	12 38	12°39′	33 01	32°47′	85	84	N.E. to N.W.	W., WSW.,N.E.	N.E., N.	Moderate and pleasant.
22	13 30	—	33 04	—	78	83	N.NE.toN.N.W.	Variable.	S.by E.to S.byW.	Light breezes and variable.
23	14 27	14 23	34 49	35 05	83	82	S.S.E.	S.S.E.	S.S.E.	Fresh and cloudy.
24	15 36	15 38	36 26	37 10	81	80	S. by E.	S. by E.	"	Fresh and squally.
25	16 51	16 49	37 50	38 27	79	81	"	"	S. by E.	Moderate breezes.
26	18 11	17 54	37 46	38 38	81	79	S.	S.E. by E.	S.E. by E.	Light and pleasant.
27	19 29	19 46	37 54	38 48	83	77	Baff. N.E. by E.	N.E.	N.N.E.	" "
28	21 36	21 18	39 16	39 04	80	79	N.E.	N. to E.N.E.	N.N.W., N.W.	Moderate and pleasant.
29	21 51	22 22	40 21	40 08	81	79	N.W. by W.	Westward.	N.W.	" "
30	—	22 48	—	—	82	78	N.W.	N.W. by N.	Baffling.	Moderate and pleasant. Standing in towards Cape Frio.
May 1	—	—	—	—	77	78	"	Baffling.	Baffling.	Moderate and pleasant. Anchored in harbor of Rio de Janeiro.

As to this candid statement and fair exhibit of the Log, no comments are required to exempt Captain Goodrich from all blame in the matter, nor is any remark necessary to show that the length of the passage is in any way ascribable to the new route. Routes had nothing to do with the conduct of passengers, who interfered with the navigation of the ship in the most unjustifiable manner.

I may here remark, before dismissing the subject of complaints against the Wind and Current Charts, that I have heard that complaints have been made on the part of other vessels also. But in every instance, except the two quoted, the masters of the complaining vessels have taken care to conceal their journals. They have not, as they were under the pledge of word and honor bound to do, furnished me with an Abstract Log of their voyage. With the evidence before one, that that affords, the impartial navigator would be at no loss to decide whether the fault of the passage be owing to the new route or bad navigation.

Those navigators were supplied with the charts on condition that they would keep and furnish me regularly with Abstracts of their Logs. They signed a receipt for the charts containing such a condition. And whether they make long or short passages, I am equally entitled to the fulfilment of their engagement. The Abstract of a long voyage is more valuable than that of a short one, because the former has more observations, and may lead to the discovery of faults in the charts.

To the honor of American ship-masters be it said, that those who fail to keep Abstracts according to promise are very few. The great majority of them are co-operating with me in this great work, with a zeal, ability, and effect, the most creditable. And to such I cannot too often, or too sincerely express my grateful acknowledgments. I am proud of their assistance. Their aid encourages me.

Returning to the study of the monthly passages by the two routes, and to the examination of the charts, it will be perceived that the most pertinent question for the navigator to make with regard to the route hence to the southern hemisphere, is not "where shall I cross the equator?" but "where shall I lose the N. E., and where get the S. E. trades?"

Hence, it will be observed that these Sailing Directions sometimes recommend vessels to go as far East as longitude 25° W.; but that this is North of the equator, and in those regions and months where the N. E. trades usually fail.

I have given, with all the mistakes, the passages of 89 vessels that have attempted the new route, and of 73 also taken at random, that have gone by the old route. And the result shows, that the routes which I have proposed, and which were followed by these 89 vessels—many of them doubtingly—has reduced the average sailing distance from the ports of the United States to the equator, as much as two weeks for some months; 10 days as the average for the winter and spring, and one week as the average the year round.

The average passage to the Line the year round is, by the old route, 41 days, by the new, 34.* Thus exhibiting a saving of about 17 per cent. of the usual time under canvass hence to the equator; which saving

*This was written and published a year ago. Since that time navigators have learned to follow the new route better. Twenty days is now not an uncommon passage from New York to the Line, and some of the new ships talk of making it in 16.

is the first fruit of the Wind and Current Charts, and of that system of investigation, with regard to the winds and currents of the ocean, that the patriotism, intelligence, and public spirit of American ship-owners and masters have enabled me to pursue with such signal advantage to the commerce of the country.

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*Routes to and from Europe.**

The information contained in this notice relates to the best routes, under canvass, between New York and Europe, from January to September inclusive.

The best route, each way, as it regards the *winds*, independent of currents, is indicated for each one of these months.

Upwards of thirty thousand observations on the winds during these months, and in this part of the ocean alone, have been collated, compared and discussed for these routes.

The routes now indicated are the results of this mass of materials, and these routes are to be looked upon as the mean or average track of all the vessels engaged in making the voyages which have afforded these observations, supposing that each vessel under all circumstances and on every occasion, had made the most judicious courses.

My information is yet quite meager in many portions of this part of the ocean, and the present routes should be regarded, not as fixed and final determinations; they are rather approximations.

Though they be approximations to those routes which further investigation, based on more ample materials, may establish as the best routes, their importance will no doubt be readily appreciated, when it is considered that the average per centum of calms, head and fair winds, is stated for each district of 5° square of ocean through which the vessel is recommended to pass; and that they are stated in the tables and exhibited on the charts in such a manner, that the navigator who pursues these routes and consults the authorities before him, will be freed from all doubt and perplexity as to which tack to take when the wind comes out *dead* ahead.

Upon a right decision in such cases often depends the success of the voyage, as to time.

I have now before me the Log-books of two vessels, which afford a case in point; they were bound to Europe—were together and had accomplished more than half the voyage; the wind came out ahead; one stood off to the northward on the starboard tack, the other to the southward on the opposite tack; one was right and the other wrong, for in consequence, one got into port 10 days before the other.

In such cases, those who pursue these routes with the Pilot Charts on board, would be left in no doubt as to the tack having the greatest number of chances in its favor.

Permit me to call your attention to a very remarkable part of the ocean through which these tracks pass. It is about 45° N. and 50° W. The water here is permanently cold, so cold that the water thermometer is sometimes found within the distance of a few miles to fall 40° of Fahrenheit, and I notice in many Log-books the remark "water, colored."

*Letter to Sec. Navy, Jan. 1, 1850.

The spot is also remarkable for its fogs and its disturbed atmospherical conditions. If a vessel could be sent to examine into it, important service might be rendered to navigation, by showing how, when the heavenly bodies are obscured, the mariner may determine the position of his ship by dipping his thermometer into the water; or the examination might lead to other results not less important. It is probably the centre of great atmospherical disturbances.

There is said to be somewhere along these routes, a rock just awash and not known to any chart. The doubtful existence of such a danger is always perplexing and harassing to navigators: not knowing its exact position they have to turn far aside out of the way, to be sure of avoiding it. The rock is small—only a few feet across—with bold water up to it. And because it is said to be in a part of the ocean that is so much frequented as is this, it is a matter of great importance to the mariner that all doubts as to its existence and locality should be removed. I have the reports of navigators who have seen it, and who have passed so close to it that they might have thrown a biscuit upon it. But its position is vaguely described.

Since writing the above I have received the following "Notice to Mariners."

"On the 2d Dec., the Ship 'Marmion,' Capt. Freeman, from Liverpool, when in Long. 69° 29′ W., "Lat. 41° 05′ to 41° 01′, got in between two tide rips, which broke. Capt. F. had been sounding 21 fathoms, "and on steering S. by E. to S. by W. found as little as seven fathoms, which of course would be dangerous "in blowing weather. * * *

G. W. BLUNT."

And in addition the following has been published touching the same:

NATIONAL OBSERVATORY, *February* 10*th*, 1851.

SIR:—Capt. R. F. Hartshorn of the ship "E. Z.," reports in his "Abstract Log" kept for this office, the discovery of a shoal in a much frequented part of the ocean, viz: near Nantucket shoals and directly in the route hence to Europe.

Extract from his Log from Liverpool to New York, last July—

"N. B.—During the two days, the 20th and 21st July, I was beating between Lat. 41° 10′ to 41°, and Long. 69° to 69° 40′; the fog very thick; several times I shoaled the water suddenly from 20 fathoms to 8 and 7—steering S. S. W. to S. by W. I am certain there must be a very shoal spot in the neighborhood of 69° 30′, or 69° 35′, and Lat. 41° to 41° 08′. I had the lead constantly going during the 56 hours, and the soundings differed very materially from Blunt's Chart soundings.

"I have sounded a good deal about Nantucket shoals during the last 8 years, and find the depths of water in the same places have changed more than I could have possibly believed; but it is a positive fact." The place of this shoal is 6 or 8 miles to the southward and eastward of Davis' Bank, discovered by the Coast Survey in 1846.

It is possible that this may be the shoal reported by Captain Hartshorn; but doubt as to the existence of dangers in such a frequented part of the ocean, cannot be harmlessly tolerated. I, therefore, would recommend a careful examination of the locality.

Respectfully, &c.

M. F. MAURY.

HON. WM. A. GRAHAM,

Secretary of the Navy.

The best average routes to and fro, between New York, Cape Clear, and the English Channel.

These routes are calculated from the Pilot Chart also; and they represent each for its month, the best track, *on the average*, which a vessel can make.

The navigator who intends to follow any one of these routes should lay it down on his chart from the table; and when he gets thrown off of it by the winds and currents, as he often will, he should then, instead of turning out of his way to get back to it, recollect that if a special route were now calculated for him from his position, it probably would not touch the projected route at all. He, therefore, is in a new position, and must consult his pilot chart as to future courses and route. In recommending these routes, and in speaking of them, I wish navigators to understand and to bear in mind *always*, that I am speaking from the information before me, which is sometimes imperfect and often deficient. When full and complete, it may modify present conclusions; present conclusions, therefore, must be regarded only as approximations.

If every vessel, whose log between this and Europe has afforded materials for the Pilot Chart, had always taken the most judicious course; and when she was headed off, if she had in every instance taken that tack which was really the best, and then if a line had been drawn to represent on the chart the average or mean track of all those vessels for January, February, March or April, and the other months, then that line would be represented by the route as given in the tables for that month.

In other words, the vessels that shall pursue the routes here given, will pursue exactly that course which the experience of all has shown to be the best on *the average*.

By consulting the Pilot Chart, or the column "Total No. of Observations," in the table, it will be observed that for the months for which the routes are given for European traders, I have not observations enough to the North of 45° N., and West of 45° W., to enable me to speak of the advantages or disadvantages of making that part of the ocean a greater thoroughfare than it is.

Take the route *from* New York in March for illustration: It will be seen by the table that the course recommended from longitude 55° to 50°, is East, and that the winds are from E. on *the average* 1.9 per cent. of the time, and that a vessel in steering E. there, would be headed off from her course by slant winds from the northward 2.8 times, and by slant winds from the southward 15.9 times in the hundred—and that these proportions are derived from the records of 108 vessels between these meridians in that month, or which is the same by 108 observations there, during the month of March of different years.

The South therefore is the windward side then and there: therefore these facts thus presented will leave the navigator, when he comes to be headed off in that part of his route, in no doubt as to which tack to go upon: with the wind directly ahead or East, he should stand to the southward or to windward, because the probabilities of the wind's coming out from that quarter are greater than from the northward.

Again, from the meridian of 35° to 30°, the best average course is E. N. E.—1.3 per cent. of the winds are *dead* ahead, and 19 are slant from the northward against 4.3 from the other side. Here then it is shown from the records of 80 vessels, that the northward is the windward side.

I have the records of two vessels which were together in this part of the ocean, on their way to Europe; they had kept together so far on their way; they sailed alike; when they arrived here, the wind came out ahead —one went off on the larboard and the other on the starboard tack; the latter arrived in port ten days before the other. With the Pilot Chart on board, it would have been impossible for the other vessel so to have mistaken the chances in favor of her proper course.

I have not calculated the track beyond 10° W. off Cape Clear for the Liverpool track; nor beyond 5° W. for the English Channel, because beyond these meridians, the best course to steer is governed by the land.

ROUTES BETWEEN NEW YORK AND EUROPE.

Best average routes between New York and Long. 10° *W., for vessels bound to and from Liverpool; also between New York and Long* 5° *W., for vessels bound in or out of the English Channel.*

NEW YORK TO EUROPE—JANUARY.

Latitude.	Long'de.	Course.	DISTANCE. True.	DISTANCE. Per Ct.	DISTANCE. Average.	WINDS; PER CENT. Head.	Slants from N'd.	Slants from S'd.	Fair.	Calms.	Total. No. observ'ns.	
40°28′	74°00′	to										
40 28	70 00	E.	182	6.2	193	6.2	6.0	5.0	82.8	2.1	97	
42 02	65 00	E. N. E.	245	10.4	271	2.8	5.6	*w* 13.3	78.3	3.6	143	
43 33	60 00	E. N. E.	238	20.8	287	8.0	12.8	12.8	66.4	3.2	64	
43 33	55 00*d*	E.	217	4.2	226	0.0	*w* 11.0	4.4	84.6	4.4	94	
45 03	50 00	E. N. E.	233	14.4	266	4.8	*w* 13.2	8.4	73.6	8.5	89	
45 03	45 00	E.	212	11.4	236	0.0	14.3	14.3	71.4	0.0	7	
45 28	40 00*d*	E.	212	6.8	226	0.0	3.1	*w* 18.6	78.3	0.0	32	
45 27	35 00	E.	212	5.1	223	1.5	3.0	4.5	91.0	9.2	71	
46 30	30 00	E. N. E.	227	8.5	246	2.2	9.9	9.9	78.0	2.1	94	
47 55	25 00*d*	E. N. E.	221	5.6	233	0.0	4.8	*w* 13.2	82.0	7.0	92	
47 55	20 00	E.	201	8.1	217	1.5	9.0	*w* 12.0	77.5	3.1	67	
49 17	15 00	E. N. E.	214	2.2	219	0.0	1.4	*w* 8.4	90.2	2.8	74	
50 00	12 20	E. N. E.	113	6.3	120	2.1	4.2	4.2	89.5	0.0	43	To
50 38	10 00	E. N. E.	98	15.1	112	5.8	*w* 13.6	2.9	77.7	1.9	105	Liverpool.
			2825		3075							
49 17	10 00	E.	196	8.0	212	4.2	*w* 4.2	0.0	91.6	0.0	43	To
49 36	5 00	E.½	196	24.9	245	8.3	0.0	*w* 41.5	50.2	0.0	12	Channel.
			3006		3300							

NEW YORK TO EUROPE—FEBRUARY.

Latitude.	Longitude.	Courses.	DISTANCES. True.	Per Cent.	Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	S'd.	Fair.	Calms.	Total No. observ'ns.	
From 40°27'	74°00' to											
40 45	70 00	*E. ½ N.	182	7.7	196	1.0	8.7	*w* 10.5	79.8	1.9	106	
41 42	65 00	E. by N. ½ N.	233	8.2	252	3.4	*w* 8.5	3.4	84.7	6.6	62	
43 13	60 00	E. N. E.	238	5.7	251	0.0	*w* 12.0	8.4	79.6	0.0	84	
44 42	55 00	E. N. E.	234	10.8	259	2.2	11.0	11.0	75.8	7.8	96	
44 42	50 00 *d*	E.	213	9.0	232	3.3	*w* 12.1	3.3	81.3	2.3	88	
44 42	45 00	E.	213	7.4	228	0.0	*w* 13.0	8.0	79.0	2.9	105	
45 00	40 00	E. ½ N.	212	5.9	229	2.8	1.4	*w* 2.8	93.0	4.4	70	
46 26	35 00	E. N. E.	225	6.1	235	0.0	3.2	*w* 19.2	77.6	3.1	65	
47 50	30 00	E. N. E.	221	7.8	239	1.0	7.0	*w* 13.0	79.0	4.9	106	
49 13	25 00	E. N. E.	217	3.6	225	0.9	2.7	*w* 4.5	91.9	4.3	111	
49 13	20 00 *d*	E.	197	10.3	216	3.0	8.0	8.0	81.0	4.0	103	
50 00	15 00	E. by N. ¼ N.	200	8.5	217	4.2	4.2	*w* 5.6	86.0	1.4	69	
50 50	10 00	E. by N. ¼ N.	196	11.2	217	3.6	5.4	*w* 16.2	74.8	3.5	118	To Liverpool.
			2,781		2,996							
49 30	10 00	E. ¾ S.	200	16.7	233	5.7	*w* 22.8	*w* 7.6	63.9	1.9	52	To Channel.
49 30	5 00	E.	195	9.9	214	0.0	16.6	16.6	66.8	0.0	6	
			2,980		3,226							

Average sailing distance to 10° W. by this route to Liverpool 2996 miles, for 215 of which the winds, on the average, are *dead* ahead.

Ditto—to 5° ditto English Channel, for 246 of which the winds on the average, are *dead* ahead.

*NOTE.—*Nantucket shoals are in the way of an E. N. E. course, which would be the best.*

NEW YORK TO EUROPE—MARCH.

Latitude.	Longitude.	Courses.	DISTANCES. True.	Per Cent.	Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	S'd.	Fair.	Calms.	Total No. observ'ns.	
40°27'	74°00 to											
40 27	70 00	E.	182	12.4	205	6.2	2.8	*w* 6.9	84.1	4.1	151	
40 00	65 00	E. N. E.	245	7.2	263	7.2	7.1	*w* 15.8	69.9	1.4	206	
42 45	62 30	E. N. E.	119	13.1	134	2.5	13.2	*w* 15.0	69.3	} 4.1	126	
42 00	60 00 *d*	E. S. E.	119	13.7	135	4.2	13.3	13.0	69.5			
43 31	55 00	E. N. E.	238	13.2	269	9.6	7.1	*w* 15.1	68.2	5.3	118	
43 31	50 00	E.	217	7.9	234	1.9	2.8	*w* 15.9	79.4	0.9	108	
43 31	45 00	E.	217	9.4	238	1.7	*w* 10.3	8.5	79.5	2.5	121	
43 31	40 00	E.	217	3.7	225	1.6	2.1	3.2	93.1	5.0	200	
43 31	35 00	E.	217	7.6	234	0.0	2.9	7.6	89.5	4.8	109	
45 00	30 00	E. N. E.	233	4.3	243	1.3	*w* 19.0	4.3	75.4	3.9	80	
46 27	25 00 *d*	E. N. E.	226	8.4	245	4.4	4.4	1.1	90.1	1.1	90	
46 27	20 00	E.	206	3.2	212	0.0	*w* 7.0	2.2	90.8	2.2	90	
47 52	15 00	E. N. E.	221	6.7	236	0.0	*w* 12.0	6.3	81.7	0.0	74	
50 00	11 45	N. E.	181	5.4	191	0.0	4.0	*w* 12.0	84.0	0.0	67	
50 44	10 00	N. E. by E.	81	10.8	90	5.4	6.0	*w* 8.4	80.2	3.5	116	To Liverpool.
			2,919		3,154							
50 00	10 00	E.	67	11.8	75	3.0	9.0	9.0	79.0	0.0	67	To Channel.
49 40	5 00	E. ½ S.	194	10.0	213	17.0	25.0	8.3	49.7	0.0	12	
			3,099		3,352							

NEW YORK TO EUROPE—APRIL.

Latitude.	Longitude.	Courses.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.	
			True.	Per Cent.	Average.	Head.	SLANTS FROM		Fair.	Calms		
							N'd.	S'd.				
40°27′	74°00′ to											
40 27	70 00	E.	182	9.2	199	3.0	9.6	w 11.4	76.0	7.1	180	
42 00	65 00 d	E. N. E.	244	12.3	274	3.2	8.3	w 11.1	77.4	2.5	161	
42 00	60 00	E.	223	12.7	251	5.2	7.8	w 9.1	77.9	7.3	86	
43 31	55 00	E. N. E.	237	7.9	256	2.4	6.4	5.7	85.5	4.1	126	
45 00	50 00	E. N. E.	233	5.0	244	0.0	w 9.9	w 7.2	82.9	10.1	120	
46 21	45 00 d	E. N. E.	226	3.3	233	0.0	0.0	8.3	91.7	0.0	12	
46 27	40 00	E.	207	6.6	320	0.0	w 5.5	w 16.5	78.0	5.6	19	
46 27	35 00	E.	207	5.5	218	2.5	5.0	0.0	92.5	7.6	42	
46 27	30 00	E.	207	10.1	228	0.0	8.8	w 20.9	70.3	5.5	92	
47 52	25 00	E. N. E.	221	15.6	255	5.2	11.8	w 16.3	66.7	7.4	145	
49 14	20 00 d	E. N. E.	215	12.9	242	4.2	6.7	w 10.9	78.2	5.9	125	
49 14	15 00	E.	196	8.8	213	3.6	w 13.2	3.6	79.6	7.5	86	
49 14	10 00	E.	196	4.6	205	1.1	1.1	w 7.7	90.1	0.0	89	
49 30	5 00	E. ½ N.	196	20.9	237	5.5	11.0	w 33.0	50.5	5.6	12	To Channel.
			2990		3375							
50 00	13 06	E. N. E.	79	4.0	82	1.1	4.4	5.5	89.0	0.0	89	To Liverpool.
Cape Clear	10 00	E. N. E.	130	3.6	135	0.0	3.6	3.6	92.8	0.0	80	
			2807		3150							

NEW YORK TO EUROPE—MAY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns
			Direct.	Per Cent.	True.	Head.	North.	South.	Fair.	Calms.	
Sandy 40°27′	Hook to 74°00′										
40 00	70 00	E. ¾ S.	185	14.4	211	5.4	9.1	7.7	77.8	4.0	235
41 34	65 00	E. N. E.	246	10.2	271	2.7	11.0	6.8	79.5	7.3	281
43 06	60 00	E. N. E.	240	10.4	265	1.2	18.2	7.8	62.8	3.9	189
44 36	55 00	E. N. E.	234	8.8	254	1.2	4.3	11.0	83.5	3.0	170
44 36	50 00	E.	214	11.5	238	3.9	8.5	8.5	79.1	3.9	160
44 36	45 00	E.	214	7.3	229	2.2	7.6	6.0	84.2	4.8	195
44 36	40 00	E.	214	5.6	226	1.1	6.8	5.1	87.0	2.9	180
45 00	35 00	E. ½ N.	215	4.3	224	0.0	5.3	10.1	84.6	1.5	136
45 00	30 00	E.	212	4.8	222	0.7	7.8	4.3	87.2	4.8	132
45 00	25 00	E.	212	5.1	223	0.8	6.4	4.0	88.8	5.6	131
48 25	20 00	N. E.	290	9.6	318	3.0	9.0	9.0	79.0	3.0	137
48 25	15 00	E.	198	11.5	220	2.9	10.9	10.2	76.0	3.6	142
48 25	10 00	E.	198	16.8	231	4.8	21.6	10.4	63.2	3.2	129
To Channel.		E. N. E.	210	16.8	245	2.8	11.3	33.6	52.3	5.5	38
			3082		3377						
50 16	15 00	E. N. E.	212	16.4	246		8.7	8.7	75.3	3.6	142
To Liverpool.	10 00	E. N. E.	194	14.0	221		4.4	13.2	79.1	1.1	96
			2882		3148						

NEW YORK TO EUROPE—JUNE.

Latitude.	Longitude.	Course.	DISTANCE.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	North.	South.	Fair.	Calms.	
Sandy	Hook to										
40°08′	73°00′	E. S. E.	50	9.7	55	1.7	11.0	9.2	78.1	2.7	232
41 13	70 00	E. N. E.	170	8.7	185	1.8	4.8	10.9	82.5		
42 45	65 00	E. N. E.	241	8.5	261	1.8	3.5	3.9	90.8	3.5	235
42 45	60 00	E.	220	10.9	244	4.5	8.0	4.5	83.0	3.8	216
44 15	55 00	E. N. E.	236	8.5	256	3.3	3.8	7.1	85.8	1.1	184
45 43	50 00	E. N. E.	230	5.1	242	0.5	5.8	8.2	85.5	3.1	202
47 10	45 00	E. N. E.	224	5.9	237	2.3	0.0	6.8	90.0	0.0	44
48 33	40 00	E. N. E.	217	4.8	227	1.4	0.9	7.0	91.6	9.9	78
49 54	35 00	E. N. E.	212	10.7	234	3.1	5.0	11.9	80.0	3.1	165
51 13	30 00	E. N. E.	207	2.0	211	4.0	0.0	2.0	94.9	0.0	47
51 13	25 00	E.	188	0.8	189	0.0	9.0	2.0	98.0	6.1	52
51 13	20 00	E.	188	2.2	192	0.0	0.0	6.9	93.1	2.3	44
51 00	15 00	E. ½ S.	190	15.4	218	7.2	6.0	4.7	82.1	0.0	82
50 40	10 00	E. ½ S.	194	10.0	214	4.9	13.3	15.4	66.4	5.6	150
To Channel.			209	5.1	219	3.9	18.2	1.3	76.6	0.0	78
			2976		3184						

According to the Charts, this is the best track yet developed, and ought to give the shortest passages.

NEW YORK TO EUROPE—JULY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observations.	
			Direct.	Per Ct.	True.	Head.	North.	South.	Fair.	Calms		
40°27′	74°00′ to											
40 27	70 00	E.	182	12.0	204	3.6	7.2	5.1	84.1	4.2	322	
42 00	65 00	E. N. E.	246	5.9	260	3.0	7.0	9.1	80.9	8.7	414	Calms.
43 30	60 00	E. N. E.	237	4.2	247	0.9	3.3	4.8	91.0	8.4	350	Calms.
43 30	55 00	E.	218	10.3	240	4.4	5.6	8.0	82.0	5.6	263	
44 59	50 00	E. N. E.	233	5.9	244	0.4	8.8	7.6	83.2	5.4	236	
44 59	45 00 *d*	E.	212	12.6	238	4.4	8.1	8.1	79.4	8.1	173	
45 40	40 00	E. by N.	214	8.0	231	1.0	8.0	3.0	88.0	4.0	103	
47 06	35 00	E. N. E.	224	3.3	231	0.0	2.2	11.0	86.8	4.6	95	
47 06	30 00	E.	204	5.9	216	1.1	10.6	4.1	84.2	3.2	97	
47 06	25 00	E.	204	9.0	222	2.1	10.6	8.2	79.1	6.5	100	
48 29	20 00	E. N. E.	218	8.8	237	4.2	2.1	6.3	87.4	9.4	105	
49 50	15 00	E. N. E.	213	8.5	231	2.5	13.2	3.3	81.0	2.5	125	Liverpool.
50 30	10 00	To Li'rpool.	195	13.4	220	5.7	5.6	9.1	79.6	4.5	92	
			2800		3021							
48 29	15 00	E.	198	5.8	209	2.5	5.8	0.8	90.9	2.5	125	Channel.
48 29	10 00	E.	198	17.8	234	6.5	17.5	3.2	72.8	2.2	94	
49 00	To Channel	E. N. E.	213	12.8	240	0.0	28.0	8.0	64.0	0.0	24	

NEW YORK TO EUROPE—AUGUST.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.	
			Direct.	Per Ct.	True.	Head.	North.	South.	Fair.	Calms.		
40°27′	74°00′ to											
40 00	70 00	E. ¾ S.	186	13.0	209	3.0	9.5	18.0	69.5	6.0	194	
39 12 *d*	67 30	E. S. E.	125	8.7	135	3.1	2.9	10.7	83.3	3.6	229	
39 12	65 00	E.	116	6.6	123	1.6	17.0	7.1	74.3			
39 12	62 30	E.	116	8.0	125	3.0	6.5	5.5	85.0	4.3	193	
40 00	60 00	E. N. E.	125	7.6	134	2.0	9.5	5.0	83.5			
41 34	55 00	E. N. E.	246	7.1	263	7.1	7.0	8.4	77.5	6.8	157	
43 06	50 00	E. N. E.	241	11.1	268	3.0	6.5	11.0	79.5	6.5	213	
44 36	45 00	E. N. E.	235	14.3	268	4.8	12.0	12.6	70.6	3.7	166	
45 00	44 26	N. E.	34	9.4	37	2.8	4.5	11.2	81.5	5.0	147	
48 08	40 00	N. E.	260	7.6	279	0.0	11.4	12.6	76.0	7.9	123	
48 00	35 00	E.	201	8.2	217	2.4	7.2	7.2	83.2	9.4	129	
48 00	30 00	E.	201	8.0	217	3.0	4.0	5.0	88.0	2.9	106	
48 00	25 00	E.	201	3.0	207	0.0	5.0	6.0	89.0	1.1	92	
48 00	20 00	E.	201	8.4	218	3.0	9.0	1.5	86.5	7.8	69	
48 00	15 00	E.	201	3.0	207	0.0	8.0	2.0	90.0	4.2	100	
49 22	10 00	E. N. E.	214	3.7	221	0.8	11.2	0.0	88.0	3.2	130	Liverpool.
49 30	5 00	E.	195	5.0	205	0.0	5.1	8.4	86.0	0.0	36	Channel.
			3098		3333							

NEW YORK TO EUROPE—SEPTEMBER.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.	
			True.	Per Ct.	Average.	Head.	North.	South.	Fair.	Calms.		
40°27′	74°00′ to											
40 00	72 35	E. S. E.	71	5.4	75	0.0	9.9	5.4	84.7	4.5	115	
40 49	70 00	E. N. E.	128	15.3	147	0.9	30.6	9.0	59.5			
40 49	65 00	E.	227	10.4	250	4.2	9.0	3.6	83.2	5.3	178	
40 49	60 00	E.	227	15.5	261	6.3	13.3	4.9	75.5	5.3	159	
42 22	55 00	E. N. E.	243	5.6	256	0.0	13.8	5.4	80.2	3.7	167	
42 22	50 00	E.	222	16.3	257	6.0	14.4	9.6	70.0	6.2	172	
43 53	45 00	E. N. E.	237	15.0	272	4.9	11.2	14.0	69.9	5.8	147	
45 22	40 00	E. N. E.	232	9.8	255	4.2	8.4	4.2	83.2	2.2	138	
46 48	35 00	E. N. E.	225	8.9	245	2.6	9.1	7.8	80.5	1.3	78	Liverpool.
48 12	30 00	E. N. E.	220	4.7	229	1.2	6.3	5.1	87.4	6.2	85	
49 35	25 00	E. N. E.	213	4.2	222	0.0	9.0	5.0	86.0	8.0	109	
49 35	20 00	E.	192	12.2	216	3.6	11.7	15.3	69.4	0.9	111	
50 33	15 00	E. by N.	201	7.6	216	1.8	3.6	19.2	75.4	1.8	64	
50 33	10 00	E.	191	12.8	213	3.3	7.7	17.6	71.4	1.0	96	
			2830		3114							
45 22	35 00	E.	211	9.9	232	3.9	5.2	6.5	84.4	1.3	78	To Channel.
45 22	30 00	E.	211	5.3	222	1.3	2.5	8.8	87.4	6.2	85	
46 48	25 00	E. N. E.	225	4.2	234	0.0	9.0	5.0	86.0	8.0	109	
46 48	20 00	E.	205	12.2	230	3.6	11.7	9.0	75.7	0.9	111	
48 12	15 00	E. N. E.	220	11.4	245	3.6	2.4	9.6	84.4	1.2	81	
48 12	10 00	E.	200	14.8	230	3.6	21.6	5.4	69.4	1.8	57	
49 34	5 00	E. N. E.	213	15.0	245	0.0	10.0	40.0	50.0	0.0	20	

EUROPE TO NEW YORK—JANUARY.

Latitude.	Longitude.	Courses.	DISTANCES. True.	Per Ct.	Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	S'd.	Fair.	Calms	Total No. observ'ns.	
49°30'	5°00' to											
49 30	10 00	W.	192	0.0	192	0.0	0.0	0.0	100.0	0.0	12	From Long.
49 30	15 00 *d*	W.	192	30.2	250	12.6	16.8	16.8	53.8	0.0	43	5° W.
50 40	10 00											From Long.
49 30	15 00 *d*	W. by S. ¾ S.	202	36.1	275	16.5	15.5	17.5	50.5	1.9	105	10° W.
48 08	20 00	W. S. W.	213	37.1	293	14.0	*w* 30.3	23.8	31.4	2.8	74	
46 45	25 00	W. S. W.	219	24.0	272	9.0	*w* 22.5	7.5	61.0	3.1	67	
45 18	30 00	W. S. W.	226	29.3	292	10.8	18.0	*w* 24.0	47.2	7.0	92	
45 18	35 00	W.	211	22.7	259	6.6	15.5	*w* 20.9	57.0	2.1	91	
45 18	40 00	W.	211	28.8	270	9.0	12.0	*w* 28.5	50.5	9.2	71	
43 49	45 00	W. S. W.	232	18.9	276	5.5	*w* 18.7	16.5	59.3	6.8	78	
43 49	50 00 *d*	W.	215	19.6	256	4.4	*w* 20.9	13.2	61.5	0.0	91	
42 19	55 00	W. S. W.	237	17.0	277	3.6	13.2	*w* 19.2	64.0	8.5	89	
40 46	60 00	W. S. W.	244	22.1	298	5.5	*w* 25.3	15.7	53.5	4.4	94	
40 46	65 00	W.	225	16.3	261	6.4	*w* 14.8	12.8	66.0	3.2	64	
40 46	70 00 *d*	W.	225	26.8	285	9.1	*w* 21.0	16.7	53.2	3.6	143	
40 27	74 00 *d*	W. ½ S.	183	24.4	226	9.0	*w* 23.0	11.0	57.0	2.1	97	
			2843		3,540							

Average sailing distance from 5° W. by this route, 3,707 miles—and from 10° W. coming out of Liverpool, 3,540. The aggregate of adverse winds expressed in their equivalents of *winds dead ahead*, give 697 miles from Liverpool and 687 from the Channel, for the average number of miles to be overcome by a dead beat during the voyage. It will be observed that the most difficult parts of the route, are between Longitudes 15° and 20°; 25° and 30°; and 35° and 40° W.; and that calms are most prevalent between Longitudes 25° and 30°, 35° and 45°, and between 50° and 55° W.

EUROPE TO NEW YORK—FEBRUARY.

Latitude.	Longitude.	Course.	DISTANCES. True.	Per Ct.	Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	S'd.	Fair.	Calms.	Total No. observ'ns.
49°00'	*d* 10°00' to										
47 38	15 00	W. S. W.	216	9.9	237	1.9	*w* 20.9	0.0	77.2	1.9	52
47 38	20 00	W.	202	18.8	239	5.6	11.2	*w* 19.6	63.6	1.4	69
47 38	25 00	W.	202	16.6	235	4.0	15.0	*w* 21.0	60.	4.0	103
47 38	30 00	W.	202	24.8	242	6.3	17.2	*w* 25.4	51.1	4.3	111
46 12	35 00	W. S. W.	225	22.2	275	4.0	*w* 27.0	24.0	45.0	4.9	106
46 12	40 00	W.	208	29.4	269	11.2	12.8	*w* 19.2	56.8	3.1	65
46 12	45 00	W.	208	17.1	244	3.0	16.5	*w* 22.8	57.7	1.5	66
44 44	50 00 *d*	W. S. W.	230	5.5	242	0.0	9.1	*w* 27.3	63.6	9.0	12
44 44	55 00	W.	213	23.9	264	8.8	*w* 22.0	16.5	52.7	2.3	88
43 15	60 00	W. S. W.	234	16.7	275	4.4	*w* 25.3	7.7	62.6	7.8	96
41 44	65 00 *d*	W. S. W.	239	20.9	288	6.0	*w* 31.2	8.4	55.0	0.0	84
40 44	70 00	W. by S. ½ S.	233	24.1	290	8.5	*w* 27.2	11.9	52.4	6.6	62
40 29	74 00	W. ½ S.	184	11.3	204	0.0	*w* 21.1	13.5	65.4	1.9	106
			2796		3304						

Average sailing distance from 10° W. by this route, 3,304 miles; for 508 of which the winds average ahead. It will be observed that from Longitude 25° to 35°, a vessel is more liable to adverse than fair winds, and further, that in this month the winds prevail very much from the westward, though not so much as in some of the other months. From port, steer for Longitude 10° in Latitude 49°.

EUROPE TO NEW YORK—MARCH.

Latitude.	Longitude.	Courses.	DISTANCES. True.	Per Ct.	Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	S'd.	Fair.	Calms.	Total. No. observ'ns.	
49°30′	5°00′ to											
50 00	6 54	W. N. W.	79	6.6	85	0.0	*w* 16.6	8.3	75.1	0.0	12	From Channel.
50 49	10 00	W. N. W.	128	15.4	147	3.0	14.0	14.0	69.0	2.7	38	
50 00	13 06	W. S. W.	128	25.9	161	10.0	16.4	18.0	55.6	3.5	110	
49 30	15 00	W. S. W.	79	23.0	97	3.0	*w* 38.0	21.0	38.0	0.0	67	
49 30	20 00	W.	195	24.6	244	6.0	*w* 26.0	23.0	46.0	0.0	74	
49 30	25 00 *d*	W.	195	17.5	228	3.3	17.0	*w* 25.3	54.4	2.2	90	
46 05	30 00	W.	290	26.5	366	9.0	*w* 30.8	8.2	52.0	1.1	90	
46 05	35 00	S. W.	208	14.8	238	3.4	15.4	*w* 21.0	60.2	1.7	59	
46 05	40 00	W.	208	25.0	260	9.1	7.0	*w* 25.0	58.9	1.2	82	
46 05	45 00	W.	208	22.6	253	6.0	19.0	20.0	55.0	1.5	67	
46 05	50 00	W.	208	12.6	234	6.0	*w* 6.0	3.0	85.0	0.0	36	
45 00	53 40 *d*	W.	170	10.0	187	0.0	*w* 25.0	0.0	75.0	8.3	13	
44 37	55 00	W. S. W.	61	13.9	148	4.7	*w* 12.3	8.4	74.6	0.9	108	
43 08	60 00	W. S. W.	234	8.9	255	0.9	*w* 16.9	8.9	73.3	5.3	118	
41 36	65 00 *d*	W. S. W.	239	17.3	280	4.2	*w* 18.2	14.1	63.5	4.1	126	
40 02	70 00	W. S. W.	245	17.2	286	4.1	*w* 18.8	12.8	64.3	1.4	200	
39 37	71 00	W. S. W.	65	19.4	77	5.7	15.2	14.4	64.7	2.0	457	
40 27	74 00 *d*	W. by N. ¾ N.	146	20.7	176	5.5	*w* 20.0	15.6	58.9	3.0	304	
			3,086		3,722							

Average sailing distance from 5° W. by this route 3,722 miles. The average per centum of adverse winds is equivalent to winds *dead ahead* for 636 miles. It will be observed that the most difficult part of this route is between Longitude 10° and 30° W., where there are few calms, but a great prevalence of westerly winds.

EUROPE TO NEW YORK—APRIL.

Latitude.	Longitude.	Course.	DISTANCE. Direct.	Per Ct.	True.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observ'ns.	
49°30′	5°00′ to											
49 30	10 00	W.	195	9.0	213	5.5	*w* 11.0	5.5	78.0	5.6	19	From Channel.
49 30	15 00 *d*	W.	195	12.7	230	1.1	14.7	13.2	71.7	0.0	89	
50 40	10 00											
49 30	15 00	W. ¾ S.	205	21.0	248	7.5	17.1	18.2	57.2	4.0	85	
46 06	20 00	S. W.	289	9.8	317	9.8	*w* 18.0	13.2	49.0	7.5	86	
45 00	21 34	S. W.	93	11.9	104	2.5	*w* 14.3	11.7	71.5	5.9	125	
44 46	25 00	W. ½ S.	147	15.1	168	0.0	14.0	*w* 33.6	52.4	5.7	37	
45 00	30 00	W. ½ N.	147	16.2	171	6.0	7.5	*w* 13.0	73.5	4.5	70	
44 46	35 00	W. ½ S.	147	16.8	172	6.7	8.6	*w* 10.5	74.2	1.0	104	
44 46	40 00	W.	313	20.2	256	12.4	12.5	*w* 22.9	52.2	2.7	115	
44 46	45 00	W.	213	27.5	271	7.1	23.9	24.0	45.0	2.7	115	
44 46	50 00 *d*	W.	213	18.7	253	5.2	14.7	*w* 17.3	62.8	6.9	115	
43 16	55 00	W. S. W.	234	22.9	268	8.2	*w* 18.1	10.0	63.7	10.1	120	
41 43	60 00	W. S. W.	242	14.3	276	4.1	14.7	*w* 26.2	55.0	4.1	126	
41 43	65 00 *d*	W.	223	22.4	272	6.5	19.5	19.5	54.5	7.5	86	
40 27	70 00	W. ¾ S.	240	19.9	268	7.3	*w* 14.8	12.8	66.4	2.5	161	
40 27	74 00	W.	182	15.4	210	3.6	16.2	*w* 19.8	60.4	7.1	180	
			2973		3437							

Average sailing distance from 5° W., 3,437 *miles*; average per centum of adverse winds equivalent to winds *dead ahead* for 464 miles. Frequent calms in this month.

EUROPE TO NEW YORK—MAY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	North.	South.	Fair.	Calms.	
Channel	to										
50°50′	10°00′	W. N. W.	209	7.8	225	2.8	11.2	2.8	83.2	5.5	38
50 50	15 00	W.	191	17.6	226	5.5	18.7	11.5	64.3	1.1	96
50 50	20 00	W.	191	13.2	216	4.4	5.5	15.4	74.7	6.7	95
50 50	25 00	W.	191	8.2	206	0.0	12.0	9.6	78.4	0.0	42
50 50	30 00	W.	191	20.5	228	9.6	6.4	12.8	71.2	3.2	32
49 30	35 00 *d*	W. S. W.	209	14.1	237	2.9	5.9	17.7	73.5	0.0	17
46 08	40 00	S. W.	286	18.2	337	5.0	20.0	9.0	66.0	5.0	104
44 41	45 00	W. S. W.	228	15.2	261	0.0	24.0	28.0	48.0	3.9	53
44 41	50 00 *d*	W.	213	21.3	258	7.0	9.8	23.2	60.0	4.8	195
44 41	55 00	W.	213	22.3	260	7.2	13.7	22.2	56.9	3.9	160
43 11	60 00	W. S. W.	234	18.0	276	3.1	15.8	21.3	59.8	3.0	170
41 39	65 00	W. S. W.	239	21.7	282	7.2	17.1	11.0	64.7	3.9	189
40 05	70 00	W. S. W.	245	27.2	310	10.6	17.1	13.0	59.3	7.3	281
Port		W. ½ N.	184	10.0	202	2.5	10.8	14.5	72.2	4.0	235
			3024		3524	From	Channel				
			2815		3299	"	Liverpool				

Aim to make a straight course from *d* to *d*.

EUROPE TO NEW YORK—JUNE.

Latitude.	Longitude.	Course.	DISTANCE.			WINDS; PER CENT.					Total No. observations.
			Direct.	Per Ct.	True.	Head.	North.	South.	Fair.	Calms.	
Channel	to										
48°18′	10°00′	W. S. W.	213	29.4	276	9.1	16.9	35.1		0.0	78
44 52	15 00	S. W.	292	12.1	327	1.7	21.0	9.3		8.4	129
41 13	20 00	S. W.	310	2.4	316	0.0	3.0	6.0		0.0	33
39 39	25 00	W. S. W.	247	14.2	281	4.0	18.0	11.4		0.0	51
39 39	30 00	W.	230	23.2	283	7.1	14.3	22.0	57.0	4.4	189
39 39	35 00	W.	230	12.5	259	0.0	12.0	20.0	68.0	5.6	200
39 39	40 00	W.	230	26.0	290	11.0	15.8	17.3	55.9	3.4	215
39 39	45 00	W.	230	18.2	272	5.0	8.0	24.5	62.5	3.4	213
39 39	50 00	W.	230	13.2	263	2.8	6.0	22.8	78.4	2.5	251
39 39	55 00	W.	230	22.3	281	7.2	10.0	22.3	65.5	4.1	281
41 13	60 00	W. S. W.	247	20.4	297	7.6	3.1	22.0	67.3	0.9	225
41 13	65 00	W.	226	25.3	283	8.0	7.0	36.0	49.0	3.8	210
40 28	70 00	W. by S.	231	30.0	300	14.0	7.5	19.4	59.1	3.5	235
Port		W.	184	19.3	220	6.2	11.5	23.3	59.0	2.7	232
			3330		3948						

A tedious time of the year is the month of June to the homeward-bound.

EUROPE TO NEW YORK—JULY.

Latitude.	Longitude.	Course.	DISTANCE.			WINDS; PER CENT.					Total No. observations.
			Direct.	Per Cent.	True.	Head.	North.	South.	Fair.	Calms.	
49°40′	5°00′ to										
48 18	10 00	W. S. W.	213	15.6	245	4.2	25.0	0.0	70.8	0.0	24
48 18	15 00	W.	200	23.0	246	5.5	27.5	14.3	52.7	2.2	94
44 50	20 00	S. W.	295	14.2	336	1.6	27.8	8.2	62.4	2.5	125
44 50	25 00	W.	212	37.8	292	15.0	15.0	30.0	40.0	2.8	36
44 50	30 00	W.	212	18.5	251	5.0	14.9	16.2	63.9	16.2	93
44 50	35 00	W.	212	11.0	235	3.0	4.0	14.0	79.0	7.4	104
44 50	40 00	W.	212	24.9	264	10.5	5.6	18.2	65.7	6.3	151
44 50	45 00	W.	212	14.8	244	5.4	8.1	8.7	77.8	4.7	155
44 50	50 00	W.	212	24.2	263	8.7	10.0	20.0	61.3	8.1	173
43 20	55 00	W. S. W.	233	20.0	279	5.5	17.8	17.1	59.6	5.4	236
41 48	60 00	W. S. W.	240	26.9	305	8.4	21.2	19.2	51.2	5.6	263
40 14	65 00	W. S. W.	245	35.0	330	13.6	19.8	21.3	45.3	8.4	350
40 14	70 00	W.	230	27.8	294	10.7	10.8	26.0	52.5	8.7	314
Port	74 00	W.	183	29.9	237	11.2	7.7	35.9	45.2	4.2	322
			3111		3821	From	Channel.				
			2950		3623	From	Liverpool.				

EUROPE TO NEW YORK—AUGUST.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observations.
			True.	Per Cent.	Average.	Head.	SLANTS FROM N'd. or E'd.	SLANTS FROM S'd. or W'd.	Fair.	Calms.	
49°40′	5°00′ to										
48 20	10 00	W. S. W.	210	19.0	250	5.6	11.2	16.8	66.4	0.0	36
44 55	15 00	S. W.	291	22.4	255	7.2	26.4	5.6	60.8	3.2	130
43 25	20 00	W. S. W.	234	14.9	269	6.2	12.4	0.0	81.4	6.2	17
41 54	25 00	W. S. W.	238	15.6	275	1.7	28.9	11.9	58.5	0.0	60
41 54	30 00	W.	223	16.8	260	5.8	11.6	11.6	71.0	2.9	35
41 54	35 00	W.	223	21.4	270	6.0	15.0	22.0	57.0	1.9	106
41 54	40 00	W.	223	18.6	264	4.8	12.0	20.8	62.4	4.7	133
41 54	45 00	W.	223	18.1	263	5.6	9.8	19.6	65.0	5.0	147
41 54	50 00	W.	223	16.3	259	7.8	4.2	7.2	80.8	3.7	166
40 20	55 00	W. S. W.	244	17.9	268	3.5	19.5	17.0	60.0	6.5	213
38 44	60 00	W. S. W.	250	22.7	306	6.6	12.6	20.4	60.4	7.9	164
40 20	65 00	W. N. W.	250	10.8	277	2.0	7.0	17.5	73.5	4.3	193
40 20	70 00	W.	229	19.0	272	7.5	9.6	16.2	66.7	6.3	336
40 20	74 00	W.	183	16.3	208	7.0	8.0	12.5	72.5	6.0	194
			3244		3696						

EUROPE TO NEW YORK—SEPTEMBER.

Latitude.	Longitude.	Course.	DISTANCE.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Cent.	Average.	Head.	North.	South.	Fair.	Calms.	
49°30′	5°00′ to										
46 09	10 00	S. W.	284	3.0	292	0.0	10.0	0.0	90.0	0.0	20
45 00	11 38	S. W.	98	13.3	111	1.8	19.8	12.6	65.8	1.8	57
44 00	15 00	W. S. W.	155	3.6	160	0.0	0.0	18.0	82.0	0.0	17
44 00	20 00	W.	216	7.7	231	0.0	22.0	5.5	72.5	0.0	18
40 18	25 00 *d*	S. W.	314	6.2	333	0.0	7.7	7.7	84.6	7.7	14
40 18	30 00	W.	229	19.6	274	6.8	18.7	10.2	64.3	7.0	62
40 18	33 07	W.	143	6.8	152	1.3	8.8	7.5	83.4	8.7	87
39 42	35 00 *d*	W. S. W.	94	14.0	107	6.2	2.6	11.3	79.9		
39 42	40 00	W.	230	15.2	265	4.4	13.2	13.2	69.2	0.0	95
39 42	45 00	W.	330	14.2	263	3.2	8.0	20.8	68.0	7.7	139
39 42	50 00	W.	230	16.7	269	6.3	3.5	16.8	73.4	5.1	145
39 42	55 00	W.	230	13.9	262	5.6	6.3	10.5	77.6	3.6	144
40 39	58 00	W. N. W.	149	16.1	173	4.4	10.8	16.0	68.8	4.0	148
38 45	65 00 *d*	W. S. W.	349	14.0	398	3.5	10.5	16.1	69.9	3.4	154
40 20	70 00	W. N. W.	250	19.1	298	6.5	9.5	16.5	67.5	5.4	194
Port		W.	183	16.4	212	6.3	5.4	20.7	67.6	4.5	115
			3384		3800						

The routes to and fro, between Europe and the United States, *do not* require any written explanation. If the navigator will project them, and then consult these pages and the Pilot Chart, he will never be at a loss as to his best course *on the average*. In projecting these tracks, he will find them running sometimes inconveniently near the land or over shoals. Of course he will not infer that he is recommended actually to stand over such places. The route of the tables being intended merely as a guide, from which the land as well as the winds and currents will sometimes turn him aside. Navigators who pursue these routes, will confer a favor by making a note of the fact in their abstracts, accompanied with an expression of their opinion as to the advantages of them, mentioning also whether they have had longer or shorter passages than vessels sailing about the same time without the Wind and Current Charts on board.

At the moment of going to press, I have to acknowledge my obligations to Captain Oliver Eldridge, of the "Roscius," for such an act of kindness. Under date of May 21, 1850, he writes: "In reply to your inquiries as to my opinion in regard to the New Sailing Directions and Routes recommended by yourself, I would say that, as far as I have had opportunity of judging, I think they will be of great advantage, and in particular to that part of the commercial community who depend upon wind as a propelling power.

"On my last passage to Liverpool, I think it was lengthened some *two* or *three days* by not following more closely the directions recommended by you in your No. for January, 1850. As a ship that left New York with us, kept in company, or nearly so, to the longitude of 25°. The wind then came out ahead; we stood on the southern tack, and she on the northern, (as recommended by you.) The wind afterwards came N. N. E.; she brought up to Cape Clear, and we 200 miles south of it."

Explanation of the Route Tables.

Columns 1, 2 and 3 (see tables of routes, pp. 219 to 229, and 255 to 263,) explain themselves.

Column 4 gives the distance by middle latitude sailing to be run, when the winds are fair, on the course in column 3.

Column 5, shows the per centage by which the distance in column 4 is practically increased on the average, by adverse winds. The numbers in this column are obtained upon this principle: that, if a ship sail with the wind dead ahead, and within 6 points of it, she loses 62 miles in every hundred—that is, she has to sail 100 to make 38 miles good; when she sails within 4 points of her course, that is, when she has a *slant* wind that will allow her to lay within 4 points of her course, she loses 29 miles only in 100; and when she sails within 2 points of her course, that is, when she has a *slant* wind 4 points from the course she wishes to steer, she then loses only 7.6 miles in 100. In other words, a vessel sailing 5 knots an hour will get as far on her course in 5½ hours with a *slant* wind 4 points from her course, as she will, at the same rate, in 13 hours, with the wind *dead* ahead. According to the ratio here indicated, the 2 and 4 point *slant* winds, have been reduced to their equivalent as winds *dead* ahead, and this equivalent in distance is given in column 5.

Column 6, shows the distance in column 4 after the per cent. in column 5 has been added to it. It is the average distance to be sailed from point to point, not allowing for currents, and supposing the vessel to sail within 6 points of the wind.

Column 7, shows the average per centage of winds that are *dead* ahead.

Column 8, shows the average per centage of *slant* winds from the northward or eastward that will head a vessel off the course given in column 3.

Column 9, shows the average per cent. of *slants* from the southward or westward that will head a vessel off the course given in column 3.

Column 10, shows the average per centage of winds that are entirely fair for the given course.

Column 11, shows the average per centage of calms.

Column 12, shows the number of observations from which the quantities in the other columns, and the courses recommended, have been obtained.

When the winds are fair, and the vessel is near the route recommended, she should steer straight from *d* to *d*, instead of making a zigzag track as by the projection.

w, where it appears in columns 8 or 9, means that that side is the windward side. But it is not necessary so to designate the windward side. It is obvious from mere inspection.

e, in the column of calms means that this part of the route is through the region of calms that border the northeast trade winds, North and South, or that that part of the ocean is peculiarly liable to calms.—(See Trade Wind Chart.)

The courses given are *true*.

It will be perceived by the tables that the average European passage in February, ought to be nearly two days shorter than it is either in January or March.

According to the Pilot Charts, I make the average distance to be sailed by a New York Packet ship by the routes, from January to April, not estimating for the set of currents, to be, when bound—

TO LIVERPOOL.

In January	3075	miles to 10° W.,	for 250	of which a vessel will have winds dead ahead.					
February	3015	"	"	"	234	"	"	"	"
March	3150	"	"	"	231	"	"	"	"
April	3051	"	"	"	244	"	"	"	"

TO ENGLISH CHANNEL.

In January	3300	miles to 5° W.,	for 293	of which a vessel will have winds dead ahead.				
February	3245	"	"	261	"	"	"	"
March	3448	"	"	249	"	"	"	"
April	3275	"	"	265	"	"	"	"

According to the Log Books taken at random, both of Packet ships and transient traders, I find the average time between these meridians and New York to be as per statement subjoined:

When bound to Liverpool, average length of passage from New York to 10° W.			When bound from Liverpool, average length of passage from 10° west to New York.			When bound to English Channel, average length of passage from New York, to 5° W.			When bound from English Channel, average length of passage from 5° west to New York.		
Month.	Days passage	Number of passages.	Month.	Days passage.	Number of passages.	Month.	Days passage.	Number of passages.	Month.	Days passage.	Number of passages.
January	18	25	January	33	16	January	20	11	January	40	7
February	20	18	February	35	36	February	23	6	February	41	13
March	20	20	March	31	41	March	25	10	March	33	10
April	21	9	April	29	17	April	22	6	April	30	2

It is important that navigators should bear it in mind, that when the winds are fair, they are not expected to make the zigzag track of the tables, but to steer straight from *d* to *d*.

New York to New Orleans—Capt. William C. Berry to Lieut. Maury—New York, Feb. 1, 1851.

"Having had long experience in the trade between New York and New Orleans, I herewith furnish you with a few remarks on wind and currents. For the last six years I have commanded the ship Vicksburg, constantly trading between these two ports. In making the passage out after passing the Hole-in-the-Wall, I have frequently found a current from 1 to 3 miles per hour setting to the eastward through the northwest channel of Providence, particularly after the wind has prevailed from the westward a few days. This, no doubt, has been the cause of putting a number of vessels on shore among the Berry Islands. I have latterly made it a point to take the last bearings of the light on the Hole-in-the-Wall, and either haul up or keep off as I found the current; generally running on a West course until quite down with Little Stirup Keys, then steering W. by N. ½ N., by compass if in the night, until I was up with the Great Isaacs. The last three voyages having reached the vicinity of the Little Isaacs in the day time. I have hauled in on the Bank between the western Little

Isaacs and the East Brother Rock, and steered S. W. by W., by compass, which has brought me out in good passing distance from the Moselle shoal—during one of my summer passages out, after passing the above shoal I was compelled to anchor, and remained there for six days, the wind during all this time was light from the southward, and I could not help remarking the regularity of the current setting along the Bemini Islands, ebb and flow, about two miles per hour; this continues as far as Gun Key, when it is broken off by the Gulf which sets close into the Key. From this point up to Orange Key, when close in, little or no current is experienced except the ebb and flow, which is directly off the Bank. In crossing the Santaren Channel the current is governed greatly by the winds; with strong southerly winds the current sets about N. N. W., 2 miles per hour; on the other hand, with strong northerly winds, little or no current is felt. After leaving the Double-Headed-Shot Key, I have generally hauled over for the Florida Reef, and in the day time kept close in, when I have frequently found an eddy current setting to the westward from 1 to 1½ miles per hour. After passing the Tortugas I have invariably felt a southerly current until I had reached the Long. of 74° 30′, and even further than this at times, as will be seen by referring to my journals, particularly in November, 1848. Returning from New Orleans I have always made it a point to keep to the westward until I had reached the Long. 85°, Lat. 28°, before keeping off; my object for doing this is that the wind here generally prevails from the northward and eastward, and that the current generally sets to southward and eastward, which greatly facilitates the passage after rounding the Tortugas; with the wind from the eastward I have generally beat down on the Florida side, knowing that the strongest current prevails on that shore, unless too close in, from Carrysfort Reef to Matanilla. I have always endeavored to keep in the centre of the stream. During all my voyages I have made it a rule to steer from Matanilla to Lat. 29° N. by W., and then North to Lat. 31° before hauling up N. E. by N.; by so doing I have, with few exceptions, kept the strongest current. On some other occasions I have hauled up on a N. E. by N. course when in Lat. 30° Long. 79° 40′, and have soon found myself on the eastern edge of the Gulf. After rounding Cape Hatteras it is advisable to keep to the westward, especially in the winter season, on account of the prevailing westerly winds."

Sailing Directions for the Coatzacoalcos river—Capt. Foster, of the "Alabama," to Lieut. Maury.

"Sailing vessels bound for the Coatzacoalcos ought to make the land to the eastward. This precaution necessary on account of the prevailing trade winds which cause a strong westerly current; also in case of a norther, to have the advantage of sea-room. The entrance to the river may be known by the vigia or tower situated upon the western side; likewise from the sand cliffs extending from that point to the westward.

The bestmark for crossing the bar is to bring the tower* to bear S. ¾ W. by compass. Having passed the bar haul up to the East of South, and steer in midway between the two points that form the entrance to the river. The wind, after crossing the bar, often falls to calm; for this reason it is necessary to have an anchor ready to let go, as the current on the ebb, even in the dry season, sets out strong.

The extent of the bar, East and West, is about 220 fathoms, and the width, by actual measurement, 108

*This tower of great solidity, is destined to last for ages.

feet. The bottom composed of sand and clay is hard, on which account it is not liable to shift. It forms in hard northerly gales, a narrow barrier of breaks, and cannot be crossed without imminent risk. The depth at high water on full and change is about 13 feet, and falls as low as $10\frac{6}{12}$ feet. The general depth, however, is 12 feet, from which in sailing, deepens to 5 or 6 fathoms.

Except in heavy weather, there prevails a regular land and sea breeze. The latter sets in between the hours of 9 A. M. and noon.

April, 1851."

Letters of Lieutenants Foote and Porter—Coast of Africa.

United States Brig Perry,

St. Paul de Loanda, May 17th, 1851.

Sir:—In a letter addressed to the commander of any U. S. vessel who may come to the Southern Coast, I have enclosed a copy of notes drawn up by Lieutenant Porter, who has cruised on the southern coast of Africa, severally in the Marion, John Adams, and this vessel.

I transmit a copy of these notes, (which fully accord with my own observations and experience,) under the impression that they may be available in the Hydrographical Department.

I have the honor to be,

Very respectfully, your obedient servant,

ANDREW H. FOOTE,

Lieut. Commanding.

Commodore Lewis Warrington,

Chief of the Bureau Ordnance and Hydrography."

Passage from the Cape de Verds to the S. W. Coast of Africa, with remarks upon that section of the coast.

From Lieut. W. C. B. S. Porter to Andrew H. Foote, Lt. Com'ding U. S. Brig Perry—Loanda, *May 17th*, 1851.

"In the season of February, March, April and May, there is no difficulty in making the passage from Porto Praya to Ambriz in thirty days, provided the run from Porto Praya to Monrovia takes not more than eight days.

The direct route, and that which approaches the great circle, leads along the coast, touching the outer soundings of St. Ann's Shoals, thence to half Cape Mount, to allow for a current when steering for Monrovia. From there, follow the coast along with the land and sea breezes, assisted by the current, until you arrive at Cape Palmas; keep upon the starboard tack notwithstanding the wind may head you in shore, (the land breezes will carry you off,) and as the wind permits, haul up for 2° west longitude; cross the equator here if convenient, but I would not recommend going to the westward of it, you will encounter westerly currents from thirty to fifty miles a day. In the vicinity of Prince's Island the S. W. wind is always strong. In the latitude of about 1° 30′ N. there is a current. Should it not be practicable to weather the Island of St. Thomas, stand on, approach the coast, and you will meet with North winds to carry you directly down the coast. Our Salem vessels make the passage from the United States in 56 days, arriving at Ambriz in May. I have made three different cruises to this coast in the same season, in the Marion, John Adams, and Perry.

The impulsive desire to attain the object of our duty will as much in nautical matters as others, mislead our better judgment when there is a prospect, or any temptation to success, without experience to forewarn us. Thus, our vessels after arriving at Cape Palmas, have generally gone upon the port tack, because the wind carried them towards the coast or Gulf of Guinea, and seemed to favor them for the port tack the most; which, on the contrary, although slowly veering towards the S. E., was hauling more ahead, and leading them off into a current, which, under a heavy press, it is impossible to work against. The consequences were, they had to go upon the starboard tack, and retrace the ground gone over. On the starboard tack, as you proceed easterly, the action of the wind is the reverse, and it allows you to pursue the great-circle course.

It employed the Marion eighty odd days to Kabenda, a port 200 miles nearer than Ambriz, to which port (Ambriz) from Monrovia; in this vessel, (the Perry,) we went in 23—making 31 from Porto Praya. In the John Adams, 10 to Monrovia, and 46 to Ambriz, by the way of Prince's Island; about 10 of which was lost working to the south of Cape Palmas. In standing to the eastward the currents are with you, and "vice versa."

The practice along the coast in this vessel (the Perry) was, to keep near enough to the land to have the advantage of a land and sea breeze, and to drop a kedge whenever it fell calm, or, we were unable to stem the current. Upon this part of the coast near the Congo, the lead line does not always shew the direction of the current which affects the vessel. On the bottom there is a current in an opposite direction from the surface; therefore, before dropping the kedge, the better way is, to lower a boat and anchor her—which will show the drift of the vessel. Between Ambriz and the Congo, I have seen the under current so strong to the S. E., as to carry a 24 lb. lead off of the bottom, while the vessel was riding to a strong S. W. current—but the under current is the strongest.

In crossing the Congo, I would always suggest crossing close to its mouth, night or day; going North, with the wind W. N. W., steer N. N. E., with a 5 or 6 knot breeze, when you strike soundings on the other side you will have made about a N. ½ E. course in the distance of 9 miles, by log from 11½ fathoms off Shark Point. The current out of the river sets West about 2 knots the hour. With the land breeze it is equally convenient; and may be crossed in two hours. In coming from the North, with Kabenda bearing N. E., in 13 fathoms, or from the latitude of 5° 48′—wind S. W., a S. S. E. course will carry you over in four hours outside of Point Padron—and by keeping along shore, the current will assist you in going to the South. Vessels which cross to seaward from latitude of 5° 45′, and 9° W., are generally six days or more to Ambriz; by the former method it occupied us (the Perry) only two days."

I alluded at page 24, in giving an account of the history of these charts, to the circular letter of Commodore Wm. M. Crane in 1842; and to the fact, that though great care had been taken to distribute that letter among navigators, not a single reply had been received to it.

A few days after that page had passed through the press, the following reply was received, written on the fly leaf of the circular.

I therefore quote both the circular and the reply to it. Each is possessed of a peculiar interest.

Circular.

Bureau of Ordnance and Hydrography,
Washington City, 16*th December*, 1842.

Sir:—This Bureau is making arrangements for collecting, with the view of rendering accessible to navigators, all that valuable information relating to the navigation of distant seas, which is collected by our enterprising commanders of merchant vessels in their various pursuits; and much of it hitherto, for the want of some regular channel of communication, has been lost to the public at large.

To enable it to bring this undertaking to a useful issue, this Bureau relies much on the public spirit and intelligence of American owners and masters of ships. It takes this opportunity of inviting their co-operation, and of requesting the favor of you to communicate any information of a general character, that you may now or at any time possess, relating to the following subjects.

1. Discoveries of islands, rocks, shoals and dangers, or obstructions of any kind to navigation.
2. Shifting bars and shoals, errors of charts, wrong or corrected latitude and longitude.
3. Direction, rise and fall of tides, time of high and low water on full and change days at ports but little known. Any tidal phenomena, such as extraordinary rises, one ebb and flow in the 24 hours, etc.
4. Discoveries of new anchorages or harbors, with sailing directions, together with information as to wood, water, and every thing of interest to the navigator.
5. Force and set of currents.
6. Variation of the compass.
7. Latitude and longitude of icebergs when out of their usual track.
8. Tracks of remarkable short passages.
9. Limits of the trade winds at particular seasons of the year.
10. Any information relating to commerce and navigation.

Respectfully, your obedient servant,
W. M. CRANE.

William M. Crane, Esq.

Sir:—According to your request I note the following particulars. On my passage to Japan sea in March of 1848, passed over the position of Bishop's Rock of Hone's Chart; 20° 10′ North, 136° 50′ East.

Does not exist. Saw Douglass Reef, which is dangerous; Lat. 20° 25′ North; Long. 136° 25′ East. Saw Loo Choo Islands, passed to westward of them; which is a good route for Straits of Corea. April 17th, passed Tsusima Island in Straits of Corea, leaving it on the starboard hand, which is the best passage in to the sea of Japan; the Straits of Matsmai being dangerous and difficult on account of strong currents; several ships having lost cables and anchors in this passage. Cruised in this sea until the 4th of August, when I went through Perouse Straits.

Winds in Japan sea variable, but mostly from S. to S. W. Ships bound through Perouse Straits must give the Island of Kefunkerz or Tee Shee, a good berth, as there is a reef off the N. W. end of the island not on the chart—distance 5 to 10 miles—on which the ship David Poddoik was totally lost in July, 1848.

September 10th,—ran through Boussole Strait. Found the Island of Marikan laid down 30 miles to westward of its true position; have been informed that the most of the Kurile Islands are laid down wrong.

This information is generally known to the whaling fleet, but perhaps may not be known to your department.

Respectfully, your obedient servant,

OLIVER POTTER,

AT SEA, *April 30th*, 1851. *Ship Mechanic, Newport, R. I.*

Notwithstanding the tables and explanations given in the body of this work, concerning the route to Rio, I find navigators who attempt to follow the charts, frequently setting up their own individual experience against that which the charts give of the multitude; and generally as often as they do this, I find them going astray, prolonging their passage, or committing blunders of some sort for which there is no necessity, and for which owners and the commerce of the country are made to suffer.

The tracks with the arrows (Plates VI and VII) are the tracks which I have recommended, and the dotted tracks are some of the tracks which have actually been performed.

Now, suppose we had the tracks of a hundred ships, hence to Rio, all made in the month of January of different years; that in every instance, and with every change of wind, each one of the ships making these tracks had have been managed without a mistake—that they had in every instance steered the best course it was possible to steer—that when necessary to go about, each one had gone about exactly at the right moment; and, *that whenever the wind came out ahead, they had, all of them, without exception, invariably gone off on the right tack*; and that the tracks of all these 100 vessels—no two of them having, let it be supposed, sailed in company—was projected on a chart before us. What should we have? We should probably have a hundred separate tracks, for it can scarcely be supposed that any two of them would coincide all the way. And the navigator with that chart before him, would have before him, as clear as he has the Sun at midday in a cloudless sky, the best route to Rio in the month of January.

Now, suppose that with these 100 tracks before us, we should wish to draw a line or describe a route, which should represent the mean average track of the entire 100 ships. We should then point to this track and say, this is the route pursued by these 100 vessels, and this, therefore, is the route for all vessels to take in the month of January; and when we should come to look at the January route thus recommended, we should find, probably, that not one of these 100 vessels had actually sailed, even for one mile, or for one foot, upon it; that they had crossed this mean path, now in this place, now in that; at one time from this side, and again from that. Under such circumstances, no right-minded mariner would hesitate for a moment about taking this route. But he would not attempt to describe, with the keel of his ship; the line that he had drawn on the chart merely to designate the parts of the ocean through which she was to pass.

Now, this has been actually done with regard to the routes here recommended: they are the mean or average tracks, in some parts of the way, of 700 such vessels in a month; in other parts, only for 20, or whatever be the number of observations that could be procured.

It is true, that in the case of the charts, I have not actually had 100 such unerring vessels to give me the mean or best average route for each month, but I have had what perhaps was better. I have had the direction of the wind in each district of the ocean given for 100 times and upwards for each month, in different years; and when the navigator is told the direction whence the wind comes, he can tell as well what course he could have steered as though he had himself been there, and actually steered it.

I have, therefore, summed up all the winds and calms for each month in every district on the Pilot Chart, and calculated the chances of head winds, and of fair winds, for every point of the compass, through every such district. With these, I then proceeded to determine, by mathematical discussion, the mean or average route, which, taking both calms, head winds, and increase of distance into account, should give on the average the shortest passage, in time, to the equator.

Of course then, when a vessel comes to try the route thus computed, and to project on the chart the track she actually makes through the water from day to day, it is not to be expected, that the track so performed, will when laid down, exactly overlay the one already projected on the chart as her guide. There will be a general conformity between the two, but nothing like the actual coinciding of two lines.

These remarks are called forth by the fact, that some navigators appear to think that there is some sort of virtue in the black mark on the chart, which represents any one of these routes—as the April route for instance: if driven from the April route by head winds, one of these navigators, had he been in the "Memnon" at *a*, (Plate XI,) would have stood North to get her keel on the black mark for April; and again at *b*, he would have stood to the southward and westward to get upon the April track again.

Now, the "Memnon" at *a*, or at *b*, was in just as good a position as she would have been had she been "right upon the track." Her very clever master, therefore, did right; he conformed to the sailing directions, and was pursuing the route recommended, as closely and as well as though his track had fallen all the way from *b* down to the equator, upon the line with the arrows which is projected on the chart to represent the April route.

The tracks of the vessels projected on Plates XI and XII, have not been selected on account of their short passages; many other vessels have made passages shorter than these. I have taken them only for the purpose of illustration and demonstration.

In the conformity between the April route of the chart, and the actual track of the "Memnon" in crossing the calms of Cancer, the charts show a sharp elbow thence to the equator. The "Memnon," without intending to make this elbow, was forced by the winds to make it; and the sailing directions indicated that there probably would be an elbow here. The "Memnon" (Captain Joseph R. Gordon) crossed the Line in 19 days; she had no difficulty in clearing Cape St. Roque, and made a fine passage.

It was the same case with the "Surprise," (Captain P. Dumaresq;) with the "Seaman," (Captain Joseph Myrick,*) and with the "Dragon," Captain Andrew. They had to the equator 22, 20, and 24 days respectively. And it is remarkable how the tracks of these vessels, and of all others that have followed these sailing directions, have conformed in their windings and irregularities to the tracks of the charts.

See the place at which all four of these vessels crossed the parallel of 5° N. to the place where they crossed the Line; it is very nearly a direct south course, as represented by the tracks with the arrows, generally for winter and spring; and as before remarked, the lines which represent the tracks for these months do not represent the tracks which it is possible for one ship in 100 actually to make, but they represent the mean or average track, which 100 ships sailed by navigators that never were wrong, would make.

Let us turn now to Plate XII, which is an illustration of the summer and fall routes.

This is the season of the year in which short passages are the most difficult by any route, old or new.

Track x is the track of a ship that had the charts on board. The Captain of that ship, judging from the track that he made, evidently undertook to set up his "own experience" against the experience of the thousand of navigators who had gone before him, and all of which the charts held, spread out before him.

The track of the Brig "Acasta" is given as an illustration of an attempt often made to "split the difference" between the old and new route.

She sailed from Sag Harbor, September 20th, 1850; went as far as 22° W., and crossed the Line in Long. 26°—November 14th—55 days. She got "the doldrums" in about 11° N., and they stuck by her for 15 days, and until she reached 2° N.

The fragment of the track w, illustrates the case of a vessel that attempted the new route, and abandoned it when she fell in with the equatorial "doldrums," in 11° N.—September 25th, 1850. She was going on very

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*— SAN FRANCISCO, *March 28th*, 1851.

LIEUT. MAURY, *Washington.*

DEAR SIR:—In compliance with my obligation, I herewith enclose Abstract Log of ship Seaman, from New York to this port.

In regard to the comparative passages of other vessels to the equator, I have no means of informing you; as there have arrived only two vessels since I have been here, which sailed near the time of the Seaman's leaving; and those two vessels, (Helena and Hazard,) though they arrived here after me, they sailed from New York three or four weeks before me.

In respect to your route, it is THE track for all smart sailing ships to pursue, and shall hereafter never think of following any other.

It is much to be regretted, that so little is known to the general navigator of winds and currents in the North Pacific; as I find many vessels have made long passages in consequence of knowing not the proper place to cross the equator, and how to take advantage of the wind, when they lose the N. E. trades near the California coast.

I cannot close without making the acknowledgment, that I consider myself indebted to your "Wind and Current Charts" for the short passage I have had from New York to this port; as I passed through all the tropical latitudes without any calms, and was in latitude of the river Plate, in 35 days from New York, which run I consider rarely, if ever, equalled.

Respectfully yours,

(SIGNED) JOSEPH MYRICK.

well, but here she met the southerly monsoons which the charts warned her of at this season of the year. The wind came out S. S. W., and she went on fanning to the eastward and to *leeward*. From this place, it took her 16 days to reach the Line.

Such cases as these are common:—the errors are generally committed by standing too much towards the old track.

Sometimes, though rarely, vessels make mistakes by going on the other extreme. I find an example of this sort in the case of the U. S. ship "Vincennes," Commander Hudson, on a voyage from New York to Rio, in 1849.

She had the "Wind and Current Charts" on board, and claims to have taken them for her guide. But I have not been able to reconcile the course pursued by her with the route recommended.

To enable others to judge for themselves in her case, and to profit by her example, I shall quote her Abstract Log, which has been copied by Passed Midshipman J. J. Hanson, U. S. Navy, from the smooth Log returned by her to the Bureau of Ordnance and Hydrography.

I take this occasion to request the navigators who are co-operating with me, not to use the abbreviations —as the "Vincennes" does—to describe the weather; nor to give any but compass corners for the winds. The reason of this request is, that with only two or three exceptions, all who send me their Abstracts give compass corners, and describe the weather in the "old fashioned way." And in dealing with such a vast quantity of materials, these departures from the general practice, always create more or less difficulty, and involve liability to error.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	Ther. 9 A.M. Air.	Ther. 9 A.M. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1849											
Nov. 13	—	—	—	—	—	—	—	—	—	—	At 3.30, Sandy Hook Light bore N. W. by W., dist. 11 miles.
14	38°50′ N.	71°28′W.	—	—	30.30	58°	63°	W. by S.	S. W.	W. S. W.	b,
15	37 06	68 32*d*	8, N. E. ½ E.	6°45′W.	—	64	72	W. S. W.	N. W.	N. E. by N.	First part b, latter part b, c.
16	34 37	65 50	13, S. 28° W.	—	30.20	64	72	E. N. E.	E. N. E.	E. by N.	" c, " o, n.
17	33 52	65 26	24, N. ¼ E.	—	30.17	69	72	E. by N.	E. ½ N.	E. by N.	" c, " o, q.
18	34 14	65 20	—	—	30.08	70	72	E.	E. S. E.	S. E.	" o, q, " d, o, q.
19	35 12	64 11*e*	For two days	—	30.30	72	72	S. S. E.	W.	W.	" b, c, " b.
20	33 36	61 03	20, E. 32° N.	8 W.	30.20	72	72	S. W.	S. W. by S.	S.W. by S.	" b, " b.
21	32 43	58 03	—	8 30 "	30.18	72	72	S. by E.	S. by W.	S.W. by S.	" b, c, " c.
22	31 56	55 59	—	—	30.18	69	73	S. S. E.	S. S. E.	S.W. by S.	" c, r, " b.
23	31 18	54 48	—	—	30.18	72	74	W. S. W.	W. N. W.	N. N. W.	" b, " b, c.
24	30 00	53 47	18, W.	6 W.	30.18	73	75	E. N. E.	N. E.	N. E.	" b, c, " b, c.
25	28 00	51 55	7, W.	8 "	30.16	72	77	N. E.	N. W.	S. S. W.	" b, c, " b, c.
26	26 17	50 59	10, W. S. W.	10 "	30.22	72	76	S. E.	E. S. E.	E. S. E.	" c, r, " b, c.
27	23 38	50 56	12, W. 28° S.	10 "	30.15	77	76	E. by S.	E. S. E.	E. by N.	" b, " b.
28	20 54	50 43	18, W. 41° S.	9 "	30.25	77	80	E. S. E.	E. by S.	E. S. E.	" b, c, " b, c.
29	18 56	49 58	—		30.25	73	79	N. E. by E.	E. N. E.	E. S. E.	" c, " c.
30	16 24	49 56	—	6 W.	30.25	78	78	E. by N.	E. S. E.	E. by S.	" c, " b, c.
Dec. 1	13 48	49 31	20, S. W. ¼ S.	4 "	30.23	80	82	E. by S.	E. by S.	E. by S.	" b, c, " b, c.
2	11 22	48 27	19, S. 41° W.	2 "	30.20	75	79	E. N. E.	E. N. E.	S. E.	" c, q, t, " c, r.
3	10 11	47 53	16, S.	None.	30.20	77	81	E. S. E.	E.	E. N. E.	" c, " b, c.
4	8 48	47 17	11, S.	2 W.	30.20	80	82	E.	E. S. E.	E. by N.	" b, c, " b, c.
5	8 58	46 55	20, W.	None.	30.20	78	80	N. E.	E.	E. S. E.	" b, " b, c.
6	9 45	46 30	12, N.	None.	30.22	82	80	E. by N.	S. W.	S. E.	" b, " c.
7	10 04	46 18	13, N. 20° W.	1 10 W.	30.20	81	82	E. S. E.	E. by S.	E. S. E.	" b, c, " b.
8	8 16	45 46	—	—	30.19	82	82	E.	E.	E.	" b, " b, c.
9	8 17	45 15	For two days	—	30.28	76	80	E. S. E.	E. S. E.	S. E. by E.	" o, c, r, " c, q.
10	9 01	44 48	39, W. 23° N.	—	30.25	80	80	S. E.	E. by N.	E.	" b, c, " b, c.
11	6 10	43 37	12, S. by E.	—	30.25	77	82	E. by N.	E.	E. by S.	" b, " b, c.
12	3 55	43 59	18, S.	—	—	77	81	E.	E. by S.	E. by S.	" b, c, " b, c.
13	2 09	42 49	—	—	30.24	84	82	E. S. E.	S. E. by E.	E. S. E.	" b, " b, c.
14	0 23 S.	43 33	57, W. 14° N.	—	30.23	82	80	E. by S.	E. S. E.	E. S. E.	" b, c, " b, c.
15	1 30 N.	43 36	60, W. 33° N.	—	30.23	82	81	E.	E. by S.	E. by S.	" b, c, " b, c.
16	3 46	42 27	25, N. 22° E.	—	30.22	81	80	E. by S.	E. S. E.	E.	" b, " b, c.
17	4 11	41 27	—	—	30.24	74	79	E. by N.	N. E. by E.	E. N. E.	" o, d, " b, c.
18	3 29	41 49	17, N. 35° W.	—	30.24	81	81	E.	E. by N.	E. N. E.	" b, c, " b, c.
Dec. 19	2°34′ N.	41°10′W.	10, W. by S.	—	30.24	85°	83°	E. N. E.	E.	E.	First part b, c, latter part b, t.
20	3 35	41 04	10, W. 13°S.	—	30.23	81	82	E. by S.	E. by N.	E. by N.	" b, c, " b, c.
21	5 18	40 41	—	—	30.22	78	82	E.	E.	E. S. E.	" c, " c, m.
22	6 21	40 39	—	—	30.23	79	80	E. by N.	E. N. E.	E. S. E.	" b, c, " c, r.
23	5 52	39 04	—	—	30.25	80	80	E. N. E.	N. E. by E.	N. E. by E.	" c, " c,
24	4 20	37 30	For two days	—	30.24	75	80	E. N. E.	N. E. by N.	E. S. E.	" c, r, " b, c.
25	4 50	37 23	56, NEbyE½E.	—	30.22	77	80	E. by S.	N. E. by E.	N. E. by E.	" b, c, " b,
26	4 17	35 33	—	8°23′W.	30.23	79	80	N. E. by E.	E. S. E.	E. by S.	" b, c, " b, c.
27	3 58	35 23	—	—	30.20	78	80	E. S. E.	E. by N.	E. by S.	" b, c, " b, c.
28	4 20	35 07	—	8 30 W.	30.27	76	80	E. N. E.	S. E.	S. E. by S.	" c, r, " b, c.
29	4 54	34 46	23, N. 15° W.	8 30 "	30.28	80	81	S. E.	E. N. E.	E. N. E.	" b, c, " b, c.
30	4 01	33 32	9, N.	8 30 "	30.26	80	82	E.	E. S. E.	E. by S.	" b, c, " b, c.
31	4 54	33 21	23, N. by W.	8 30 "	30.32	83	82	E. by S.	E. by S.	E.	" b, c, " b, c.
1850											
Jan. 1	4 39	32 45	19, N. by W.	9 "	30.33	79	81	E. N. E.	E. N. E.	E. S. E.	" c, r, " c,
2	3 50	32 04	—	—	30.31	76	81	E. N. E.	E. N. E.	N. E.	" c, r, " c,
3	3 13	31 24	14, S. 47° W.	—	30.36	80	81	E. N. E.	S. E. by E.	S. E. by E.	" c, " b, c.
4	3 52	30 52	35, W.	9 W.	30.34	85	82	S. E. by E.	S. E.	E. S. E.	" b, c, " b, c.
5	3 22	30 53	21, W. ¾ S.	9 "	30.34	79	81	E. by S.	E.	E. by S.	" c, r, " c,
6	2 47	31 05	39, W. 20° S.	9 "	30.35	77	80	S. E.	S. S. E.	E. S. E.	" c, " c, r.
7	2 57	30 54	25, N.	9 "	30.34	76	80	E. S. E.	E.	Calm.	" c, r, " b, c,
8	2 59	30 25	11, N.		30.34	77	80	S. W.	E. S. E.	S. W.	" b, c, " b, c.
9	2 16	30 44	—	11 W.	30.34	77	81	E. by S.	S. E. by S.	S. by E.	" b, c, " b, c.
10	2 30	30 21	26, 38° N.	11	30.34	80	80	S. S. E.	S. by E.	S. S. E.	" b, c, " b, c.
11	1 45	30 18	23, N. 45° W.	—	30.32	79	80	S. S. E.	S. S. E.	S. E. by S.	" b, c, " b.
12	0 26	30 51	36, W. 26° N.	—	30.34	80	80	S. E. by S.	S. by E.	S. E. by S.	" b, c, " b.
13	1 26	29 48	48, W. 36° N.	—	30.34	81	81	S. by E.	S. by E.	S. S. E.	" b, " b, c.
14	0 01	31 14	36, W. 35° N.	—	30.35	80	80	S. S. E.	S. by E.	E. S. E.	" b, " b.
15	2 09 S.	31 25	12, N. 20° W.	—	30.35	78	80	S. E. by E.	S. E. by E.	S. S. E.	" b, " b, c.

This vessel came out of Sandy Hook, November 13th, and had the wind out from the westward till the 15th, making a fine run to *d*, as per Plates XI and XII.

On the 18th the wind came out from the South, and continued there, or with westing in it, for a week, and then it hauled to the North, or so as to be mostly fair, for two days more. I have marked this place *e* on the chart, and in the log.

With these fine winds, what was that ship doing for this whole week? Why, actually hugging a S. W. wind, or standing as though she wanted to go to the West Indies.

She reached the Line the first time, it's true, in 30 days from New York, but too far to clear Cape St. Roque.

The track of the "Vincennes" beautifully proves the correctness of the charts; it conforms in its general direction to the track of the charts, but it is too far off. Any one who will examine the Log of that ship—her track, and my Sailing Directions—will see that it would be just about as reasonable for that ship to have gone over to the Cape de Verdes, (which would have been not quite as far on the other extreme,) and then meeting with a long passage of 60 days, to ascribe it to the charts. The ship whose track I have marked *x*, might, with the same propriety, ascribe her long passage to the charts also.

Navigators often follow the new route bravely, until they get into the equatorial calms; here their heart seems to fail them, and they bolt at the very time when they should stick more closely to their guide.

The region which these calms usually include is in the shape of a wedge; it shifts about, but Plates XI and XII show its mean place at the four seasons. In each season, it is sometimes above and sometimes below the place assigned it on the chart. But I have drawn it there to show navigators how they mistake, when being as far West even as 31° or 32°, they fall into these calms, and think of making longitude by fanning along to the eastward on an E. N. E. or perhaps a N. E. course. The farther they go on such occasions, the broader grows the belt, and the greater becomes the difficulty of getting across it.

I have projected on Plate XII, the track of a ship, and marked it *y*, as an illustration of bad management under such circumstances, though it is by no means an extreme case. This ship had 40 days to the Line, took the new route, and followed it bravely until she reached these calms, in longitude 29°. She was then far enough to the eastward, and should not have been afraid to cross the Line as far West as 32°. But instead of proceeding to make the best of her way across this belt where it was narrow, and where two or three days at most would have sufficed for crossing it, she proceeded to flap along to the eastward as far as 21°; and thus, in consequence of the monsoons, found herself to *leeward*. When at *h*, that ship should, instead of making about an E. by S. course, have stood on the other tack, making the best of her way South, and not caring to get east of 30°. She might have been content to keep herself between 29°, or 30° and 31° or 32°, while she crossed these calms.

I have not yet found a single case in which there has been, after crossing the Line as far as 32°, the least difficulty in clearing St. Roque. Navigators should not hesitate, if they are pinched, to go inside of Fernando do Norhona. I have the track of one vessel that dashed on, crossed the Line in 41° the 19th day out, and on the 32d day was south of the parallel of Rio. This, though, was in the winter and spring when vessels can afford to keep to the westward, and it was going further West than I should advise.

But suppose a vessel to cross in 32° or 33°, and to get the S. E. trades at S. E. By standing on S. S. W., she keeps herself in a position in which any change of wind is favorable. If it haul to the eastward, she can lay up and clear the land; if it haul to the southward, she can go about and make easting, and get along rapidly by stretches upon long and short legs.

The current so much dreaded off St. Roque is a good deal of a bug-bear. Navigators have been frightened at this current ever since some transports were cast ashore by it, sometime in the last century. But it should be borne in mind, that it was quite as much of an undertaking for the clumsy transport-built ships of England in the last century, to contend against a current of one knot, as it is now for one of our first-rate sailing clipper-built ships, to contend with one of 4 or 5 knots.

Take the Log-book of the "Celia" (pp. 29–37) as an example. It would have been impossible for that ship to beat against a one-knot current. In the days of this wreck, the passage from England to India averaged nine months. Warren Hastings, when he went out, was 10 months on the way. The passage is now often made by our ships in less than three months. Therefore, the ships of those days might be well cautioned against currents as dangerous, which the ships of the present day would scarcely regard.

Now, my investigations show that there is rarely off Cape St. Roque, and in the fair way from the equator South, either a sweeping or a horsing current. Indeed many accurate and close observers pass there without reporting any current at all; and though navigators should always be on the look-out for a current there, and should always make allowances for one that is to set them on the land; yet when they do encounter a current there, they may be assured, that as a general rule, it is neither difficult to overcome nor dangerous on account of its set.

The schooner "Anna Sophia," J. T. Tuthill, sailed from Greenport, New York, for California, December 24th, 1849. She had the charts on board; claims to have followed them, and had a long passage. Vessels by following the charts may have long passages, as they sometimes do over all parts of the ocean. But I am not disposed to permit navigators to commit blunders, and ascribe the consequences to the charts.

The "Anna Sophia" was evidently not a smart vessel; she had a passage of 9 months, without touching, to California.

She crossed the Line in about 31° 30', fell to leeward, and was a month in getting clear of St. Roque. I quote so much of her Abstract as relates to her track between the Line and Cape St. Roque.

Abstract Log of the Schooner "Anna Sophia," J. T. Tuthill, Master, bound from Greenport, N. Y., to California, 1849.

Date.	Latitude, at noon.	Longitude, at noon.	WINDS.			REMARKS.
			First Part.	Middle Part.	Latter Part.	
Feb. 8	0°30′ N.	31°28′ W.	S. E.	S. E.	S. E.	Current 1 W. N. W. Lots of birds.
9	0 41 S.	32 20	"	"	"	
10	2 02	33 07	"	"	"	Current 1 W. N. W.
11	3 34	33 40	"	"	"	Fair weather.
12	4 07	33 20	"	"	"	
13	4 44 ☞	36 10	"	☞ E.	E. N. E.	Sounded in 5 fathoms water on the banks of St. Roque—water green. Current 1½ W. N. W.
14	4 03	36 19	☞E.N.E.	E. N. E.	E.	Standing in to 2 fathoms and off soundings.
15	4 37	36 07	S. E.	S. E.	"	" " "
16	4 32	35 48	E. N. E.	"	S. E.	Standing off and on.
17	4 55	35 34	E.	"	"	
18	4 29	35 40	"	"	E.	
19	4 43	35 38	E. N. E.	"	S. E.	Gaining to windward slowly.
20	4 56	35 38	E. S. E.	"	"	
21	5 00	35 39	"	"	Calm.	Nearly 1 month gaining 1½ of longitude and two degrees of latitude; which is the result of falling in to leeward of Cape St. Roque. When I cross the Line again in this direction, I shall probably aim to cross it in the longitude of 26° West, instead of 28° or 30° as recommended in this work. (Signed) J. T. TUTHILL.
22	4 02	35 26	E.	"	S. E.	
23	4 48	35 36	E. S. E.	E.	"	
24	4 03	35 00	E.	"	"	Standing off towards the Line.
25	2 56	34 00	S.E.byS.	S. E.	"	
26	1 54	32 48	E. N. E.	E.	E.	
27	1 03	31 40	S.E.byS.	S. E.	S. E.	
28	1 43	32 10	S. E.	"	"	
Mar. 1	2 50	33 17	"	"	"	
2	3 21	33 40	"	"	"	
3	3 08	33 58	"	"	"	
4	3 57	34 03	S.E.byS.	S.E.byS.	S.E.byS.	Standing southerly again.
5	5 00	34 47	"	"	"	Sounded in 15 fathoms—water green.
6	5 20	35 12	"	"	"	
7	5 27	35 07	S. E.	S. E.	S. E.	
8	5 48	35 05	"	"	"	

With this abstract before the navigator, comment is unnecessary. Why should Captain Tuthill, on the 13th of February, have run off before the wind? On the 12th he was in 4° 7′ South, and 33° 20′ West, Cape St. Roque bearing S. W. by W., with the wind at East, or E. N. E. for most of the 13th and 14th. He, therefore, could have laid up all this time to the southward and *eastward*; but instead of that, he ran for one whole day about W. S. W., with the wind *dead* aft, and Cape St. Roque on the port bow. He made on this course nearly 3° of westing, viz: from 33° 20′ to 36° 10′.

It is obvious to every one, that this schooner met with no difficulty in consequence of taking the new route, and of crossing the Line in 32°; had she stood to the southward on the 13th, she might have gone with the wind free, by Cape St. Roque, passing out of sight of it to windward; for with the wind at East and to the North of East, she could have gone South as easily as West, and by making on that day 3° of latitude, instead of 3° of longitude, she would on the 13th have crossed 7° South, and been in the "fair way" to Rio and ports beyond.

Captain N. A. Bachelder, of the barque "Imaum," sailed from Salem for San Francisco, October 16th, 1850. He also had the Charts on board, took the new route, crossed 5° N. in 34° W., and the Line in 35°, after a fine run of 31 days. He stood on for three days more, and until he reached 4° 10′ S., in 35° 13′ W., meeting no *current*. But instead of taking advantage of the slants, (the wind varying from E. by S. to S. E. by S.) or of making short and long stretches—as to the advantages of which I have so earnestly endeavored to impress navigators when they happen to be pinched here—he stood on, amidst all this veering and hauling of the wind, (except for twelve hours, the day he crossed the Line, when he steered N. E. by E.; and again, in latitude 4° S., longitude 35°, when he stood four hours N. E.) Finally he put about, stood to the northward and eastward, and reached the Line again, after an absence of seven days in 31° W., from which position he cleared St. Roque, without difficulty, passing about 2° to windward of it. In ten days from the Line this time, and in seventeen from his crossing it the first time, he was south of Rio. Thus making the passage, notwithstanding the falling to leeward, and losing a week in consequence, in eight or ten days less than the average time by the old route.

Indeed I have no doubt but that his difficulty, as it was, in getting by St. Roque, was less than it would have been in clearing the equatorial "doldrums," had he taken the old route.

With regard to the current off St. Roque, he remarks: "This" (meeting a current of 20 miles N. W. by W. in latitude 2° 17′ S. longitude, 34° or 35° W.) "this is the first time for six days in which I have experienced the least current." He had then been down to St. Roque, and was on his way back to the Line. And to show that that much dreaded current is not always in motion here, he continues, "and on my way, last voyage to California, the N. E. trades failing me, I was obliged to cross the equator in longitude 32° 30′, November 20, 1849, in three days cleared Cape St. Roque, with little or no current."

For the guidance of navigators who follow the new route, and are pinched in clearing St. Roque, as they no doubt will occasionally be, I repeat the following suggestions:

From the Line in longitude 33° Cape St. Roque bears S. S. W. From this crossing place, in a smart ship that will fetch where she looks, a S. E. wind all the way from the Line, would just prevent the vessel from clearing. But the chances are more than a hundred to one, that the wind will not hang steadily at S. E. all the way from the Line to St. Roque. If it haul to E. S. E. you can lay up and clear. If it haul to S. S. E. you can put about and make easting.

But suppose the wind holds steadily at S. E. or at any other point which will prevent you from clearing the Cape; draw a line from your place on the Chart to the Cape, and avoid falling to the west of that line, by taking advantage of slants, or by beating, accordingly as you may have the wind, and making long and short stretches. I quote the case of the "Stag Hound," as an example.

Captain Richardson to Lieutenant M. F. Maury.

"SAN FRANCISCO, *June* 12, 1851.

"Herewith I send you abstract of ship "Stag Hound's" passage from New York to San Francisco, stopping at Valparaiso. Our passage from New York to Valparaiso was sixty-six days; from Valparaiso to San Francisco was forty-two days—nearly all the way light trades: S. E. and N. E.

"Six days out from New York, broke off main topmast, and that in its fall took all three topgallant masts. Soon after took a W. S. W. and West gale—run the ship dead before the sea and wind: in consequence of this, crossed the equator in about longitude 28° 30′ W. in twenty-one days from New York. Losing topmast, we had no main topsail in the ship for nine days, and no topgallant sails for twelve days; had we not met with the accident, I think we should have been down to the Line in sixteen days.

"In latitude 4° N. the N. E. trades left us, then baffling down to latitude 2° N. Then took the wind at S. S. E. and S. E., until near the coast of Brazil, when the wind hauled so we did not have to make a tack; presume had we crossed in longitude 30° W., we should have fetched along the coast."

This letter of Captain Richardson is quoted as an illustration of what I have endeavored to impress upon navigators, with regard to their course, after crossing the Line well to the westward, and when it appears to be touch-and-go as to clearing St. Roque, viz: stand boldly on, and take advantage of slants and short legs, to make long ones.

I received the abstract of another vessel about the same time that crossed in 31°, and I notice in the remarks after crossing the Line—"back strapped"—"no chance of weathering Cape St. Roque,"—"shall evidently fall to leeward," "bad luck," &c. Yet this desponding navigator stood boldly on, took advantage of a slant, stood off for eight hours, went passed St. Roque like a shot, and the thirty-second day out from New York, crossed the parallel of Rio.

During the last year the average passage to Rio of the ships that have used the charts, has been about forty days, showing a clear gain upon the old route of at least two weeks.

That vessels will sometimes meet with unfavorable winds by this as they will by all routes, I need but quote as an illustration the Log-book of the barque "Mermaid," bound from Boston to San Francisco, May, 1851.

It will be observed that that vessel did not get the N. E. trades at all, except for one day; and that notwithstanding, that after reaching the region where she ought to have found the N. E. trades, she found the winds for the most part south of east, yet she had no difficulty in crossing the Line in 30°; and moreover, that notwithstanding she was dismasted in 1° S. 31° W., she had no difficulty, even under these circumstances of clearing St. Roque, and of arriving at Pernambuco 36 days out.

I have heard of such puffs of wind about Para as dismasted the "Mermaid," but never in this region before. There was a vessel of war some years ago, in the mouth of the Amazon, that had her forward sails and some of her spars carried away by one of these "puffs" when there was not wind enough aft to fill the mizzen topsail. Such "whiffs," I understand, are not unfrequent about the mouth of the Amazon.

ABSTRACT LOG OF THE BARQUE "MERMAID," GEO. J. O. SMITH, COMMANDER, BOUND FROM BOSTON, MASS., TO SAN FRANCISCO, CAL., 1851.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M.		WINDS.			REMARKS.
						Air.	Water.	First Part.	Middle Part.	Latter Part.	
1851. May 12								S. E.	S. E.	S. E.	Monday, May 12th—Started in tow of a steamer at 9 A. M.—at meridian Minot's Ledge bore S. W. by W., (Mag.) distance 8 miles.
13	42° 10′ N.	67° 40′ W.	Regular tides.	No obs.	30.00	42°	40°	S. E.	S. S. E.	S.	Fresh winds, accompanied with fog and smooth sea.
14	40 42	62 53	Slight easterly.	do.	29.85	60	58	S. S. W. to		S. W.	Strong winds with thick weather. In the Gulf Stream.
15	39 44	58 17	1 knot N. E.	do.	29.85	68	59	S.	to	S. W.	Strong winds and irregular swell running. In the Gulf Stream.
16	38 10	53 53	Easterly.	do.	29.85	70	60	S. W.	S. W.	S. W.	Strong gales—all light sails furled—latter part of this day rained in torrents for four hours from S. W.—at noon calm.
17	37 01	52 10		do.	30.05	72	67	N. W.	N. E.	Calm.	Light winds from N. W., fresh and squally from N. E.—calm.
18	37 00	49 57		do.	30.15	72	67	S. S. W.	S. S. E.	S. S. E.	Light winds from S. S. W.—Fresh from S. S. E. with clear sky—Saw this morning gulf-weed for the first time since we left port—During this day made tacks to the S. S. W.
19	36 26	49 10		do.	30.10	74	67	S. S. E.	S. S. E.	S. E.	First part of the day had pleasant winds from S. S. E.—middle part moderate—latter part from S. E. and moderate.
20	35 20	49 03		do.	30.10	76	67	S. S. E.	S. S. E.	N. W.	First and middle part light airs from S. S. E.—latter part breezes from the N. W., being calm for 2 hours previous to the N. W. wind.
21	33 06	46 51		do.	30.15	77	68	N.	N. N. E.	N. E.	First part pleasant winds from N. W.—middle part from N. N. E.—latter, N. E. and fine weather.
22	31 24	44 56	N. E. 36 miles.	N. 14 02 W.	30.05	78	68	N. N. E.	N. W.	N. W.	First part fresh winds from N. N. E.—middle part, from N. W.—latter part calm—Large quantities of gulf-weed floating.

Date.	Latitude, at noon.	Latitude, at noon.	Currents. (Knots per hour.)	Variation. *observed.*	Bar.	Ther. 9 A. M. Air.	Ther. 9 A. M. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1851.											
May 23	29°51′ N.	43°42′ N.	East 18 miles.	No obs.	30.10	78°	70°	N. W.	N. N. W.	N. N. W.	First part light winds from N. W.—middle part rain squalls from W.—latter part light winds—Gulf-weed about.
24	29 05	43 00	East 12 miles.	do.	30.15	78	72	N. W.	N. W.		Ligh unsteady airs from the westward through the day.
25	28 25	42 11	East 12 miles.	do.	30.10	78	72	W. S. W.	S.W.toE.	S. W. to E.	First part light winds from W. S. W.—middle part calm and baffling—latter part light airs from S. W., observed tide rips—latter part midnight stars shooting from S. S. W. to N. N. E.
26	28 00	41 32	East 12 miles.	16 10 W.	30.20	82	72	S. W.	W. S. W.	S. W.	Throughout this day have had light baffling airs from the S. W. with a smooth sea—observed lightning from E. to S. W.
27	28 00	41 16	East ½ knot.	15 39 W.	30.30	84	73	W. S. W.	Calm.	Calm.	First part light winds from W. S. W.—middle and latter part calm and no appearance of a breeze—the Sun powerfully hot.
28	27 57	41 22		14 50 W.	30.25	85	74	Calm.	Calm.	Calm.	Calm through this day, not having a breath of wind.
29	27 28	41 00			30.20	80	74	Calm.	Calm.	S. W.	First and middle part calm—at 9 A. M. a breeze sprang up from the S. W.
30	26 13	39 39		14 25 W.	30.20	80	76	S. W.	North and squally.	S. W.	First part light breezes from the S. W.—middle part squally from the northward—latter light winds from S. W.
31	24 40	37 56			30.25	82	77	S.W.bW.	S. S. W.	S. S. W.	First part light winds from the S. W. by W.—middle and latter parts light winds from S. S. W.
June 1	24 10	36 15			30.25	82	77	S. S. W.	S.	S.	First part light winds from S. S. W.—middle and latter parts very light airs from the southward.
2	23 00	36 27		12 56	30.25	80	75	S. S. E.	S. E.	E. S. E.	First part light airs from the S. S. E.—middle part light from the S. E.—latter part light from the E. S. E., the weather having the appearance of *trades*.
June 3	21 07	35 10			30.25	78	75	E. S. E.	E.	E. by N.	First part light winds from E. by S.—middle part pleasant breezes—latter part moderate—entered the trades.
4	18 32	33 30			30.25	78	75	E. by N.	E. by N.	E. S. E.	First and middle parts fresh winds from the E. by N.—latter part wind from E. S. E.
5	15°29′ N.	32°18′ W.			30.20	78°	74°	E. by S.	E. by S.	E. by S.	Through this day have had the wind from E. by S., squally from sunrise to sunset.
6	11 43	30 56			30.15	78	76	E. by S.	E.	E.	Through this day have had strong winds from the eastward, squally from sunrise to sunset.
7	8 23	29 46		9 30 W.	30.10	82	76	E.	E. S. E.	E.	Through this day the wind has been unsteady from the eastward—at midnight calm for 15 minutes
8	6 05	28 50			30.10	83	76	E.	E. S. E.	N.E. to E.S.E.	Begins with light winds from the eastward—middle part light from the E. S. E.—latter part heavy squalls of rain, the wind baffling from N. E. to E. S. E.
9	4 50	28 42			30.10	81	76	E. S. E.	E. by S.	E. S. E.	Throughout this day have had light baffling winds from N. E. to S. W., tacking as the wind hauled—the wind principally or averaging as per column—a heavy rain squall this P. M.
10	4 27	28 40			30.10	82	75	S.	S. S. E.	E. S. E.	First part light winds and squalls from the southward—middle part from S. S. E.—latter, wind from E. S. E.—lightning in the S. E.—Ends with heavy rains.
11	2 18	29 10			30.10	84	75	S. E.	E. S. E.	E. S. E.	First part moderate—middle and latter fresh, accompanied with heavy squalls of wind and rain; likewise a heavy sea running from S. S. E.—Ends calm.
12	0 18 S.	30 42			30.10	82	80	S. E.	S. S. E.	S. E. by E.	First part moderate—middle and latter parts fresh—a heavy sea on from S. E. and S.
13	1 22	31 22			30 05	82	81	S. E.	E. S. E.	E. S. E.	First part fresh—at 9 P. M. the sea very irregular and high from S. E. and S.—in a sudden puff

ABSTRACT LOG OF THE BARQUE "MERMAID."—CONTINUED.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	Ther. 9 A.M.		Winds.			Remarks.
						Air.	Water.	First Part.	Middle Part.	Latter Part.	
1851.											of wind from the southward carried away our jibboom, foremast and masts above it; laying in the trough through the rest of this day, laboring hard, being in an unmanageable state. I have crossed the equator in all seasons, and never saw so much nor so irregular sea on; the puff lasted no more than to list the ship and dismast her—at 9 A. M. got steerage-way aboard, making for Pernambuco, calculating she made about a due *West drift.*
June 14	3°06′ S.	31°30′ W.			30.05	80°	80°	E. S. E.	E. S. E.	E. S. E.	Throughout this day have the wind from the E. S. E., interrupted by squalls of wind and rain from the southward.
15	5 03	32 19			30.00	78	80	S. E.	E. S. E.	S. E.	First part moderate—middle part squally—latter part moderate.
16	6 43	33 19						E.	S. S. E.	S. E.	Winds unsteady, with squalls from the southward.
17	8 30	34 00			30.00	80	80	S. E.	S. S. E.	S. E. by S.	Winds unsteady, with heavy squalls of wind and rain from the southward.
18	8 17	34 35			29.55	79	79	Baffling.	S. S. E.	S. S. E.	Standing in-shore for Pernambuco bay, and anchored in 5 fathoms—light bearing W. by N., dist. ½ mile, having been set to the N. W. 15 miles by the current. GEO. J. O. SMITH.

Of the passage around Cape Horn.

The force engaged upon the Charts at the Observatory has been so much interrupted, that I have not yet had time to discuss the Cape Horn route, according to the method used for discussing the best route to the Line.

Vessels bound round Cape Horn, however, should, after leaving Cape St. Roque, aim, if the winds will let them, to cross 25° South in about 35° W. At any rate, as far off from the land as, with a good clean rap-full, they can, without going to the East of 33° or 34°.

After passing the parallel of Cape Frio, they should make the best of their way South, aiming always to pass *inside* of the Falkland Islands.

The reason for this recommendation is this: After crossing the parallel of Tierra del Fuego, the difficulty is to get to the westward. Therefore it is better to make westing on this side, when it is practicable and where the weather is mild, than to put it off for the stormy latitudes, where it is more difficult.

Captain Smyley, who has been engaged for many years in the seal fishery of the South Seas, has furnished me with some remarks and sailing directions in relation to this part of the ocean, so also has Capt. Bryson; navigators may find these remarks useful; I therefore copy them.

From Captain Leslie Bryson of the Brig "Daniel" to Lieutenant M. F. Maury.

"In compliance with your published request, I avail myself of the earliest opportunity to forward to you an abstract journal of the "Brig Daniel," formerly the United States Bomb brig Hecla, kept by me on her voyage from New York to California, which is but a poor tribute for the manifest advantage and valuable knowledge, imparted by the aid of your truly useful and ingenious system, which I regard as one of the most valuable inventions of the age, and doubtless will yet lead to results, far beyond its present apparent purpose to speed the voyage.

Noticing your intimation to West India traders for further data, to complete your Wind and Current Chart of the "West Indies," I have written a friend to send you my private journals, embracing a period of about six years, commencing May, 1838. These journals were kept for the purpose of facilitating a practical knowledge of winds, &c., for which I thirsted, without the means of obtaining any reliable information, except the divers accounts furnished by casual observers, which like the various sailing directions for Cape Horn, serve rather to distract the mind than to assist the judgment. I was in the constant habit for several years of referring to these journals with the sole view of obtaining the very information that your charts so plainly and beautifully illustrate. My personal observation, therefore, confirms me in the truth of your system. Having been kept solely for private use, you will find many remarks in those journals quite irrelevant to your purpose, nevertheless in your hands, I trust they will be acceptable. The temperature of the air and water were only noted in approaching and departing from our coast. At different times I have found a cold place in the centre of the Gulf bearing about S. E. by S. from "Montauk." I do not know whether the remark is noted in my journals, but I am certain of the fact.

The currents may not always have been regularly noted, except when unusually strong. In reference to my present passage, I would state that I followed your directions, as near as winds would permit. Although the vessel was deep, and sailed heavy, I have reason to think our passage was thus materially shortened.

About the parallel of 45° S. a marked change in the weather occurred, followed by a constant succession of gales. The temperature of the sea had also suddenly fallen some 6° below the temperature of the air, as indicated by the thermometer attached to the barometer in the cabin. This difference of temperature between the air and the water continued with little variation, until we passed the Cape, except a part of the 14th, 15th, and 16th of February, when we stood far enough eastward to bring Falkland Islands in a line with Cape Horn. At those times the temperature of the sea rose to about the same range as the air; from that circumstance, in connection with the constant N. E. current, I was strongly impressed with the idea that a steady cold stream set to the northward and eastward like the Gulf Stream on our coast, the elements being only reversed, which would account for the continual storms that seem to prevail in that region.

The current continued more or less strong in proportion to the strength and duration of the gales; but varying more easterly as we drew up with the "Horn," until we were fairly past it, and nearly up with the the latitude of "Cape Pilar," amounting to no less than 650 miles! Considering this great drawback in connection with the almost constant adverse gales, many of which were so heavy that no ship could bear canvass, it seems highly important to ascertain the most desirable route, if possible to avoid such serious dangers and delays. It was my intention to have doubled the Cape close, and keep near the land all the way round. But after making the "Diegos," the violence of the gales seemed to render it a matter of prudence to keep an offing, then there was difficulty in making northing without also making much easting. When we finally succeeded in again attaining the latitude of the "Horn," the gales were not so furious but that we could carry close-reef topsails. The second day after our departure from Diegos, the current had set us so far to the E., I could not believe my chronometer, and supposed that I might have inadvertently stopped her 10′, which I deducted in order to make our position where I wished it to be. I continued to work time every day when opportunity offered, and seldom missed a day, considering the dreadful weather. Arriving at "Juan Fernandez," *I found my chronometer perfectly correct,* and have since corrected the longitude for the 10′ subtracted. I mention the above to show that you may rely upon my observations upon the currents, &c., with more accuracy than is usually bestowed by merchantmen. Adverting to the winds of "Cape Horn," I would state that I projected wind circles like yours on the margin of your Chart of "Tracks" for the Cape. The result led me to expect S. W. and N. W. as the prevailing winds for the months of February and March; but it was our hard fate to find them from W. S. W. to W. N. W. per compass. I contemplate making the voyage round via China. If so, shall continue the abstract with such remarks on the movement of the elements and natural phenomena as may come within the range of my observation."

From Capt. Smyley to the same.

"In looking over your valuable Sailing Directions and Charts, which I consider the best guides ever given to the navigator in pointing out the means of shortening the passage to his port, as well as shunning the calms, which has caused so much detention in vessels crossing the Line, and also of the advantages taken by standing more to the westward, and passing nearer Cape St. Roque. I have tried both routes to my own satisfaction, and am well satisfied on my own part that the western route is far the best, and have for several years recommended it to be taken, and I am happy to say I have been since told by many that it is the most preferable.

I sailed from Newport, R. I., July 3d, 1836, in the schooner "Sailor's Return"—myself master—bound to the Falkland Islands and South Shetlands. The schooner "Geneva," Captain A. Padack, my consort, sailed the same day, and kept company with me until we arrived in the latitude of 4° N. and 25° West. The winds were light and baffling from S. W. to S. S. W. for one or two days. I stood to the westward, but *he* began to worry for fear of falling to leeward. I left him, giving him instructions to proceed with all possible dispatch, and meet me at the Falkland Islands: we were then in 4° 16′ North, and 26° West, wind S. S. W. The "Geneva" stood on her eastern tack, *I* to the westward, and arrived at the Falkland Islands twenty-one days before her.

On examining our journal, I found I gained thirteen days of the time between 4° North and 8° South, by nothing but his being afraid of falling to leeward; whilst I could lay the land along, he was continually tacking about; and as for a current, I tried several times, and found but very little setting N. W. There was the schooner "Ann Howard," of New London, had the same passage as the "Geneva," and took the same route; she had eighty-one days to the coast of Patagonia, and eighty-three to Port Desire, latitude 47° 45′ S., longitude 65° 54′ W. The A. H. sailed within one day of the Geneva, and arrived within two days of her, giving me twenty days ahead of one, and twenty-three ahead of the other.

"Sailor's Return," second voyage, sailed 22d August, 1838; and in thirty days was cast away at Cape St. Roque, standing along shore on the off-shore tack, having made the land that morning. I was bound in to Rio Grande North to repair my sheathing which had started off the bottom. I crossed the line in 35° 40′. I found no trouble in getting up the coast, until I struck on the reef at Cape St. Roque.

I found the tides tolerably regular at the Cape during the few days I was on shore, and the pilots say the currents are trifling on the coast from St. Roque to St. Augustine, when you are in more than forty fathoms water, and I believe it is true, for I have tried it since, and found very little, if any.

Schooner "Benjamin DeWolf," W. H. Smyley, master, sailed from Newport, R. I., for the Falkland Islands, 2d of April, 1839. Having a sharp vessel, and every confidence in my own mind of the western route, I determined to steer my course as if bound to Fernando do Noronha, and to pay no attention either to winds, weather or currents, no more than if such was not to be found on the route. I found no calms, and but little rain. I passed inside of Fernando do Noronha, distant twelve or fifteen miles, and passed Olinda in twenty-one days and eight hours, and from St. Augustine to Port Egmont, I had but twenty days—making but forty-one days, and eight hours, passage to the Falklands.

Schooner "Benjamin DeWolf," second voyage, W. H. Smyley, master, sailed from Newport, R. I., 28th May, 1840, for Patagonia, and arrived at Rio Negro, latitude 41° 4′ S. longitude, 62° 49′ W. in forty-one days, passing about fifty-five miles East of Fernando do Noronha, and crossing the Line in 36° 15′. I found the wind from N. W. to S. W., more than from any other quarter, from the line to St. Roque. The current I had no opportunity to try, but am sure it is more governed by the wind than anything else, but far less than people in general suppose.

Schooner "Ohio," W. H. Smyley, master, from Newport, R. I., to Rio Negro, Patagonia, sailed September 29th, 1842, in company with the "Sarah Ann," Gough, master—consort to the "Ohio"—kept company until in 16° North and 40° West. Captain Gough, as well as Padack, wished to cross the line well to eastward, and although they were both under my instructions and control, I permitted them to have their choice. After leaving Captain Gough, I steered for Fernando do Noronha as before, but kept on until I found myself in sight of Cape St. Roque, passing inside of the Rocases, ten miles, and by making a short tack off Mananguapa, passed Pernambuco, distant about eight miles, being then out thirty days. I stopped three days at San Francisco, and three at Isapacaray, making my passage to Rio Negro in sixty days, including stoppages.

The "Sarah Ann" made no stoppage, and came in ten days after me, making my passage sixteen days shorter than hers, exclusive of being embayed two days. I found by overhauling their Journal and Log that they kept well to the eastward in that old *beaten turnpike* of former navigators, crossing in from 24° to 25° W., and that most of my gaining was from about 4° N. to 8° S., which convinced me of the advantages of the western route.

Schooner "Ohio," first voyage, W. H. Smyley, master, sailed from Newport, R. I., July 14th, 1841—making my passage in fifty days, including two days stoppage at the Brazils for recruits. I passed so close to the Rocases, and not being able to get good observations, owing to the weather, that I am not sure which side I went on.

On my arrival in the Brazils, I tried my chronometer by artificial horizon, and found it correct. It was in the day time, and I kept a good look out for them, until I was sure I was to the South of them. This voyage I had no consort; I found but little current setting W. N. W., this was near the Rocases, perhaps one degree, or a little more North of them.

There is another thing still more remarkable: although you have more wind near the land, yet the sea is much smoother than it is further to the eastward. The natives who fish on the Catamarans along the coast, have repeatedly told me that the current was but trifling: you will often see two of these Catamarans at anchor, toiling in different directions, but generally with the wind. If the current about Cape St. Roque was as strong as persons in general imagine it to be, the clump built coasters would not be able to make head way, and beat from ——— up to Pernambuco at all seasons of the year as they do.*

*In consideration of this very strong evidence in favor of the western or new route to the Line, I append, by way of note, an extract from the Log-book of the Brig "Eolian," (C. A. L. Blanchard, master,) received while the proof-sheets of Capt. Smyley's letter are before me.

The "Eolian" sailed from New York, May 3d, 1851, with the Charts on board. She crossed the equator in 31° W.—June the 9th—passed St. Roque, June 12th, (40 days out) without going to the west of longitude 33°.

Schooner "Catharine," of Newport, W. H. Smyley, master, bound to Patagonia. I left Newport, September 10th, 1845, and stood to sea, with the intention of taking my old route, that is, to steer for Fernando do Noronha, or nearly that course, so as to pass East of the Bermudas, but the wind prevailing more to the South, gave me a chance to keep well to the eastward; I stood boldly on; but had the winds light, with heavy rain squalls, and much thunder and lightning; crossed the line in 23° 32′, making little head way, having light airs, and a very irregular sea. Although I found so much rain and light winds, the sea did not seem to fall in the least, causing the vessel to thresh heavily, and be very uneasy. I spoke a brig which had been eight days longer than myself in these rainy regions, and off Pernambuco I spoke one which had been ten days less, being to the westward of me. I was forty-five days to Olinda, and twenty days from there to Rio-Negro, Patagonia, and I fully believe, if I had taken the western route, I would have made a very short passage, as the vessel sailed very fast, was in good trim, and well manned.

Pilot boat "John E. Davidson," W. H. Smyley, master, from New-York, towards Coast of Patagonia, sailed July 5th, 1849.

July 6th - -	The Hook and Light-house in sight.			
7th - -	Wind W. S. W.	Latitude 38° 43′ N.	Longitude none.	True Longitude.
8th - -	Wind light S. E.	" 38 31	" none.	
9th - -	" S. S. E. and S. E.	" 38 14	" none.	
10th - -	" S. S. E. and calm	" 38 03	" none.	
11th - -	" Calm	" 38 00	" none.	
12th - -	" North	" 35 07	" 66° 53′	59° 07′
13th - -	" S. W. and calm	" 35 04	" 65 02	
14th - -	" South	" 34 48	" 63 21	
15th - -	" South	" 34 29	" 61 23	47 40
16th - -	" Variable	" 33 38	" 60 52*	

The Captain, in compliance with my general request, that every navigator would state in his Abstract whether he has had a longer or shorter passage than vessels arriving about the same time without the Charts, says:

"You will see by this Abstract, my passage has been somewhat lengthy, but in comparison with many vessels which have arrived without your Sailing Directions it has been short. One Barque from Boston having a passage of seventy-five days, and two Baltimore vessels (fast sailers) had a passage of sixty-eight and seventy days; also one from the same port of eighty-five days. The above vessels crossed the Line far to the eastward."

I have also the Abstract of the "N. B. Palmer," (Charles P. Low, master,) that sailed from New York, April 7th, (4 days after the "Eolian,") also with the Charts on board. She too took the new route:—she passed the "Eolian," May 10th, (the third day out) Both vessels that day crossed the parallel of 37° N.; the "Eolian" in longitude 56°; but the "N. B. Palmer" 8° farther West. This ship crossed the Line in 31° W.—June 2—aud the parallel of Rio, June 15th, or two weeks ahead of the "Eolian;" and from 29 to 46 days ahead of the vessels mentioned by Capt. Blanchard which had not the Wind and Current Charts, and which went the old route.

*Note.—The above is taken from the Log-book of the mate, the winds and latitudes are put down correctly, but the longitude is 13° 15′ out of the way. I merely put down this to show you how erroneous some persons will be. I gave him his longitude on the 16th, when I spoke a vessel whose longitude agreed with mine within four miles, but in crossing the Line, he was almost as *far out* again. I crossed the line in 34° 15′ on the 5th of August, and on the 7th passed ten miles west of Fernando do Noronha, the weather clear, the Island plainly in sight. On the 9th passed Pernambuco, I found no trouble in getting to the southward. It was my intention to have stopped at Pernambuco, for the purpose of landing some of my crew, who had mutinied on the passage, nearly killing my mate, and shooting me with a pistol. Their attempt to take the vessel, left me without a sufficient number of men to work her, which caused my

Homeward passages in the above mentioned vessels.	Days.	Hours.
"Sailor's Return" from Rio Grande North to Newport - - - - - -	17	4
"Benjamin DeWolf," first voyage, arrived from Morea Mernanguapa - - -	26	
" " second voyage, arrived in March from Morea Mernanguapa -	30	
"Ohio" from Rio de Janeiro to New York - - - - - - - - -	34	
"John E. Davidson," Rio Negro to New York - - - - - - - - -	39	16

In these five passages, after passing Cape St. Roque, I have kept "good full," and always found as I neared the West India Islands that the wind hauled favorably, and the weather became less squally.

Mernanguaba is a small port near Parahiba—See Chart.

There are few portions of the continent of America less known than from the Rio de la Plata to Cape Horn, and none of more importance. The whole of that portion of country, except part of Belgranna and Rio Negro, being inhabited only by Indians. It has been the custom of vessels bound to the Pacific, after passing the La Plata to go to the eastward of the Falkland Islands; some wishing to avoid running by La Agle shoal, others fearing to get *jammed* on the coast of Patagonia. This should no longer be an excuse, for the first does not exist, and of the latter there is no danger. I have cruised for the above mentioned shoal several times, taking a good departure from the Jasans and from New Island in the Falklands, and crossed to Cape Virginis and back in the long summer days, seeing no signs of it. In 1842, I left East Harbor, Staten Land, with my consort in company, and steered for the shoal, keeping about eight miles apart, the weather was clear. I kept men at the mast-heads, and saw nothing of it. My observations were to be relied upon; for I had on board three chronometers, which had been well proved at Cape St. John. I kept on for Rio Negro, and on my arrival, again tried my chronometers, and found them correct. I am well aware that no such shoal exists. I have since then tried to find it with the schooner, but without success. The Beagle and Adventure, and Captain Sullivan of the Navy, have also hunted for this shoal without finding it.

As for a vessel getting blown on shore on the Coast of Patagonia by N. E. gales, it is out of the question. I have spent twenty-two years of my life mostly from South Shetlands to the river La Plata, and once I remained six years without coming north of 41° S., and I cannot say that I ever knew during that time the wind to blow heavily directly on shore for twelve hours. My voyages being principally made for sealing or whaling, caused me to keep close into the coast, whereby I had the best opportunities for observing the weather, currents, tides, &c.; in fact my voyages depended partly on these, and it stood me in hand to make myself acquainted with them.

I have always found that the sooner I got to the westward, after crossing the Line, the better. I always

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passage to be much longer than it would otherwise have been. I kept but little reckoning afterwards, and that mostly in my head, for fear of another mutiny, for the crew shipped in New York for the purpose of taking the vessel, and nearly succeeded in doing so. The weather being squally off Pernambuco, I kept on for St. Catharine's, and arrived there on the 22d of August, on the 23d or 24th gave my men up to the U. S. Consul, on the 7th September, got under way from St. Catharine's, and on the 16th anchored on the bar off Rio Negro, Patagonia.

Giving me 30 days to the Line.
47 days to St. Catharine's.
56 days to Rio Negro.

try to make the Peninsula of St. Joseph's, between New Bay and Port Valdez. The land is high, steep, clay cliffs, flat on top. Then I endeavor to keep near enough to see the land, until I get well to the South, so as to pass close by Staten Land; by doing this, I have smooth water, winds from N. W. to W. N. W., and pleasant weather; while another vessel will have the wind W. N. W., and S. W. off the Falkland Islands, and on the South side of the Islands the wind will be from S. W. to S. This I have proved by having left men on the Jasans and the Bushenes, (these being the extremes of the Islands, both sealing grounds,) and requiring them to keep a journal of wind and weather. I found the wind to prevail much more from the S. W. and S. S. W., about one-third or one-half way between Cape Horn and ———, and beyond that distance it drew more to the westward, and even to the northward of West. It was a common thing while at anchor under Diego Ramirez, or sealing on shore, to see a vessel pass in-shore of the Island heading up two points higher than another vessel off shore of them; and I have often started to go in to anchor, heading well up for the place I wanted to come to at, and found as I drew in-shore, the wind gradually headed me off. When bound to Shetlands from the Cape, or from Staten Land (Shetland is our rendezvous on account of getting wood there to last until our return,) we always find after passing the latitude 60° S., the weather much milder, fewer blows, but more fog. The currents as well as the winds are generally the reverse of what they are off Cape Horn. The prevailing wind at Shetland is N. E., while in the tack generally taken by vessels, it is S. W. The current is similar, for it seems more like a Gulf stream than a common current following the direction of the wind.

No navigator should be afraid to approach the coast. Soundings are found far out, the water is much discolored, as the land is neared; and we have another sign that seldom fails in the day time, i. e. the small gulls which will always be found in forty or fifty miles of the coast, making their presence known by the noise they make, as soon as a vessel is perceived. This seldom fails to be the case.

The navigator should not be backward in tacking as soon as he finds himself getting off shore, for the wind will often lead him along for two or three points, and then favor him for a short distance again, by which means vessels often get so far to the eastward as to lose much time. I would always recommend a ship to tack in shore, even if she could make no better than a W. N. W. course in preference to going to the eastward; for by keeping well in, she will have smooth water, clear weather and wind more off shore. While on the other hand, when she nears the Falklands, she would begin to have fogs, rain, and sleet, and South of the islands the rain becomes hail-stones and snow. A short distance in these latitudes makes a great difference in wind, weather, and tides.

For comparison, take Santa Cruz harbor, on the coast of Patagonia, latitude 50° 8′ S., longitude 68° 21′ W., tide in spring forty-eight feet. The Jasan Island belonging to the Falklands, latitude 51° S., longitude 61° 20′ W.; tide but six feet; here is a great difference in 7° of longitude, about 260 true miles. This will show the extraordinary difference made in tides by a short distance, and the weather in proportion to the tides: on the one it is seldom known to rain, at the other it rains half the time. At the Straits of Magellan in a similar way: it seldom rains at the eastern entrance, and at the western it seldom stops; but this is owing more to the mountains leading from Cape Forward along the straits, and from thence to Cape Tres Montes or Chili.

Hereabouts we have but little thunder and lightning, but one may be on a hill above the rain, while those below have a heavy storm; I have seen this occur on Staten Land, also on Juan Fernandez and Massafuera.

Temperature in high southern latitudes differs greatly from temperature in northern; in southern latitudes there seems to be no extremes of heat and cold as at the North.

Newport, for instance, latitude 41° N., longitude 71° W., and Rio Negro, latitude 41° S., longitude 63° W. as a comparison.

In the former the cattle have to be salted and fed during the winter, not being able to get along in the fields on account of snow and ice.

In the latter, the cattle feed in the fields all the winter, there being plenty of vegetation, and no use for hay.

On the Falkland Islands, thousands of bullocks, sheep and horses are running wild in the country, getting a living all through the winter. This could not be in similar northern latitudes.

On the other hand in the latitude of 50° to 51° N., rye, barley, wheat, &c., can be raised during the summer, but in South latitude there is not sufficient heat in the summer to bring such things to maturity, for even in the depth of summer, you would be liable to snow squalls. After passing the latitude of 40° S., the summer is not so warm, and the winter not so cold as in northern latitudes.

You can see by reference to the book published by Commodore Wilkes, that the extreme cold had but in one instance been as low as 5° below zero. This I ascertained from a self-regulating thermometer, in latitude 63°, and gave him. Since that time, it has never been so low. The heat I could not ascertain, as the index in the tube shifted, while I was lifting the instrument up. I tried to procure one sometime ago in New York, but could not find one. I intended to have placed it in a much higher latitude, as very little is known about either extreme of temperature on the land. For instance, many suppose that Palmer's Land is a continent, and connects with the land laid down by Wilkes; however, this is not the case, for I have sailed round Palmer's Land and far South of it. * * * * * * * * * *

Owing partly to negligence and partly to disasters, I have no logs or books which will be of use to you. But I will try this cruise to send you some; and if you know of anything particular from the La Plata to as far as 70° S., I may be able to give you some information, for to that place I have given most of my attention, as my business has been there during the greater part of the time.

While I was at this book it occurred to me to send some leaves out of a *scratch* book which might be of some use in showing tides, harbors, &c., so I tore them out, and send them to you. I have done this very hastily and in a most bungling manner, but I did not know that I would have to go away so soon and would not be able to finish. So I have driven ahead and done what I could.

If you choose I will distribute those charts to men who I know will take care to return the journal to you on their return home, for I consider them to be a benefit to all seafaring men.

I will write you again before I leave."

The opinions expressed by these two navigators—Captains Bryson and Smyley—as to the passage to the Line, and the Cape Horn Route, are fully confirmed by the Pilot Charts; and though sometimes a vessel by going to the East of the Falkland Islands, may have good luck, fine weather, good winds, and a short passage, it should be considered as the exception, but by no means as the rule. The combined experience of all the Cape Horn navigators whose journals have been consulted during the progress of my investigations, is against the eastern, and in favor of the western, or inshore passage, as a general rule.

Capt. Young of the Ship "Venice," of Philadelphia, in his admirably kept abstract, makes some excellent remarks upon the subject.

Capt. Young's log is deserving of special notice also, for the very excellent use he makes of the barometer.

His remark that the indications of the barometer will show when the navigator enters and when he quits the trades, is perfectly philosophical.

In the calms, both of Cancer and of Capricorn, the barometer ought to stand higher—say one-tenth of an inch, (0.1) on the average—than it does either in the "variables" on the polar side of these belts, or in the "trades" on the equatorial side of them.

In the belt of the equatorial calms, it also ought to stand, on the average, a little lower than it does in the N. E. or S. E. trades on either side of these calms.

The close attention which Capt. Young gives his barometer, will, as a general rule, enable navigators in most cases to tell whether they have crossed the calms or the trade wind belts, or not.

Date.	Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M. Air.	Water.	WINDS. First Part.	Middle Part.	Latter Part.	REMARKS.
1850. Jan. 28	No obs.	—	—	—	29.6	55°	60°	N. N. W.	E. S. E.	E. S. E.	Discharged Pilot at 3.30 p. m. At 6 p. m., Neversink Lights bore W. I have determined, during the coming voyage, to keep the "Abstract Log" of Lt. Maury, and thereby, add my mite to the cause of science; in the hope that the day is not far distant, when navigation shall be so simplified, and reduced to "fixed principles," that all uncertainty may be removed.
29	"	—	—	—	29.4	59	68	S. S. W.	S. W	W. N. W.	First and middle part variable and baffling—latter, fine breezes. Strong rippling, which I judge to be the counter current of the Stream.
30	37°50′ N.	68°12′W.	1 ½ E. by N.	—	29.	62	73	W. N. W.	N. N. W.	N. N. W.	At 4 p. m., the water rose to 70°, and to 73° at 5—Water remarkably smooth, with a fine breeze blowing—Ship going fast.
31	36 55	63 32	19, E., & 5 W. S. W.	—	29.4	68	72	N. N. W.	N. N. W.	N. N. W.	Fine breezes and water smooth—temp. 73°—during the night fell to 72°; at 9.30, water 71°. Have paid particular attention to the Log since entering the Stream, and find that we began to leave the Stream about 9 a. m.
Feb. 1	35 21	60 27	15, S. W.	—	29.6	64	71	N.	N.	N.	Strong breezes with considerable sea—Barometer rising. I have determined to cross latitude 30° to the west of longitude 50°, if permitted by the wind.
Feb. 2	34 16	58 12	8, S. W.	—	29.8	66	71	N.	N. N. W.	W. N. W.	Fresh breezes & pleasant weather.
3	33 32	56 55	6, S. W.	—	29.7	67	71	W.	W. S. W.	S.	Fine clear weather—Barometer high and steady.
4	34 05	54 04	—	—	29.7	69	72	S.	S.	S. S. E.	Fine clear weather, such as is rarely met with at this season of the year in the N. Atlantic. I almost regret the wind hanging here, as I desire much, keeping to the West, for the purpose of giving the "Theory" of Lt. M. a fair trial, having a "weatherly ship," and no fear of "Cape St. Roque."
Feb. 5	34 42	51 30	—	—	29.6	68	72	S. S. E.	S. S. E.	S. S. E.	Fine clear weather—the horizon astonishingly clear. I scarcely recollect having more delightful weather—Steady glass—smooth water—everything indicating midsummer, more than the last 48 hours.
6	34 59	49 01	—	9 40 W.	29.6	68	72	S. S. E.	S.	S.	First part fine—middle, Bar. falling fast—dirty appearances—observed variation at sunset 9.40 W.
7	No obs.	—	—	—	29.	66	72	S. S. W.	W.	N. N. E.	Cloudy dirty weather—*not much wind*—Barometer steadily falling—Ship under short canvass—heavy appearances all round, and every appearance of a heavy gale.
8	"	—	—	—	28.6	64	72	N. N. E.	N. E.	S. W.	Glass still *falling*—heavy appearances—everything "snug" for a "blow."
9	"	—	—	—	28.4	64	72	S. W.	W.	W. N. W.	During the first and middle part, Bar. fell to 28.2, with very bad looking weather—At sunrise there was but little wind, but in less than half an hour, it blew furiously at S.W., veering to the West; the sea rose so rapidly I was obliged to "scud;" by 9 a. m., although the wind was blowing very heavy, *the glass began to rise.* Owing to the ship being deep, and steering badly, I was induced to try what I had frequently heard of; namely: paying a hawser out astern. I middled and payed out 45 fathoms

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	Ther. 9 A. M. Air.	Ther. 9 A. M. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
											of 11 inch hawser on each quarter, and found instant relief; so much so, that I shall most assuredly adopt it hereafter in bad steering ships.
Feb. 10	No obs.				28.6	68°		W. N. W.	W. N. W.	W. N. W.	The gale still continuing but every appearance of abating. I cannot forbear expressing the great benefit resulting from the trial with "halser," feel satisfied I could not have "scudded" without it. I regret being driven to the E.
11	27°06′ N.	38°42′W.	S. E. set in since last ob'n.		29.	70	72°	W.	W. S. W.	S. W.	First part moderating and hauling to westward and southwest—*since observation of 6th we have had* 40 miles S. E. set. In all my voyages across the equator, I have never been so far East in this parallel before; for although there can be no doubt that the westwardly route is best, yet I have had a great desire to give it a fair trial by keeping *farther than usual* to the westward.
12	25 34	36 31	W. S. W. ½ k.	11° W.	29.6	70	72	S. W.	S.	S.	Throughout moderate from southern board with a heavy N. W. swell, for which I allow 15 *miles set*, during the 24 hours, everything apparently combines to capsize my calculations. Var. observed 11° 5′ W.
13	25 18	35 42	W. S. W. ¼ k.		29.8	72	72	S. S. E.	S. E.	S. E.	During these 24 hours tacked several times to avail of a point or two in the wind. My great object is to make southing when possible.
14	24 34	35 56	None.		29.7	72	72	S. S. E.	S. S. E.	S.	Wind still hanging to the southward as I have never known before. Of course I fully expected the "*trades*" ere this, which perhaps increases the annoyance, as I shall almost entirely be deprived of availing of the Pilot Chart, which I approve of so much, that a trial thereof is imperative on me.
Feb. 15	23 30	35 12	None.		29.6	73	72	Variable	from South	to West.	Throughout variable from S. to W. I feel buoyed up that I am really to have the "trades" soon —since the 12th a heavy N. W. swell.
16	21 49	34 00	do.	13.20	29.6	73	72	W.	W.	W.	Wind breezing up again from westward.
17	20 26	32 58	do.		29.9	72	72	W. S. W.	W. S. W.	W. S. W.	Wind light and steady from W. S. W., with a tremendous N. W. swell, giving strong assurance that a gale has prevailed in that quarter, which may have interrupted the "trades." I think this the only reasonable way of accounting for their absence—Longitude per Sun and Moon 33° 3′, Chronometer 32° 58′.
18	20 00	31 44	do.		30.1	74	73	S. W.	Calm.	N. N. W.	Light airs from southward—middle, calm—heavy clouds with lightning to the N. W.—the only indication of "trades" is in the rise of the barometer, which I have generally paid some attention to. During 15 voyages across the equator, as master, I have never experienced anything like the present voyage; for at this season of the year we have every reason to expect the favorable winds of the "trades" after passing the parallel of 25°. It would be matter of much satisfaction to know what influence has thus thwarted them.
19	17 20	32 52	¼ k. W. S. W.		30.1	75°	74°	N.	N. E.	N. E.	First part light from northward—

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed*.	Bar.	THER. 9 A.M.		WINDS.			REMARKS.
						Air.	Water.	First Part.	Middle Part.	Latter Part.	
											middle, inclining to eastward—latter fine breezes and hazy appearance of these winds. The weather is really delightful, and quite a treat after the annoyances of the last ten days. I hardly yet dare to congratulate myself that the long-looked-for trades have come at last, but hope such will prove the case.
Feb. 20	14°32′ N.	32°20′W.	½ k. W. S. W.	11°15′	30.2	76	75	N. E.	E. N. E.	E. N. .E	Fine breezes—everything out, skysail, royal-steering sails, &c., going about 6 knots. The atmosphere extremely hazy—the remains of a new swell still perceptible—observation, Sun and Moon 32° 17′, chron. 32° 20′. During these 24 hours have observed *very great rippling* resembling in some instances the "tide rips" of "Nantucket shoals"—tried the temperature frequently without experiencing any change. I had intended to make the remark before, that we have not seen a bird or fish of any kind since crossing the tropic, which must be considered very unusual, particularly with regard to the birds.
21	12 16	21 16	½ knot W.		30.2	76	75	E. N. E.	E.	N. E.	Light winds and every indication of losing the "trades;" the *glass, however, keeps up*. It may not perhaps be amiss to pay some attention throughout this abstract to the barometer with reference to indicating the trade winds. The rise and fall thereof I have frequently noticed on entering and leaving the vicinity of trades. During these 24 hours the ripplings have been very strong, without any apparent change in temperature.
75 Feb. 22	9 49	30 30	1 k. W. N. W.	10	30.2	77	76½	N. E.	E. N. E.	E.	Light winds and hazy atmosphere—very frequent ripplings, more apparent from the extreme smoothness of the water—during the night light squalls, unattend-with rain. Sun and Moon 30° 31′. Variation observed 10°.
23	7 13	29 45	1½ k. N. W.		30.1	78	78	E. by N.	E. N. E.	E. by N.	Light breezes and hazy weather, water smooth, rippling very strong, indicating a strong N. W. current. These 24 hours the weather very fine, and although the barometer has fallen $\frac{1}{10}$ there is no apparent indications of losing our present favorable wind.
24	No obs'n.		1¼ k. N. W.		29.9	79	79½	E. N. E.	N. E.	E. S. E.	First and middle parts fine—midnight, barometer 30.1, at 4 A.M. 29.9—daylight, heavy appearances to S. E.—from daylight to meridian frequent squalls of wind and rain from S. E. Since 19th the barometer has remained up until within two hours of change from N. E. to S. E. I here predict it will remain below 30° until we cross the equator, or get without the influence of the rainy latitude.
25	3 10	28 40	1, N. W.	—	29.9	83	81	E. S. E.	E. S. E.	E. S. E.	Heavy squalls during first part—middle, strong breezes and heavy head sea—latter part squally—During these 24 hours, the Bar. has fluctuated *a tenth* several times—weather very warm and sultry—The first "Mother Cary's Chicken" of the voyage, seen to-day. Thus far, the voyage has

Date.	Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation observed.	Bar.	Ther. 9 A.M. Air.	Ther. 9 A.M. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
											been extremely barren of incident, not having seen any vessels for 20 days, and scarcely a bird or fish of any kind.
Feb. 26	no obs.	—	$\frac{3}{4}$, N. W.	—	29.9	82°	82°	E. S. E.	S.E. to SSE.	S.E to SbyE.	Throughout, heavy squalls rising at South; working round to S. E., with frequent heavy rain; weather very murky and close, at times quite oppressive.
27	2°24′ N.	28°57′W.	$\frac{1}{2}$, W. N. W.	—	29.8	82	82	—	Calm.	—	Throughout, calm with much rain; a confused sea from S. S. E.
28	no obs.	—	$\frac{1}{2}$, W.	—	29.8	82	82	E. S. E.	Calm.	—	Throughout, light airs and calm—heavy looking squalls, but unattended with wind—considerable rain at times.
Mar. 1	0 29	29 55	$\frac{3}{4}$, W.	—	29.8	84	82	E. S. E.	E. S. E.	S. E.	First and middle part heavy squalls of rain—Bar. fell to 29.7 at 4 a. m., up again to 29.9—Heavy head sea from S. by E.
2	1 27 S.	30 49	1, W.	—	29.7	82	82	S. E.	S. E.	S. S. E.	Throughout, fresh and squally from S. E., with rain—of course ship "close hauled"—heavy head sea from S. by E.
3	2 44	32 04	1, W.	—	29.8	83	82	S. E. by S.	S. S. E.	S. S. E.	Throughout, moderate weather, assuming the settled weather of the "Trades," *only requiring a rise in the Bar. to assure me of that fact*, and I confidently expect the coming 24 hours will so see it.
4	4 17	33 35	$1\frac{1}{2}$, W. N. W.	—	29.9	83	82	S. S. E.	S. E.	S. E.	Throughout, mod. fine weather—close-hauled by the wind—Mer. *Bar.* 30. *

*"I have no doubt that, although for the last few days the wind has been scant, yet 2° or even 3° more to West would have enabled me to cross, say in $31\frac{1}{2}$° or 32° without any fear, as from the experience of many voyages to Pernambuco, I never found any difficulty in *getting past* 'Cape St. Roque,' *even having crossed in* $34\frac{1}{2}$° on one occasion. In the event of falling to leeward, I would recommend beating along shore, *inside the reef* always. There are no dangers but visible ones; at least I found such the case, in beating up from the 'Rio Amagosa' a few years back."

Mar. 5	6°08′ S.	34°37′W.	1, W. N. W.	—	30.1	84°	82°	S. E.	S. E. by E.	S. E.	Throughout, mod. fine weather—every appearance of "Trades;" *Bar.* up.; at 8 a. m., made the land.
6	8 08	34 30	1, N. W.	2° W.	30.2	84	82	S. E.	E. by S.	E. S. E.	Throughout, moderate and fine weather; consider myself as fairly within the Trades.

* * * * * * * * * * * * * * *

MEM.—Having, as I consider, got to the westward far enough to make sure of not being "driven back," it may not be out of place to give my humble opinion with regard to the "mooted point" of making the passage around this "bug-aboo" Cape Horn. I most distinctly *disagree* with those who recommend keeping to eastward of the Falkland Islands; not conceiving the necessity of keeping so far to leeward, rendering the beating against a heavy head sea and strong current necessary. The chances for S. E. winds do *not* in my opinion, make up for the great difference in distance between eastern and western sides of those islands. My opinion is not predicated solely on the beautiful weather I experienced to the westward of those islands; but upon the fact, that to the northward and westward of "Staten Land," you are in a measure free from the heavy S. W. swell; which, by reference to *that* part of this *abstract*, it will be observed I had very smooth water, and so continued until I passed Staten Land. In Rio, I had frequent conversations with several whale captains, and their opinions are in conformity with my own. I do not hesitate to say the winter months (May, June and July) are the best for doubling the cape; with more certainty of easterly winds; the only draw-back being the interminable long nights. After all, I feel sure that masters in the European trade, who have, during the California fever, made the passage round the cape, will agree with me in saying, doubling Cape Horn is nothing in comparison with making the passage from Liverpool to New York, during our winter months.

June 2	55°09′ S.	77°30′W.			30.1	36°	41°	S. W.	S. W.	S. W. by S.	Throughout, heavy from S. W., frequent squalls of snow and rain.
3	none.	—	—	—	29.7	34°	42°	S. W. by W.	W. N. W.	W. N. W.	First part strong—middle more moderate with rain, ends strong with constant rain, under short canvass heading to S. W.
4	none.	—	—	—	29.5	44	42	W. N. W.	W.	W.	Throughout, heavy gales with constant rain. Bar. rose to 30.2 but fell again towards daylight, weather very disagreeable, *filled all our empty casks with most excellent water;* this may be considered rather singular at this season and in this latitude.
5	52 13	79 15	N. E. since last observation 52m.	—	29.4	46	43	W.	W.	W.	Throughout, strong from the westward.
6	49 49	80 05	N. E. $\frac{3}{4}$ knot	23°10′	29.7	44	44	W. by N.	S. S. W.	S.	First part, moderate—middle, squally with rain from southward, ends same.
7	46 28	80 47	N. N. E. $\frac{1}{2}$ knot	—	29.7	45	45	S. S. W.	S. W.	S. W.	Throughout, heavy with frequent squalls of wind and rain. The weather feels much colder than any we have yet had.

ABSTRACT LOG OF THE SHIP "VENICE"—CONTINUED.

Date.	Latitude, at noon.	Latitude, at noon.	Currents. (Knots per hour.)	Variation. *observed.*	Bar.	Ther. 9 A. M. Air.	Ther. 9 A. M. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
June 8	43°17′ S.	82°11′ W.	none.	22 15	30.1	49°	47°	S. W.	S. S. W.	S.	Throughout, strong breezes and frequent heavy rain squalls attended with much wind.
9	42 26	—	—	—	30.3	51	48	S.	Variable.	Variable.	First part light—middle variable and calm.
10	no obs.	—	—	—	30.	49	49	N. W.	N. W.	N. W.	First part light—middle fresh, latter strong and dirty appearances.
11	no obs.	—	—	—	29.8	52	53	N. W.	W. N. W.	W. N. W.	Throughout, dirty drizzling weather, blowing strong at times.
12	38 53	79 30	—	—	29.9	54	54	W. N. W.	N. W.	N. W.	Throughout, moderate, constant drizzling rain, very unpleasant.
13	no obs.	—	—	—	29.4	54	54	N. W. by N.	N. W. by N.	N. W. by N.	Throughout, moderate, constant drizzling rain, heavy W. N. W. swell.
14	38 03	80 12	—	—	29.4	60	54	N. W.	W. N. W.	N. W.	Throughout, a most shocking bad 24 hours, calm, heavy gales, torrents of rain, lightning, &c. This is the only *really bad* weather I have yet had, and altogether I have seen *very few* more decidedly unpleasant in my life. It is perhaps rendered more so from not expecting anything of the kind, presuming bad times had passed, with passing the cape.
15	no obs.	—	—	—	29.3	62	55	N. W.	N. W.	W. N. W.	First part strong, middle moderate, ends heavy gales and torrents of rain. The Barometer (during last 4 days) has fluctuated repeatedly from 30 to 29, several times in the course of 8 hours, presenting the most remarkable fluctuations I ever witnessed. Since 10th, the weather has been very much like the month of March North 34½° on the coast of U. States.
June 16	36 28	78 38	—	—	29.6	64	55	N. W.	W. N. W.	W.	First and middle very heavy gale, ends, moderating. Barometer down several times to 29.
17	34 28	78 59	—	—	30.	65	56	W.	W. S. W.	S.	Throughout, moderate. At 7 a. m. "Juan Fernandez" in sight bearing North.
18	34 09	80 01	—	—	29.8	65	56	Calm.	N. N. W.	N. W.	First part calm—middle stong—latter blowing hard, much rain. Barometer fluctuating $\frac{5}{10}$ several times during the 24 hours. At 8 a. m. "Massafuera" in sight West per compass.
19	no obs.	—	—	—	29.6	65	57	N. W.	N. W.	N. W.	Throughout, heavy weather, with almost constant rain. The fluctuations in Barometer still continuing, causing a deal of uneasiness, I have never had anything like it before, and this after being an attentive observer of that instrument for more than 22 years.
20	32 10	78 38	—	—	29.6	66	58	N. W.	N. N. W.	W.	Throughout variable, but most remarkable, from calm to laying to, torrents of rain, clear, lightning, heavy sea, smooth as a mill pond; and thus, during the 24 hours every variety of weather under the sun, with the same fluctuations in the Barometer. I am disposed to think *all this* is occasioned by, or prelude to, some great change, perhaps an earthquake, who knows?
21	29 58	79 41	—	15 45	29.9	63	59	S. W.	S. S. W.	S. S. W.	Throughout, squally with rain; wind during squalls hauling far as W. N. W.
22	28 46	79 51	—	—	30.	65	59	S. S. W.	Calm.	N. W.	First part squally—middle calm—latter part moderate. By looking back, it will be seen I have been unable to get to the West, being desirous of crossing the equator about 115°, at the suggestions of many experienced "Whalemen." My own judgment would have suggested 90°,

ABSTRACT LOG OF THE SHIP "VENICE"—*CONTINUED.*

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A.M.		WINDS.			REMARKS.
						Air.	Water.	First Part.	Middle Part.	Latter Part.	
											but the above advisers recommend their crossing far West, on account of better winds.
June 23	26 50	78 45	—	13 50	29.9	66	62	N. W.	N. W.	N. W.	Throughout, light winds and smooth water; wind at times favoring, so as to lay North, but mostly N. N. E., which, with the Variation, makes easting fast.
* 24	25 29	79 40	N.N.E. ½ knot.	—	30.	66	64	W.	W. S. W.	S. W.	Throughout, light winds and drizzling rain most of the time; but wind being so much better than of late, the change is quite acceptable.

* The rest of this excellent log is omitted because it throws no further light upon the subject.—M. F. M.

To California.

From Cape Horn, Valparaiso, and Callao, to the Line in the Pacific, is all plain sailing. The only charge which it is necessary to give navigators thither bound, is that they keep well off from the land, in order to be sure of better winds.

From the equator to 5° N., between 95° and 100° W., the wind is pretty steady between S. S. E. and E. S. E., all the year, except from January to March, inclusive. In March, it blows about one-third of the time from northward and eastward; and, about one-fourth of the time from the same qaurter, in January and February.

From this crossing, the wind is almost always fair to take you across the parallel of 10° N., in about 105°—say in 107° W.

From this parallel you will, also, generally have fair winds for crossing that of 15° N., between 110° and 115°; but in April, May and June, the winds will occasionally have too much northing in them for a N. W. course, good.

From this crossing and parallel, stand on to the northward and westward, unless the wind be from that quarter; when however the wind is from the northward and westward, stand on that tack upon which you can make most northing, aiming not to cross 20° N. much, if any, to the east of longitude 120° W.

Between the parallels of 20° and 25° N., from longitude 120° to 130° W., the wind prevails from—indeed it is from some point between—N. E. and N. W. *always*, except occasionally in the months of February and March, June, July, and August—when it is most variable.

Between the parallels of 25° and 30° N., and west of the meridian of 120°, the wind for a thousand miles out to sea, is steady between N. and N. E., inclusive, from May to October. In the other months it is frequently from the northward and westward.

After crossing 30° North, on your way to California, the winds are most of the time fair for making easting, and therefore for going into San Francisco. The object, then, of vessels after crossing the parallel of 20° North, and getting west of 125° is to make northing, and always to prefer that tack which will give them the most of it, and at the same time keep them from making the land south of their port. It is well to caution navigators not to be too anxious to get to the eastward in this part of their passage. They will occasionally find themselves above the parallel of 40° before they can lay up for their port.

As a general rule, vessels bound into San Francisco should not care, in this part of their route, to get east of the meridian of 125° west, until after they have got well up to the parallel of San Francisco.

The route here recommended from the Equator to California lies for the most part, through a region but little liable to long continued calms.

Vessels that are bound from Cape Horn to California without touching, may do well by crossing the equator a little to the west of the point here recommended. But if they cross too far West—as far as 115° or 120°, for instance—the winds then for the rest of the way, being chiefly the N. E. trades—it makes it the more difficult to get North without standing very far to the West.

It is a mistake, therefore, to cross the Line far to the west of 100°, on your way to California. But on this route in the Pacific, the turning point of the passage is not where to cross the Equator, but where shall you cross the parallel of 20° N.

The winds between 20° and 30° North, on this voyage, are mostly from the northward, i. e., they are mostly from the northward and eastward, and therefore adverse for making a north course. And the object with every navigator, after crossing this parallel, should be to get to the North, and consequently, to keep his ship on that tack which, without placing her under the land, will enable him to make most northing.

After reaching the parallel of San Francisco, or passing a little to the north of it, there is generally no difficulty in getting to the eastward. Aim, when the winds are fair, and you have your choice, to cross the parallel of 35°, in about the longitude of 125° W.

The advantages of crossing the Line near longitude 100°, and of not going to the west of 110° or 115° till you get the N. E. trades, are briefly these: when you do get the N. E. trades, by being well to the eastward, you can afford to make free winds of them, and so run off to the northward and westward, making up your longitude in a part of the ocean in which, cross the equator where you will, the winds will force you off still farther West. Let your crossing be where it may, the N. E. trades will, before you get through them, have forced you off 20° or 30° to the west of the meridian under which you may have crossed the equator. Thus, suppose you cross it in longitude 100°, you will be as far as 120° or 130° West, when you leave them. So by crossing the equator under the meridian of 120°, you will generally find yourself in 140° or 150° W., by the time you get through them.

Another reason for crossing near the meridian of 100°, is, that here you will carry the S. E. trades farther North than you will when you cross more to the West. In the summer and fall, they sometimes will take you up as high as 15° North; and a northwest course then, which from 10° to 15° N., is the course you want to make, till you clear the N. E. trades, is nearly always practicable.

By crossing the Line in 95° or 100°, and standing away thence to the northward and westward, you keep clear of the influence of the land; traverse a region of good winds; and when you loose the N. E. trades and get into the region of calms, which correspond to our "Horse Latitudes" in the Atlantic, the vicinity of the land interrupts the calms, and your eastern position places you nearer your port, and of course, shortens your time for fighting calms and baffling winds in the calms of Cancer.

I have the winds got out for a Pilot Chart from the equator to 30° N., all the way across the Pacific.— This Chart is not quite ready for publication, but these directions are deduced from it; and it has satisfied me that the route to California, recommended at page 218, to vessels after doubling Cape Horn, is somewhat too far West.*

The Farellones, seven small islands, about 30 miles from San Francisco, are in the fair way to the harbor. They afford a fine land-mark, and should be made by all inward-bound vessels. The true course from

*They show that, had the "Flying Cloud" have had the benefit of the information which I now, for the first time, have it in my power to impart, she would probably have shortened her passage from the Line in the Pacific to San Francisco, some four or five days, thus the South Farellon to the mouth of the harbor is about N. 73° E., *true*, distance 27 miles; or by compass N. E. by E. ¼ E. "The Fort on with the south point of the Island of Alcatraces," is said to be the best course in.*

From California to China.

Bound from west coast of United States to China, make an offing, and run down to the southward and westward, till you get south of 25° N., and well into the N. E. trades. In February and March, it will be necessary to go farther South for the strength of these winds, than at any other season.

For the information of vessels bound into Shanghae, I copy from the "North China Herald" the following by a "Young Salt."

"Vessels bound to Shanghae, should make the Barren Islands or Saddle Group, in the northerly monsoon, as being the most weatherly land-fall; but in the southwest monsoon, it is more advisable to steer for Monte Video, a bold, precipitous island, about 40 miles more southward.

reducing that most remarkable of all passages to 83 or 84 days. Her passage from the Line to San Francisco is not remarkable. It was 20 days. The "Seaman" crossed the Line in 118° and had 18 days thence to San Francisco. The "Surprise" crossed it in 110° and had 16 days: each gaining as they approached the true crossing place. The average passage from the equator to San Francisco, is about 27 days.

The "Flying Cloud" sailed from New York June the 2d, 1851; went the new route; crossed the Line in the Atlantic, June 24-5, in Long 33°; and cleared Cape St. Roque thence in two days.

She passed inside of the Falkland Islands July the 20th, and on the 24th was around the Cape; having in the meanwhile, rode out a furious gale that lasted two days.

In Lat. 37° S., July 31st, she took the wind from the southward and eastward, and so carried it to Lat. 12° N. in 127° W.—having crossed the Line in the Pacific, August 12th, in 124° W.

She was a day in the "doldrums," between these two systems of trade winds. Finally she took the N. E. trades about the parallel of 14° N. in 127° W. They held on to the *North* of N. E., having forced her on the 24th as far as 142°, on the parallel of 35° N.; from which point, after fighting for 5 days with the wind from the northward and eastward—right in her teeth—she had two days of N. W. winds which she got as she neared the shore, and so ran in at daylight of Sept. 1st.

Now compare this route with the route which the Pilot Charts point out:—and the Pilot Charts of that part of the route, not being ready for publication, of course Capt. Creesy could not have had them to guide him.

Here are the probabilities in favor of a shorter passage, had Capt. Creesy been furnished with the lights which the Pilot Charts now give us:

From his position July 31st, in Lat. 37° S., Long. 96° W., with the wind from the southward and eastward, he steered to the northward and westward, crossing the Line in 124° and the parallel of 12° N. in 127° W.—too far West.

Now had these Sailing Directions been on board, they would have recommended him, July 31st, to steer for the meridian of about 100° W., on the Line, and 107° on the parallel of 12° N. This would have given him the wind abeam and on the quarter, instead of farther aft, for this run of 16 days with the S. E. trades; would have saved him from an elbow of 24° of Long. on the Line;—and placed him in a position from which most of the winds that afterwards proved adverse—forcing him out beyond the meridian of 142°—would have been fair winds; thus enabling him probably to have reached his port without having ever gone beyond 130° W.

Capt. Creesy's log came to me while I was reading the final revise of my remarks on "the route to California."

What is here said of the "Flying Cloud's" unprecedented passage, is an interpolation of what was already in type upon the subject of the California route. And Capt. Creesy, therefore, will understand that my remarks as to his passage, are made only for the purpose of illustration, and not for the purpose of intimating that he did not navigate his ship well. On the contrary, he did. With the lights before him, the navigation of that ship was faultless, and her master may challenge the annals of navigation, past and present, to afford another instance of such navigation and speed. For 26 days, consecutively, that ship averaged, according to her Abstract Log, two hundred and twenty-seven two-fifth nautical miles a day; her least performance for any one day being 93 miles, and her greatest THREE HUNDRED AND SEVENTY-FOUR; 374 nautical miles are equal to 433⅓ English or statute miles; which give the extraordinary feat of a vessel, under canvass, having averaged for 24 consecutive hours the enormous rate of $15\frac{7}{12}$ knots, or *eighteen statute miles, per hour.*

* See Sailing Directions by Capt. Cadwallader Ringgold, U. S. N., 1851.

"If late in the day, anchorage should be caught under the Saddle Islands, which afford shelter, in both monsoons.

"Leaving the Saddle Islands, keep the North Saddle, bearing about S. E. by E., to pass Gutzlaff, at a distance of about 15 or 16 miles; and no stranger ought to enter the river, without seeing Gutzlaff, until some mark be erected for the North Sand Head.

"Thus far, the tide sets N. W. by W., and S. E. by E., from one and a half to three and a half knots; but it is affected greatly, both in direction and velocity, by the prevailing wind.

"Steering on to the north-westward, bring Gutzlaff to bear S. S. E., and sink it, on that bearing, which will be at a distance of about 22 or 23 miles; after which, steer N. W. ½ W., and if the low land is not soon seen on the port-bow from the masthead, keep more westerly by the lead, which is here a safe guide. The deepest water is near the north bank, which should always be approached with caution, as it shoals very suddenly. When the first point bears W. by N. or W., the water deepens to six fathoms; this point should be passed about two miles off, as the bank extends a long way out, and there are several knolls off it, on which ships have touched.

"Having passed the point, gradually close with the shore to a mile, and keep it about that distance, until the beacon at Woosung is seen.

"If working up from the Saddle Islands, do not bring Gutzlaff to the eastward of South, until 15 or 16 miles to the northward of it, when it may be brought to bear S. S. E., and you will then be on the edge of the south bank.

"You may now stand to the westward nearly into the vessel's draught, bearing in mind that the flood sets W. S. W. round the S. E. edge of it; and the ebb contrary.

"All vessels should keep as near as possible to this bank, and not wait for a shoal cast to tack, when standing to the north-eastward.

"I think the defect in the directions hitherto given, is chiefly, that vessels are not advised to get hold of the south bank as soon as possible.

"From the Saddle Islands to Woosung, the tide generally sets N. W. by W., and S. E. by E., when fully made, if no cause, such as N. E. gales or heavy rains interfere; but the flood makes first to the southward, then S. W., and N. W. at the entrance of the river;—the ebb making North, passing by N. E. to S. E., and it is at turn of tide that most caution is necessary to avoid being set out of the channel. I have found the set of the ship pretty correctly by the deep sea lead, and have on several occasions gone up the river at night by its guidance. Having passed the first point, which the "Conway's" surveyors mention to be distinguishable by a large tree, (although I could never make out any tree there sufficiently remarkable,) work up from three-quarters of a mile to two miles off shore, and do not wait for a second shoal-cast on the north side. The narrowest part of the channel is where the house on Blackhouse Island bears N. E. by E. It is here about 1¼ miles wide.

"When the ships at Woosung are open, a peaked tower, near the town of Poushan, will be seen to the westward; and on the embankment in front of it a beacon, which must be kept a little open to the southward of the tower, until another large beacon, at the entrance of the Shanghae river is on, between two Joss poles behind it, painted red, and bearing W. S. W. This last is an excellent mark for the channel, which is very contracted. The beacon may be sought a little open on each side of the poles, and the water shoals gradually on each side; but the tide does not set exactly fair through.

"Chinese pilots are in attendance here in sanpans, although with a fair wind they are not required, as Collinson's Chart of the Shanghae river is very good.

"The foregoing remarks apply to vessels of a heavy draught—say eighteen feet. Small craft may use much more freedom, closing with the south bank when Gutzlaff is twelve or fifteen miles off to the southward, and working up with the lead for a guide, never coming over half—three fathoms to the north-eastward. The southern shore is to be depended on all the way; but when within ten miles of Woosung the bank is very steep, and should not be approached under three-quarters of a mile."

Bound from China to Oregon and California, the course is to the northward and eastward, until you get as high as the parallel of 45° or 50°. Here, Southwesterly winds prevail, and they will take you along rapidly. The average sailing passage by these routes, between China and the Pacific ports of the United States, may be brought down to something less than 45 days. Smart vessels, well handled, may, with good luck, do it in less than 40 days.

There is a stream of warm water, from China to our N.W. coast, answering to the Gulf Stream of the Atlantic. The waters for it are heated up in the Bay of Bengal, the Indian Ocean, the Java and China seas. The Aleutian or Fox Islands are on the northern edge of this stream, for like our own Gulf Stream, it takes the great circle sweep across, running up in the middle of the ocean far towards the North, and then running down to the southward and eastward along the West Coast of America.

On the coast of China, and inside of this Gulf Stream, is a current of cold water, corresponding to that along our Atlantic coast. It is well, therefore, for navigators on the voyage from China to our Pacific ports, to know how to avail themselves of this stream.

It is exactly to the Pacific what our Gulf Stream is to the Atlantic; and navigators who, when bound from Charleston, S. C., to Europe, know how to take advantage of its drift, will, by a parity of reasoning, know how to take advantage of this Pacific stream, when bound from China to the ports of N. W. America.

I have some records of a Sargasso or weedy sea, in the Pacific, between the latitude of 30° and 40° N., and west of California. This corresponds to the Sargasso of the North Atlantic. Navigators are requested to pay particular attention to the currents, the water thermometer, the fogs, weather, weeds and drift of the North Pacific.

I feel that an apology is due to the sea-faring community, for the disjointed manner in which these "Sailing Directions" are gotten up. But it must be recollected that new, useful, and valuable information, touching some one department or another, embraced by these researches, is continually pouring in upon me.

And therefore, how disjointed soever this work may be, or how disconnected soever it may appear to others, I, for my own part, have not hesitated to sacrifice appearance to utility, and to give the public the benefit of all the information I have received up to the latest moment, however far from its appropriate place in the body of the work, the scraps of information so received might appear.

For instance, the following communication from Captain McKenzie, properly belongs to the chapter on whales, pp. 77–212. But that chapter has been in print for several months, and the letter was received while I was actually reading the proof of the very last page of this work. This letter may have the effect of provoking whalemen to give me further and fuller information upon this interesting subject; and therefore, actuated with the hope of eliciting such information, I do not hesitate to make room for it, however out of joint it may make my work appear.

From Capt. McKenzie to Lieut. Maury.

NEW BEDFORD, *October 20th*, 1851.

"The Whale Chart is a precious jewel; it seems to have *waked* up the merchants and masters to the practical utility of your researches in their behalf; there is not, and cannot be but one opinion, and that highly favorable: it is sought for by all interested in whaling. * * * * * *

All our Arctic fleet, after passing Cape Horn, touch at the Sandwich Islands for recruits; hence you will notice, that on a course direct, they would pass over an immense region of almost barren ground.

But (as I tell them all) with the Whale Chart before them, they would have the united experience of more than fifty years, as to the *whereabouts*, and probable locality of whales.

And as sperm oil is by far the most valuable of their catchings, they would protract their passage but little, by steering through the thickest of the whales, as laid down upon the chart, till they reach the latitude of 4° or 5° South, then westward to meridian of the Sandwich Islands before crossing the equator; the loss of time would be nothing, when compared to the more than probable prospect of taking sperm oil.

While writing of sperm whales, whose history I like to dwell on, I would mention a rather mysterious, and to us, (old whalers,) singular phenomenon, in regard to their remaining under water, or in any event, out of sight of those cruising for them, for days and weeks together; and when found—I mean the large males, (or bulls as they are called)—either alone, in shoals, or with the cows, their heads are lacerated and covered with scars, and deep old ulcers, evidently caused by fighting one another. This conclusion is obvious, from the regularity of the two lacerated lines, such as would be drawn by the two rows of teeth they have, and the distance apart of the old ulcers, just such as their teeth would be likely to inflict. This is remarked by all whalers, and corroborated by my long experience. If they fought on the surface, should we not find their wounds bleeding? If their wounds were recently inflicted, would they not have that appearance?

There is much doubt entertained here, whether the right whale, (or *Bowhead*,) as those are called, found in Japan and Ochotsk seas, in Anadir Bay, Behring's Straits and Arctic Circle, is the same as those found in Davis' Straits and Baffin's Bay.

Capt. Alyn, of ship "Rodman," on a recent voyage, while at the Sandwich Islands, saw a Capt. *Hasagen*, who commanded the "Clemanteen," a Bremen whaler; said captain had been whaling two seasons in Japan and Ochotsk seas; he had also been two voyages whaling, this side, in Davis' Straits and Baffin's Bay; he noticed a marked difference about the head, and thought them a separate species of the right whale; the heads of the *Bowhead* whale of the Arctic region, being entirely smooth, having no protuberance or crown, in which barnacles are thickly and deeply imbedded, as are those found in Baffin's Bay, South Atlantic, and South Pacific.

Messrs. Perkins and Smith, are owners of ship "McLellan," of New London, now on her second voyage whaling in Baffin's Bay and vicinity. I have written those gentlemen to make the inquiry of Capt. Perkins or any leading officer that might be at hand, as to the different organization (if any) as above. They kindly replied to my note, by stating, that no means were at present attainable to gratify my curiosity, but they were expecting the "McLellan" home soon, when they would make the investigation sought, and again write me.

All the evidence I can give in regard to a water communication from Behring's Straits to Baffin's Bay side, is: that I have caught and eaten at the Aleutian Islands, and at Kamschatka, the same halibut, codfish, herrings and salmon, that are caught from the waters that wash the coast of these New England States:—and that I have caught, or tried to catch, fish along the Pacific coast from Chiloe to Kamschatka,—from thence along the western Pacific,—often at the islands,—at New Zealand, and at Van Dieman's Land,—and have never found either of the kinds of fish above mentioned.*

What I have seen, therefore, I do profess to know and understand; and in my reminiscence west of Cape Horn, where I have spent (on board ship) thirty years of the best of my life, it will not, I trust, be deemed presumptuous, should I rely upon, and boast a little of, great experience in that region."

* I have understood that codfish are to be caught in great quantities at the island of Juan Fernandez.—M. F. M.

Conditions upon which the Wind and Current Charts are furnished to navigators.

These charts are based upon information collected for the most part by private ship-owners and masters. This information being furnished to the Government gratuitously, the Government incurs the expense of publishing it and of making it available to navigators. The Government then offers a copy of the chart so published to every navigator upon condition that he will continue to keep and forward to this office abstract logs of his voyages, which abstracts are required to be kept according to the form herein prescribed.

Every navigator who, after receiving a copy of the charts, fails to comply with these conditions, viz., to keep abstracts of his voyages as per form, and to transmit them to me at the National Observatory on his return to the United States, forfeits his claim to all future publications.

The charts are to be had on application either at the National Observatory, Washington, or of George Manning, New York; provided the applicant will conform to the agreement stipulated in the following form of the receipt, which he is required to sign for such charts as he may receive.

FORM OF RECEIPT.

"*Received this day of* 18 *from one Abstract Log, and sheets Nos. Maury's Wind and Current Chart, for and in consideration of which I promise to keep in the manner and form prescribed, journals of all my voyages, and on my return to the United States at the end of each voyage, to transmit said journals to the National Observatory.*"

A list is preserved of all to whom charts have been given, of all who have complied with their promise, and of the few who have not. These last are reminded that they forfeit their claims to any new supply of Charts, by neglecting to return to this office abstracts of their logs, according to form.

A form of the Abstract Log is appended, and I take this opportunity to say, the *point* of the compass from which the wind blows is what is wanted, also the variation *observed*, and not the variation that is taken from charts or books.

☞The Abstracts are to be bound. Navigators in keeping them and in cutting them out to be returned to this office, will please bear this fact in mind—and leave blank margins for binding;—and enter their winds, remarks and the like, so that all for the same day may be read at one opening, as on the pages 314, 315.

And whalemen will please recollect that their abstracts must embrace for *every day they are not at anchor*, a regular record of their Lat. and Long., force and direction of the wind three times a day, temperature of the air and water, and mention of whales whenever seen.

ABSTRACT LOG of the

Date.	Latitude at noon.	Longitude at noon.	Currents. (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M.		WINDS.	
						Air.	Water.	First Part.	Middle Part.

☞ Leave broad margin.

☞ NOTE.—Frequent mention has been made and much stress laid in this work as to the peninsula of cold water, in the North Atlantic, and as to the probabilities of soundings far to the southward and eastward as well as to the northward and eastward of the Grand Banks.

The ship "Hudson," Capt. Simpson, is said to have got soundings in 35 fathoms—mud—about Lat. 45° N., Long. 43° W.

Capt. M. D. Ricker, of the "Antarctic," on a voyage last June from New Orleans to Liverpool, reports a most remarkable change both in temperature and color of the water—the former may possibly have been caused by an iceberg, still it is very desirable to have more temperatures and soundings near the same place. This phenomenon occurred between his position, Lat. 39° 38′ N., Long. 63° 6′ W., at noon June 24th, and his position the next day at noon, viz. 39° 44′ N., 61° 2′ W.

I quote from the very excellent and valuable abstract that he has returned to this office.

Sea Account, June 24, 1851.

"At 1 P. M. observed the water to be much changed from a blue to a very light green, caught up the thermometer and hove it over, and looking at it I was very much surprised to see that it had fallen 11 degrees since 9 A. M., which was then 77, and I judged within the influence of the Gulf. One hour after, it had fallen to 54°, and in 25 minutes after, to 52; the color of the water a very light green, the ship going about 4 knots to the eastward with a light breeze from the West. At 3 P. M. a fog-bank was approaching the ship from the N. N. W. and N., which soon enveloped the ship in a cold mist, and changing the wind to that quarter, and bringing with it some considerable swell. Observed great quantities of chips, rockweed and some few sprigs of gulf-weed. Luffed the ship up in the wind and tried for soundings with the patent lead, but in the hurry did not get down but about 80 fathoms—no bottom—4 P. M. water 56°, and at 8 do. 66°, and at 12, 70°, wind W. by S.

I notice on the chart there is a bank or shoal laid down in this neighborhood, called Anne Bank, and in the "Memoir Atlantic Ocean" it is called ———— Reef, the position of which has not been very accurately determined. It is mentioned as being in about Lat. 39° N. and 64° 20′ W. Our Lat. by observation, one hour before I tried the water or at noon, was 39° 38′ and Long. by a good chronometer 63° 06′—[2, in fact, very good ones.]

I think if there was any bottom there, we had probably got past it before I sounded. During the following 24 hours we have had very little if any gulf current."

Commander, bound from to 18

WINDS.	REMARKS.
Latter Part.	

Enter under this head, force of wind, kind of weather, state of barometer just before, during, and after gales of wind. The changes and the time of changes of the wind during gales; sudden changes in temperature or color of the water, and the time when such changes are first and last noticed.

Discolorations of water, tide rips, sea-weed and drift. Flocks of birds. Whales, stating whether they be sperm or right, in shoals, pairs or single.

Always mention thunder, lightning, fogs, rain, snow, dew and hail, meteors and auroras, &c., pumice stones found floating at sea; fall of dust, &c.

When falls of dust or red fogs are encountered, collect and send specimens; and note all atmospherical or other *phenomena of interest to navigation.*

And when any of the routes herein recommended are tried, state whether you have had a longer or shorter passage than vessels sailing about the same time *without* the "Wind and Current Chart" on board, or without having tried these routes.

It is very desirable to know the temperature of the water, even for a few feet below the surface. Therefore, those vessels that are provided with the means of letting water into the hold, would render a valuable service, by drawing a bucket of water through the cock daily, and recording its temperature. Let the water so drawn run a little while first, so that it may be of the natural temperature. State the depth of the cock below the water.

☞Keep your Abstracts on paper of this size, and leave a *large* margin in the middle for binding.

☞Leave broad margin.

ERRATA.—Page 68—line 4—for "73°" read 72°.

" Page 179—line 21—for "Plate IV" read Plate IX.

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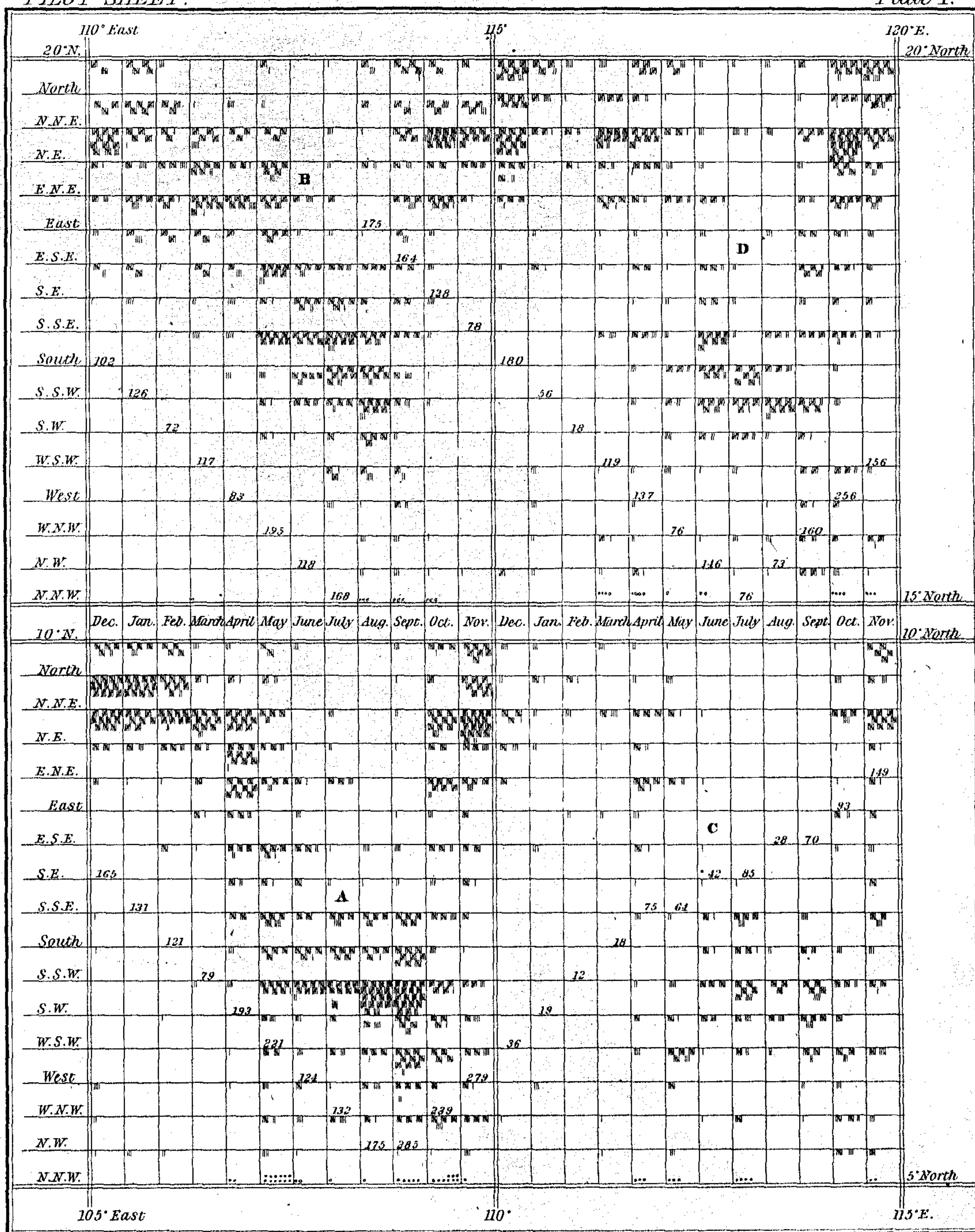

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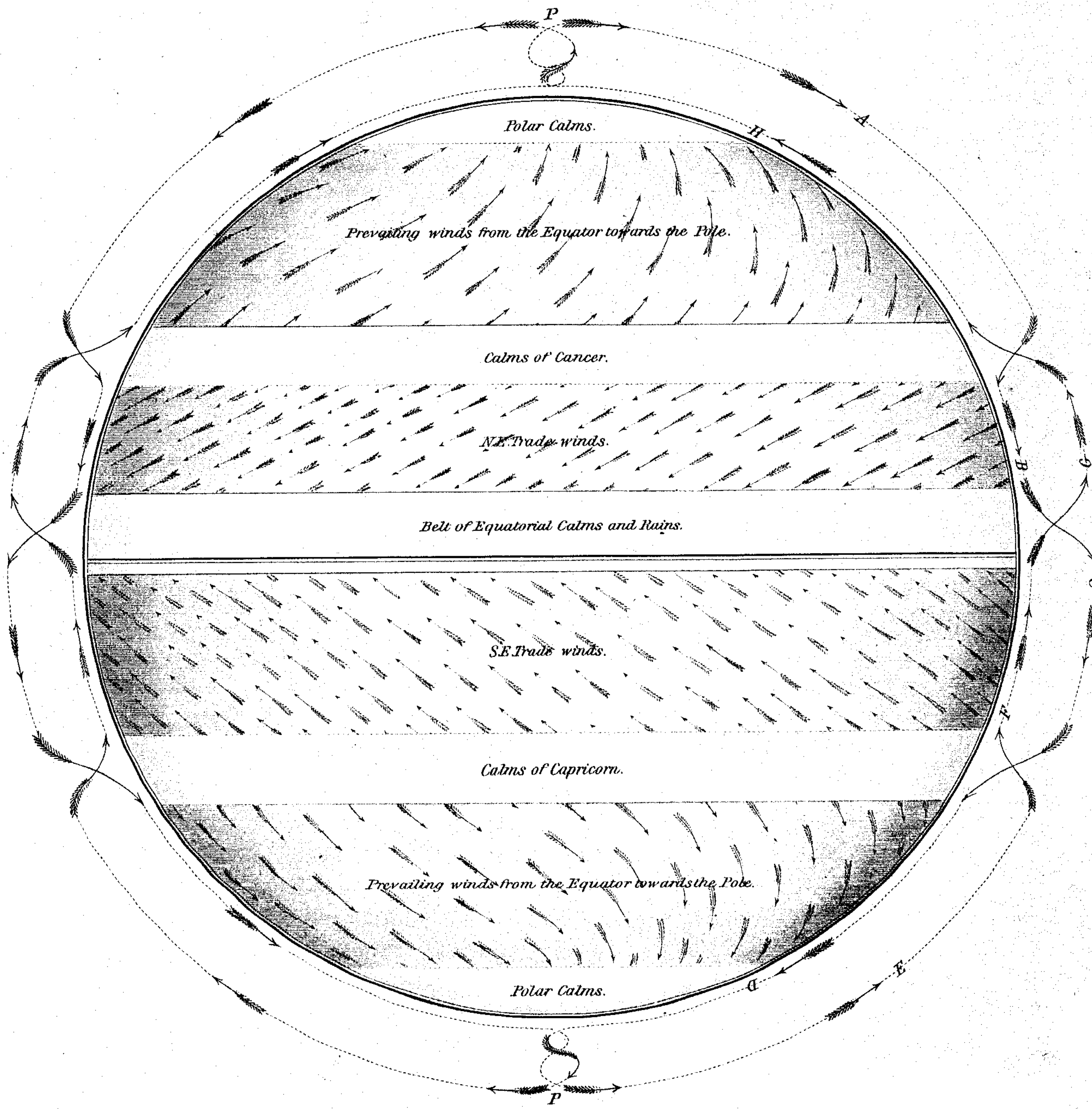

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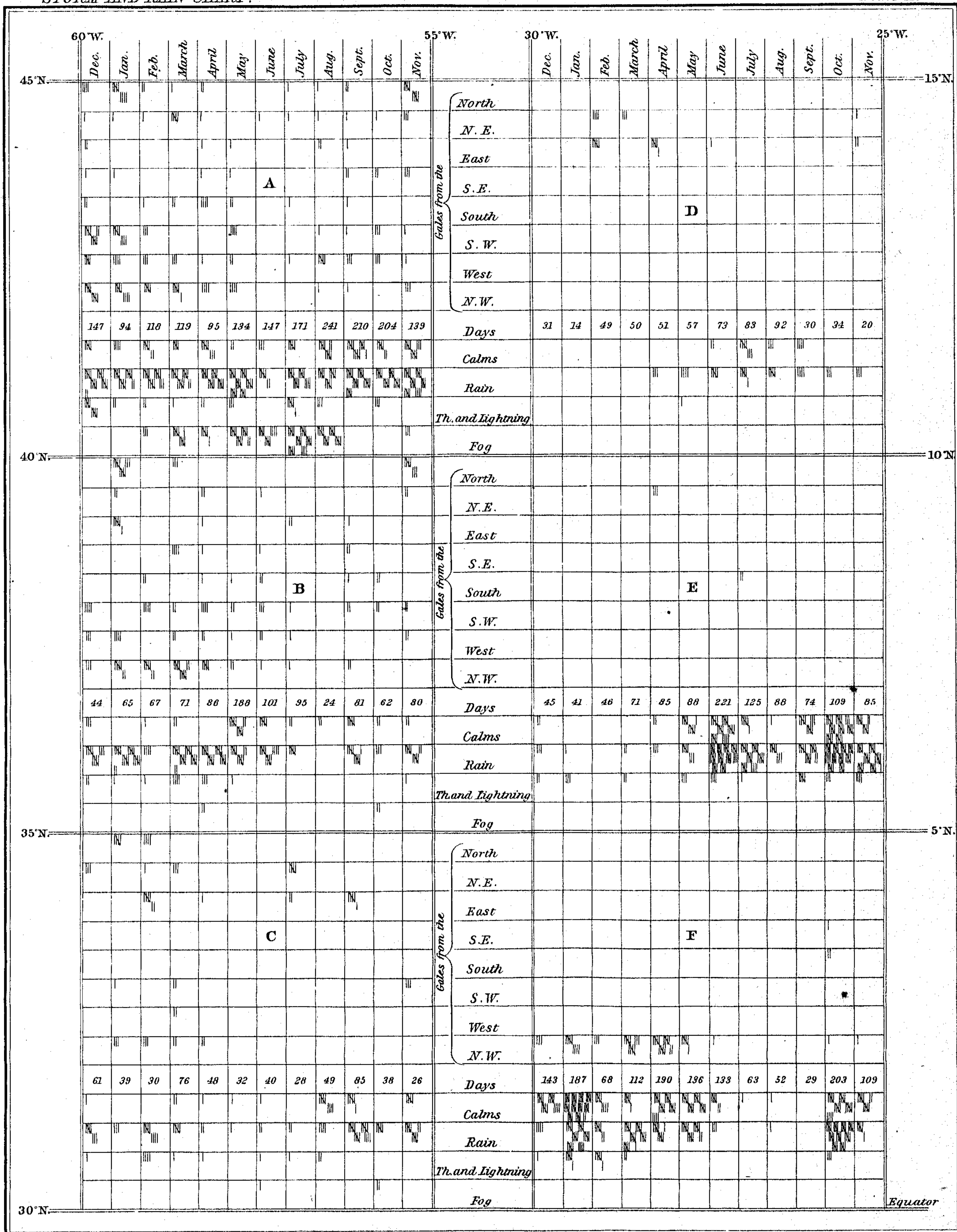

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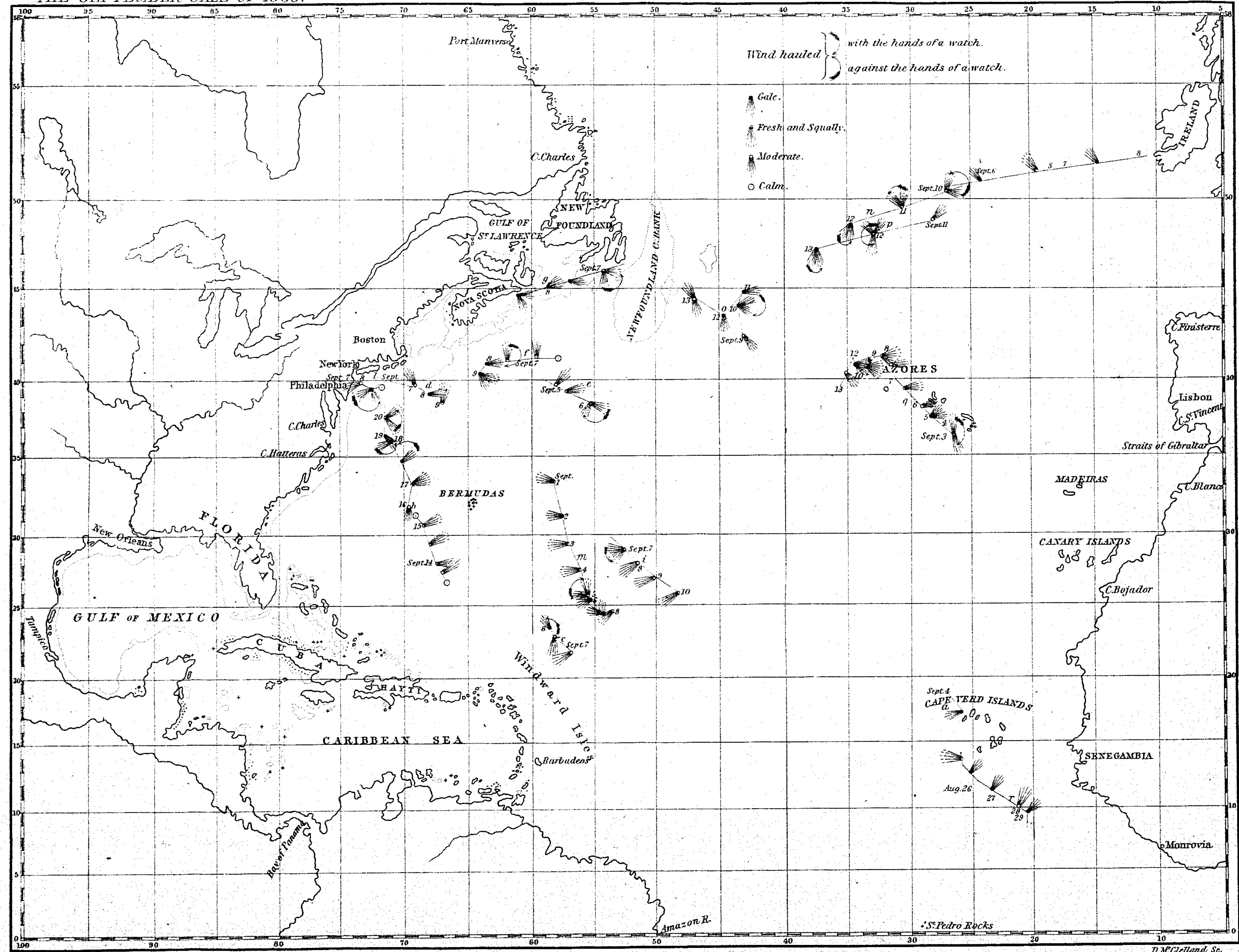
THE SEPTEMBER GALE OF 1850. Plate IV.



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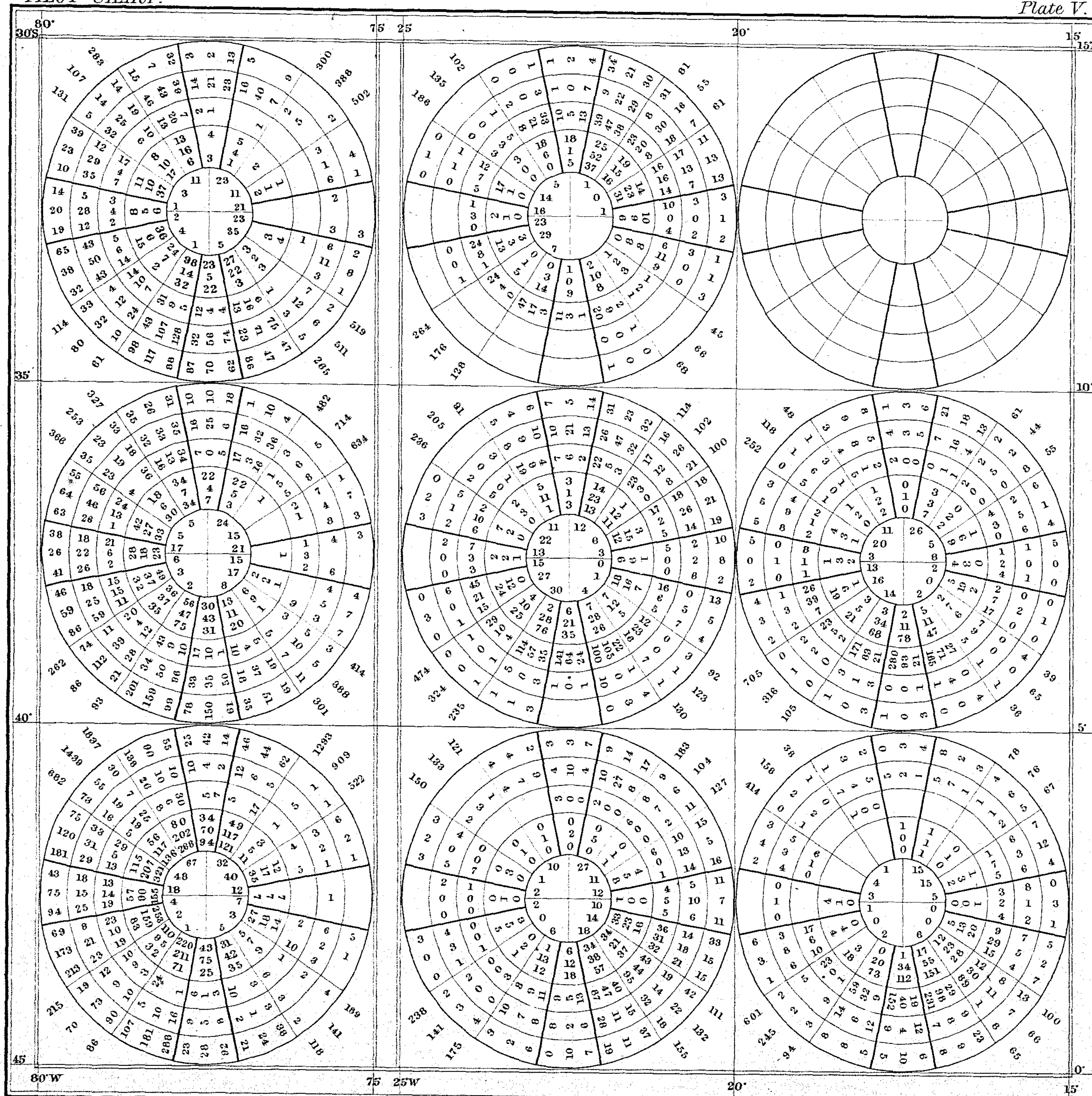

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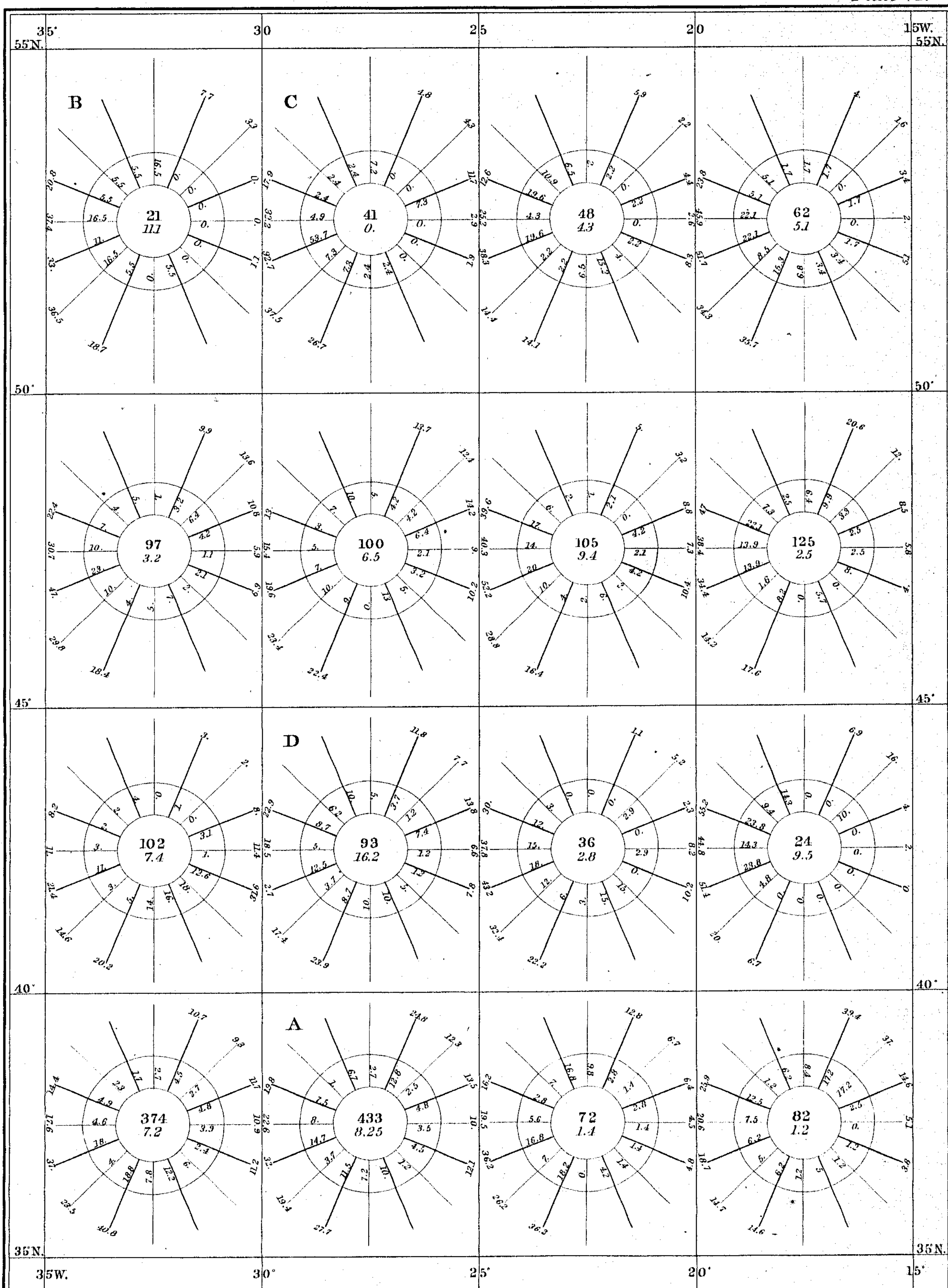

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Lat. North	130°	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov. 125°
60°–55°	N° days of search (D)												
	N° days on which found whales (S)												
	(R)												
55°–50°	N° days of search (D)									2			
	N° days on which found whales (S)												
	(R)									I			
50°–45°	N° days of search (D)							7		13			
	N° days on which found whales (S)							III					
	(R)												
45°–40°	N° days of search (D)							10	5	17	2		
	N° days on which found whales (S)							IIII	IIII				
	(R)												
40°–35°	N° days of search (D)							4	7	11	8	4	
	N° days on which found whales (S)								III				
	(R)												
35°–30°	N° days of search (D)										9	9	9
	N° days on which found whales (S)												
	(R)												
30°–25°	N° days of search (D)	28	7								4	5	3
	N° days on which found whales (S)										I		
	(R)												
25°–20°	N° days of search (D)	3		2	5		2	1	3				4
	N° days on which found whales (S)												
	(R)												
20°–15°	N° days of search (D)	4	5	6	2	5							2
	N° days on which found whales (S)												
	(R)												
15°–10°	N° days of search (D)	3	3		4	6	2						
	N° days on which found whales (S)	I	I										
	(R)												
10°–5°	N° days of search (D)	2	7	6	8	4		5	3	6			
	N° days on which found whales (S)	II	I			I				I			
	(R)												
5°–0° Equator	N° days of search (D)	5	25	25	23	45	37	4		4	6	7	2
	N° days on which found whales (S)		I 卌	II 卌	I	卌	卌						I
	(R)												

Lat. South	130°	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov. 125° W.
Equator 0°–5°	D	10	89	110	85	44	74	73	82	29	10	13	8
	S		I II 卌	卌 卌 I	卌	II 卌	卌 卌 II 卌	IIII 卌	I 卌	II		I	III
	R												
S. Lat. 5°–10°	D	3		6	4	4		2			5		
	S												
	R												
10°–15°	D	15			8			2	3	1			
	S				I								
	R												
15°–20°	D	12		2	4		4	3	3	2			
	S												
	R												
20°–25°	D	11	9		8		16		3				
	S												
	R												
25°–30°	D	4	20	14		6	15	4		5			
	S			I									
	R												
30°–35°	D		16	7			4					2	2
	S												
	R												
35°–40°	D				3	3		2					
	S												
	R												
40°–45°	D	2	2	9	4			4				3	
	S												
	R												
45°–50°	D	7	9	12	1	1	2	3	2	2			
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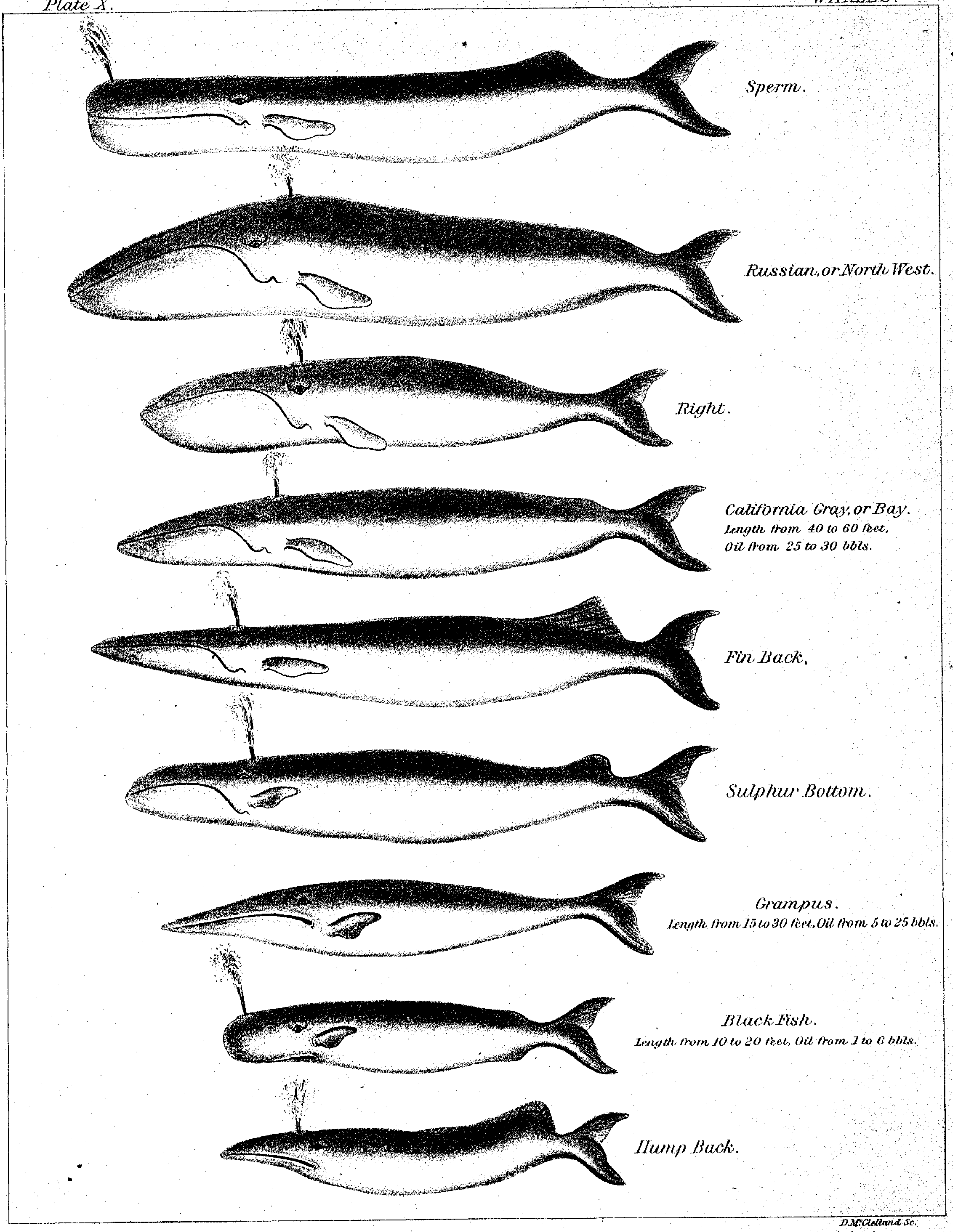

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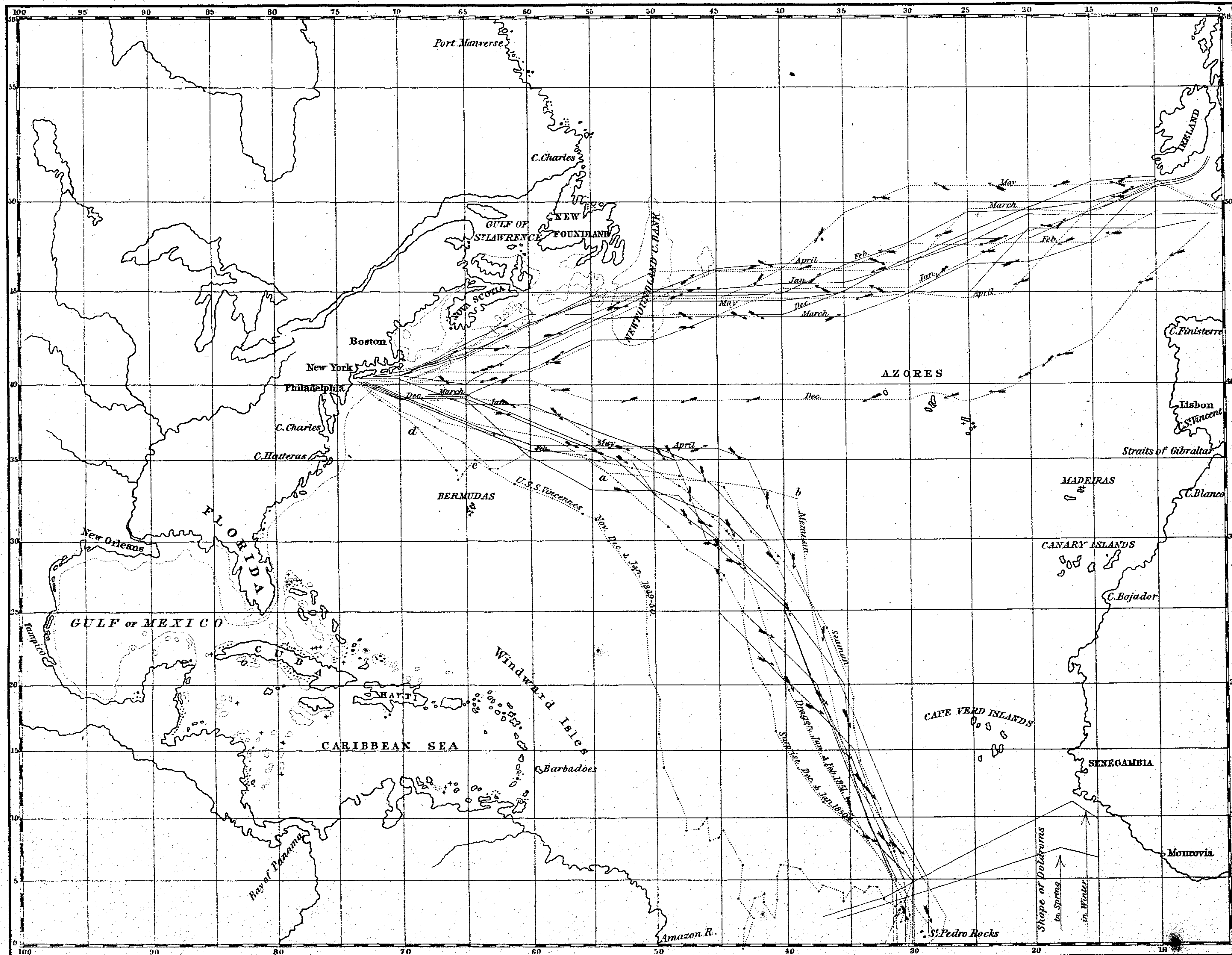
Port Manverse
C. Charles
GULF OF
St LAWRENCE
NEW
FOUNDLAND
NOVA SCOTIA
NEWFOUNDLAND C. BANK
Boston
New York
Philadelphia
C. Charles
C. Hatteras
FLORIDA
New Orleans
GULF OF MEXICO
Tampico
CUBA
HAYTI
CARIBBEAN SEA
Windward Isles
Barbadoes
Bay of Panama
Amazon R.
BERMUDAS
U.S.S. Vincennes. Nov. Dec. & Jan. 1849-50
Mountain
Seaman
Dragon. Jan. & Feb. 1851
Sunrise. Dec. & Jan. 1850
AZORES
IRELAND
C. Finisterre
Lisbon
C. St Vincent
Straits of Gibraltar
MADEIRAS
C. Blanco
CANARY ISLANDS
C. Bojador
CAPE VERD ISLANDS
SENEGAMBIA
Monrovia
Shape of Doldrums
in Spring
in Winter
St Pedro Rocks
May
March
Feb.
April
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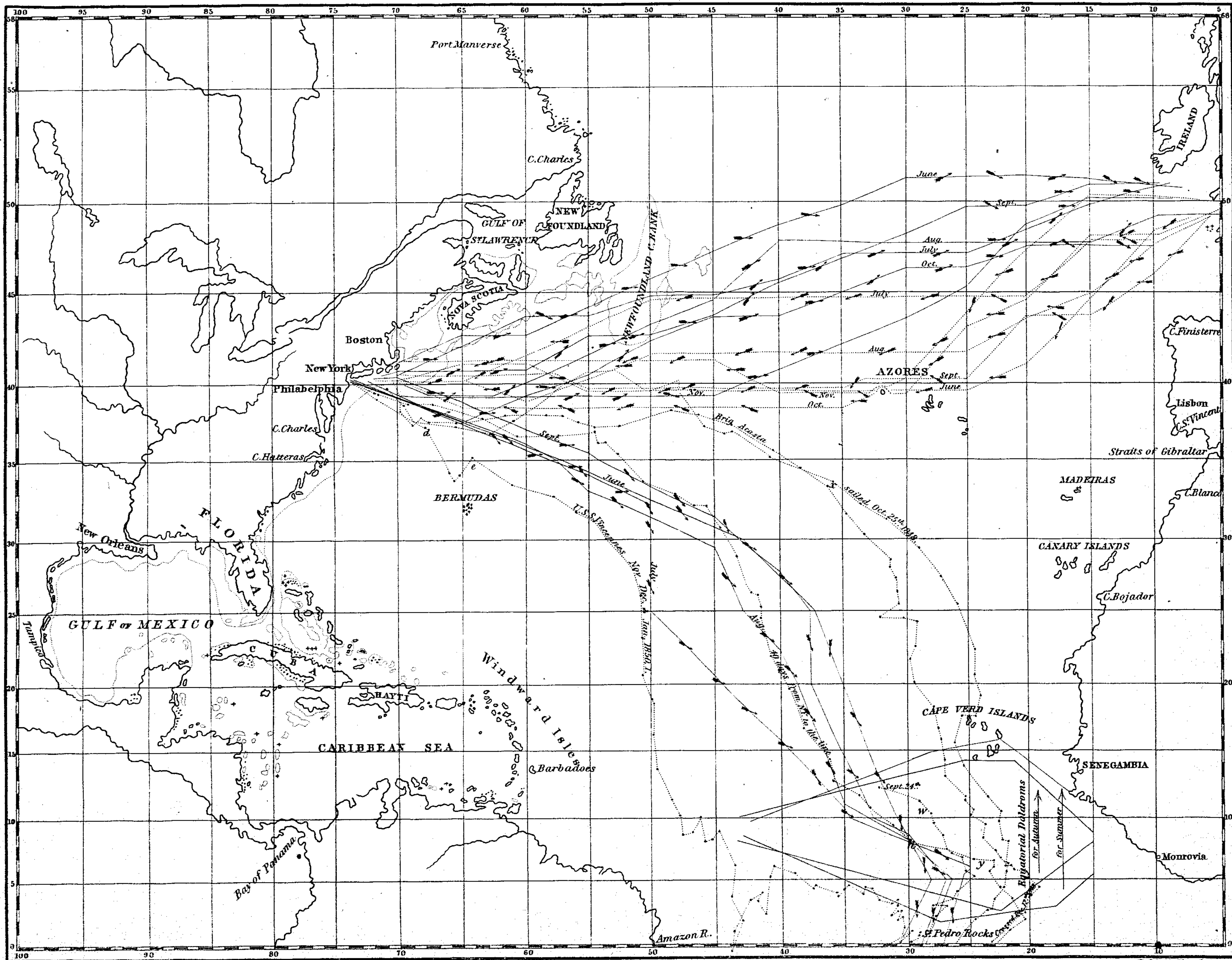
D. McClelland Sc.


Port Manverse
C. Charles
NEW FOUNDLAND
GULF OF St. LAWRENCE
NOVA SCOTIA
NEWFOUNDLAND BANK
Boston
New York
Philadelphia
C. Charles
C. Hatteras
BERMUDAS
FLORIDA
New Orleans
GULF OF MEXICO
Tampico
CUBA
HAYTI
Windward Isles
Barbadoes
CARIBBEAN SEA
Bay of Panama
Amazon R.
AZORES
Brig Acasta
sailed Oct. 25th 1849
U.S.S. Vincennes
IRELAND
C. Finisterre
Lisbon
C. St. Vincent
Straits of Gibraltar
MADEIRAS
C. Blanco
CANARY ISLANDS
C. Bojador
CAPE VERD ISLANDS
SENEGAMBIA
Monrovia
Equatorial Doldroms
for Autumn
for Summer
St. Pedro Rocks
D. McClelland Sc.