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THE OCEAN AND ITS WONDERS

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Содержание

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Chapter One

What the Ocean has to Say—Its Whispers—Its Thunders—Its Secrets

There is a voice in the waters of the great sea. It calls to man continually. Sometimes it thunders in the tempest, when the waves leap high and strong and the wild winds shriek and roar, as if to force our attention. Sometimes it whispers in the calm, and comes rippling on the shingly beach in a still, small voice, as if to solicit our regard. But whether that voice of ocean comes in crashing billows or in gentle murmurs, it has but one tale to tell,—it speaks of the love, and power, and majesty of Him who rides upon the storm, and rules the wave.

Yes, the voice of ocean tells but one tale; yet there are many chapters in that wonderful story. The sea has much to say; far more than could possibly be comprehended in one volume, however large. It tells us of the doings of man on its broad bosom, from the day in which he first ventured to paddle along shore in the hollow trunk of a tree, to the day when he launched his great iron ship of 20,000 tons, and rushed out to sea, against wind and tide, under an impulse equal to the united strength of 11,500 horses. No small portion of the ocean's tale this, comprising many chapters of deeds of daring, blood, villainy, heroism, and enterprise. But with this portion of its story we have nothing to do just now. It tells us, also, of God's myriad and multiform creatures, that dwell in its depths, from the vast whale, whose speed is so great, that it might, if it chose, circle round the world in a few days, to the languid zoophyte, which clings to the rock, and bears more resemblance to a plant than to a living animal.

The sea has secrets, too, some of which it will not divulge until that day when its Creator shall command it to give up its dead; while others it is willing to part with to those who question it closely, patiently, and with intelligence.

Among the former kind of secrets are those foul deeds that have been perpetrated, in all ages, by abandoned men; when no human ears listened to the stifled shriek, or the gurgling plunge; when no human eyes beheld the murderous acts, the bloody decks, the blazing vessels, or the final hiss of the sinking wrecks.

Among the latter kind of secrets are the lives and habits of the creatures of the deep, and the causes and effects of those singular currents of air and water, which, to the eye of ignorance, seem to be nothing better than irregularity and confusion; but which, to the minds of those who search them out, and have pleasure therein, are recognised as a part of that wonderful, orderly, and systematic arrangement of things that we call Nature: much of which we now know, more of which we shall certainly know, as each day and year adds its quota to the sum of human knowledge; but a great deal of which will, doubtless, remain for ever hidden in the mind of nature's God, whose ways are wonderful, and past finding out. It is the latter class of secrets to which we purpose directing the readers attention in the following pages.

On approaching so vast a subject, we feel like the traveller who, finding himself suddenly transported into the midst of a new and magnificent region, stands undecided whither to direct his steps in the endlessly varied scene. Or, still more, like the visitor to our great International Exhibition of *1862*, who,—entering abruptly that gigantic palace, where were represented the talent, the ingenuity, time wealth, and industry of every people and clime,—attempts, in vain, to systematise his explorations, or to fix his attention. It is probable that, in each of these supposed cases, the traveller and visitor, resigning the desire to achieve what is impossible, would give themselves up to the agreeable guidance of a wandering and wayward fancy.

Let us, reader, act in a somewhat similar manner. Let us touch here, and there, and everywhere, on the wonders of the sea, and listen to such notes of the Ocean's Voice as strike upon our ears most pleasantly.

Chapter Two

Composition of the Sea—Its Salts—Power and Uses of Water—Advantage and Disadvantage of Salts—Anecdote—Deep-Sea Soundings —Brookes Apparatus—Importance of the Search after Truth—Illustrations— Discoveries Resulting from Deep-Sea Soundings

Before proceeding to the consideration of the wonders connected with and contained in the sea, we shall treat of the composition of the sea itself and of its extent, depth, and bottom.

What is the sea made of? Salt water, is the ready reply that rises naturally to every lip. But to this we add the question,—What is salt water? or, as there are many kinds of salt water, of what sort of salt water does the sea consist? To these queries we give the following reply, which, we doubt not, will rather surprise some of our readers.

Fresh water, as most people are aware, is composed of two gases—oxygen and hydrogen. Sea water is composed of the same gases, with the addition of muriate of soda, magnesia, iron, lime, sulphur, copper, silex, potash, chlorine, iodine, bromine, ammonia, and silver. What a dose! Let bathers think of it next time they swallow a gulp of sea water.

Most of these substances, however, exist in comparatively small quantity in the sea, with the exception of muriate of soda, or common table salt; of which, as all bathers know from bitter experience, there is a very considerable quantity. The quantity of silver contained in sea water is very small indeed. Nevertheless, small though it be, the ocean is so immense, that, it has been calculated, if all the silver in it were collected, it would form a mass that would weigh about two hundred million tons!

The salt of the ocean varies considerably in different parts. Near the equator, the great heat carries up a larger proportion of water by evaporation than in the more temperate regions; and thus, as salt is not removed by evaporation, the ocean in the torrid zone is salter than in the temperate or frigid zones.

The salts of the sea, and other substances contained in it, are conveyed thither by the fresh-water streams that pour into it from all the continent of the world. Maury, in his delightful work, “The Physical Geography of the Sea,” tells us that “water is Nature’s great carrier. With its currents it conveys heat away from the torrid zone, and ice from the frigid; or, bottling the caloric away in the vesicle of its vapour, it first makes it impalpable, and then conveys it by unknown paths to the most distant parts of the Earth. The materials of which the coral builds the island, and the sea-conch its shell, are gathered by this restless leveller from mountains, rocks, and valleys, in all latitudes. Some it washes down from the Mountains of the Moon in Africa, or out of the gold-fields of Australia, or from the mines of Potosi; others from the battle-fields of Europe, or from the marble quarries of ancient Greece and Rome. The materials thus collected, and carried over falls and down rapids, are transported to the sea."

Here, as these substances cannot be evaporated, they would accumulate to such a degree as to render the ocean uninhabitable by living creatures, had not God provided against this by the most beautiful compensation. He has filled the ocean with innumerable animals and marine plants, whose special duty it is to seize and make use of the substances thus swept from the land, and reconvert them into solids. We cannot form an adequate conception of the extent of the great work carried on continually in this way; but we see part of it in the chalk cliffs, the marl beds of the sea shore, and the coral islands of the South Seas,—of which last more particular notice shall be taken in a succeeding chapter.

The operations of the ocean are manifold. Besides forming a great reservoir, into which what may be termed the impurities of the land are conveyed, it is, as has been shown, the great laboratory of Nature, where these are reconverted, and the general balance restored. But we cannot speak of these things without making passing reference to the operations of water, as that wonder-working agent of which the ocean constitutes but a part.

Nothing in this world is ever lost or annihilated. As the ocean receives all the water that flows from the land, so it returns that water, fresh and pure, in the shape of vapour, to the skies; where, in the form of clouds, it is conveyed to those parts of the earth where its presence is most needed, and precipitated in the form of rain and dew, fertilising the soil, replenishing rivers and lakes, penetrating the earth's deep caverns; whence it bubbles up in the shape of springs, and, after having gladdened the heart of man by driving his mills and causing his food to grow, it finds its way again into the sea: and thus the good work goes on with ceaseless regularity.

Water beats upon the rocks of the sea-shore until it pounds them into sand, or rolls them into pebbles and boulders. It also sweeps the rich soil from the mountains into the valleys. In the form of snow it clothes the surface of the temperate and frigid zones with a warm mantle, which preserves vegetable life from the killing frosts of winter. In the form of ice it splits asunder the granite hills; and in the northern regions it forms great glaciers, or masses of solidified snow, many miles in extent, and many hundred feet thick. These glaciers descend by slow, imperceptible degrees, to the sea; their edges break off and fall into it, and, floating southward, sometimes in great mountainous masses, are seen by man in the shape of icebergs. Frequently huge rocks, that have fallen upon these glaciers from cliffs in the arctic regions, are carried by them to other regions, and are deposited on flat beaches, far from their native cliffs.

The saltness of the sea rendering it more dense, necessarily renders it more buoyant, than fresh water. This is obviously a great advantage to man in the matter of commerce. A ship does not sink so deep in the sea as it does in a fresh-water lake; hence it can carry more cargo with greater facility. It is easier to swim in salt than in fresh water.

The only disadvantage to commerce in the saltness of the sea is the consequent unfitness of its water for drinking. Many and harrowing are the accounts of instances in which sailors have been reduced to the most terrible extremities for want of fresh water; and many a time, since navigation began, have men been brought to feel the dread reality of that condition which is so forcibly expressed in the poem of the "Ancient Mariner":—

> "Water, water everywhere,
> And not a drop to drink."

Science, however, at length enabled us to overcome this disadvantage of saltness. By the process of distillation, men soon managed to procure enough water at least to save their lives. One captain of a ship, by accident, lost all his fresh water; and, before he could put into port to replenish, a gale of wind, which lasted three weeks, drove him far out to sea. He had no distilling apparatus on board, and it seemed as if all hope of the crew escaping the most horrible of deaths were utterly taken away. In this extremity the captain's inventive genius came to his aid. He happened to have on board an old iron pitch-pot, with a wooden cover. Using this as a boiler, a pipe made of a pewter plate, and a wooden cask as a receiver, he set to work, filled the pot with sea water, put an ounce of soap therein to assist in purifying it, and placed it on the fire. When the pot began to boil, the steam passed through the pipe into the cask, where it was condensed into water, minus the saline particles, which, not being evaporable, were left behind in the pitch-pot. In less than an hour a quart of fresh water was thus obtained; which, though not very palatable, was sufficiently good to relieve the thirst of the ship's crew. Many ships are now regularly supplied with apparatus for distilling sea water; and on the African coasts and other unhealthy stations, where water is bad, the men of our navy drink no other water than that which is distilled from the sea.

The salts of the ocean have something to do with the creating of oceanic currents; which, in their turn, have a powerful influence on climates. They also retard evaporation to some extent, and have some effect in giving to the sea its beautiful blue colour.

The ocean covers about two-thirds of the entire surface of the Earth. Its depth has never been certainly ascertained; but from the numberless experiments and attempts that have been made, we are warranted in coming to the conclusion that it nowhere exceeds five miles in depth, probably does not quite equal that. Professor Wyville Thompson estimates the average depth of the sea at about two miles.

Of the three great oceans into which the sea is naturally divided—the Atlantic, the Pacific, and the Arctic—the Atlantic is supposed to be the deepest. There are profundities in its bosom which have never yet been sounded, and probably never will be.

The difficulty of sounding great depths arises from the fact that, after a large quantity of line has been run out, the shock of the lead striking the bottom cannot be felt. Moreover, there is sufficient force in the deep-sea currents to sweep out the line after the lead has reached the bottom so that, with the ordinary sounding-lines in use among navigators, it is impossible to sound great depths. Scientific men have, therefore, taxed their brains to invent instruments for sounding the deep sea—for touching the bottom in what sailors call "blue water." Some have tried it with a silk thread as a plumb-line, some with spun-yarn threads, and various other materials and contrivances. It has even been tried by exploding petards and ringing bells in the deep sea, when it was supposed that an echo or reverberation might be heard, and, from the known rate at which sound travels through water, the depth might thus be ascertained. Deep-sea leads have been constructed having a column of air in them, which, by compression, would show the aqueous pressure to which they had been subjected; but the trial proved to be more than the instrument could stand.

Captain Maury, of the American Navy—whose interesting book has been already referred to—invented an instrument for sounding the deep sea. Here is his own description of it:– "To the lead was attached, upon the principle of the screw-propeller, a small piece of clock-work for registering the number of revolutions made by the little screw during the descent; and it having been ascertained by experiment in shoal water that the apparatus, in descending, would cause the propeller to make one revolution for every fathom of perpendicular descent, hands provided with the power of self-registering were attached to a dial, and the instrument was complete. It worked beautifully in moderate depths, but failed in blue water, from the difficulty of hauling it up if the line used were small, and from the difficulty of getting it down if the line used were large enough to give the requisite strength for hauling it up." One eccentric old sea captain proposed to sound the sea with a torpedo, or shell, which should explode the instant it touched the bottom. Another gentleman proposed to try it by the magnetic telegraph, and designed an instrument which should telegraph to the expectant measurers above how it was getting on in the depths below. But all these ingenious devices failed, and it is probable that the deepest parts of the ocean-bed still remained untouched by man.

At last an extremely simple and remarkably successful deep-sea sounding apparatus was invented by Mr Brooke, an American officer. It consisted of nothing more than thin twine for a sounding-line, and a cannon ball for a sinker. The twine was made for the purpose, fine but very strong, and was wound on a reel to the extent of ten thousand fathoms. The cannon ball, which was from thirty-two to sixty-eight pounds' weight, had a hole quite through it, into which was fixed a sliding rod, the end of which, covered with grease, projected several inches beyond the ball. By an ingenious and simple contrivance, the cannon ball was detached when it reached the bottom of the sea, and the light rod was drawn up with specimens of the bottom adhering to the grease.

With this instrument the Americans went to work with characteristic energy, and, by always using a line of the same size and make, and a sinker of the same shape and weight, they at last ascertained the law of descent. This was an important achievement, because, having become familiar with the precise rate of descent at all depths, they were enabled to tell very nearly when the ball ceased to carry out the line, and when it began to go out in obedience to the influence of deep-sea currents. The greatest depth reached by Brooke's sounding-line is said to have been a little under five miles in the North Atlantic.

The value of investigations of this kind does not appear at first sight, to unscientific men. But those who have paid even a little attention to the methods and processes by which grand discoveries have been made, and useful inventions have been perfected, can scarcely have failed to come to the conclusion that *the search after* TRUTH, *pure and simple, of any kind, and of every kind, either with or without reference to a particular end*, is one of the most useful as well as elevating pursuits in which man can engage.

All truth is worth knowing and labouring after. No one can tell to what useful results the discovery of even the smallest portion of truth may lead. Some of the most serviceable and remarkable inventions of modern times have been the result of discoveries of truths which at first seemed to have no bearing whatever on those inventions. When James Watt sat with busy reflective mind staring at a boiling kettle, and discovered the expansive power of steam, no one could have for a moment imagined that in the course of years the inventions founded on the truth then discovered would result in the systematic driving of a fleet of floating palaces all round the world at the rate of from twelve to fifteen or twenty miles an hour! Instances of a similar kind might be multiplied without end. In like manner, deep-sea sounding may lead to great, as yet unimagined, results. Although yet in its infancy, it has already resulted in the discovery of a comparatively shallow plateau or ridge in the North Atlantic Ocean, rising between Ireland and Newfoundland; a discovery which has been turned to practical account, inasmuch as the plateau has been chosen to be the bed of our electric telegraph between Europe and America. The first Atlantic cable was laid on it; and although that cable suffered many vicissitudes at first, as most contrivances do in their beginnings, communication between the two continents was successfully established. Soundings taken elsewhere showed that somewhat similar plateaus existed in other parts of the Atlantic, and now the whole of Western Europe is being bound more firmly, by additional cables, to the eastern seaboard of America.

This great and glorious achievement has been the result of the discovery of two truths,—of a truth in science on the one hand,

and a truth in regard to the structure of the bed of the sea on the other. The study of electricity and of deep-sea soundings was begun and carried on for the sake of the discovery of *truth* alone, and without the most distant reference to the Atlantic Telegraph, —yet that telegraph has been one of the results of that study. Who can tell how many more shall follow? And even were no other result ever to follow, this one may prove to be of the most stupendous importance to the human race.

Another discovery that has been made by deep-sea sounding is, that the lowest depths of the ocean are always in a state of profound calm. Oceanic storms do not extend to the bottom. When the tempest is lashing the surface of the sea into a state of the most violent and tremendous agitation, the caverns of the deep are wrapped in perfect repose. This has been ascertained from the fact that in many places the bottom of the sea, as shown by the specimens brought up by Brooke's apparatus, and more recently by Professor Thompson's deep-sea dredge, is composed of exceedingly minute shells of marine insects. These shells, when examined by the microscope, are found to be unbroken and perfect, though so fragile that they must certainly have been broken to pieces had they ever been subjected to the influence of currents, or to the pulverising violence of waves. Hence the conclusion that the bottom of the sea is in a state of perpetual rest and placidity.

Indeed, when we think of it, we are led to conclude that this must necessarily be the case. There are, as we shall presently show, currents of vast size and enormous power constantly flowing through the ocean; and when we think of the tremendous power of running water to cut through the solid rock, as exemplified in the case of Niagara, and many other rivers, what would be the result of the action of currents in the sea, compared with which Niagara is but a tiny rivulet? Ocean currents, then, flow on a bed of still water, that protects the bottom of the sea from forces which, by calculation, we know would long ago have torn up the foundations of the deep, and would probably have destroyed the whole economy of nature, had not this beautiful arrangement been provided by the all-wise Creator.

Chapter Three

Waves—System in all Things—Value of Scientific Knowledge—Illustrative Anecdote—Height of Waves—Dr Scoresby—Size, Velocity, and Awful Power of Waves—Anecdotes regarding them—Tides

When a man stands on the deck of some tight-built ship, holding on to the weather bulwarks, and gazing with unphilosophic eye through the blinding spray at the fury of the tempest—by which the billows are made to roll around him like liquid mountains, and the ship is tossed beneath him like a mere chip, the sport and plaything of the raging waters—he is apt to think, should his thoughts turn in that direction at all, that all is unmitigated confusion; that the winds, which blew west yesterday and blow east to-day,—shifting, it may be, with gusty squalls, now here, now there, in chaotic fury,—are actuated by no laws, governed by no directing power.

Yet no thought could be more unphilosophical than this. Apart altogether from divine revelation, by which we are informed that "all deeps, fire, and hail, snow, and vapour, and stormy wind," are "fulfilling God's word" (which information we are bound to receive as a matter of faith if we be Christians, and as a matter of necessity if we be men of common sense, because it is mere absurdity to suppose that the "stormy winds," etcetera, are *not* fulfilling God's word—or will), we now know, to a great extent from practical experience and scientific investigation, that the winds blow and the waters of the ocean flow in grand, regular, uninterrupted currents. Amongst these there are numberless eddies, which, perhaps, have tended to fill our minds with the idea of irregularity and confusion; but which, nevertheless, as well as the grand currents themselves, are subject to law, and are utterly devoid of caprice.

In regard to these matters there is much about which we are still in ignorance. But the investigations of late years—especially those conducted under the superintendence of Captain Maury of the American Navy, and Doctors Carpenter and Thompson of England—have shown that our atmosphere and our ocean act in accordance with a systematic arrangement, many facts regarding which have been discovered, and turned, in some cases, to practical account. See Note 1.

A very interesting instance of the practical use to which scientific inquiry can be turned, even in its beginnings, is given by Maury. After telling us of the existence and nature of a current in the ocean called the Gulf Stream, he gives the following account of the manner in which upon one occasion be made use of his theoretical knowledge.

In the month of December 1853, the fine steam-ship *San Francisco* sailed from New York with a regiment of United States troops on board, bound for California by way of Cape Horn. She was overtaken, while crossing the Gulf Stream, by a gale of wind, in which she was dreadfully crippled. Her decks were swept, and, by one single blow of those terrible seas that the storms raise in the Gulf Stream, more than in any other part of the Atlantic, one hundred and seventy-nine souls, officers and soldiers, were washed overboard and drowned.

The day after this disaster she was seen by one vessel, and again, the next day, December 26th, by another; but neither of them could render her any assistance.

When these two vessels arrived in the United States and reported what they had seen, the most painful apprehensions were entertained by friends for the safety of those on board the steamer. Vessels were sent out to search for and relieve her. But where should these vessels go? Where should they look?

An appeal was made to know what light the system of researches carried on at the National Observatory concerning winds and currents could throw upon the subject.

The materials they had been discussing were examined, and a chart was prepared to show the course of the Gulf Stream at that season of the year. Two revenue cutters were then appointed to proceed to sea in search of the steamer, and Maury was requested to "furnish them with instructions."

It will be observed here that the gentleman thus appealed to was at the time engaged in his study at Washington, utterly ignorant of all that had occurred within the previous few weeks on the stormy Atlantic, except through the reports brought thence by ships. These reports furnished him with meagre data to proceed upon—simply that a crippled steamer had been seen in a certain latitude and longitude on a particular day.

But this information was sufficient for the practical man of science. Proceeding upon the supposition that the steamer had been completely disabled, he drew two lines on the chart to define the limits of her drift. This his previous knowledge of the flow of the Gulf Stream at all seasons of the year enabled him to do. Between these two lines, he said, the steamer, if she could neither steam nor sail after the gale, had drifted. And that she could neither steam nor sail he had good reason to suppose from the account of her brought in by the vessels above mentioned. A certain point was marked on the chart as being the spot where the searching vessels might expect to fall in with the wreck.

While these preparations were being made, two ships fell in with the wreck and relieved the crew. This, however, was not known at the time by the anxious friends on shore. The cutters sailed on their mission, and reached the indicated spot in the sea, where, of course, their assistance was now unnecessary. But when the vessels that had relieved the crew of the wreck arrived in harbour and reported where the wreck had been last seen, it was found to be within a few miles of the spot indicated by Maury!

Thus, upon very slight data, a man of science and observation was enabled, while seated in his study, to follow the drift of a wrecked vessel over the pathless deep, and to indicate to a rescue party, not only the exact course they ought to steer, but the precise spot where the wreck should be found.

The waves of the ocean are by no means so high as people imagine. Their appearance in the Atlantic or Pacific, when raised by a violent storm, is indeed very awful, and men have come to speak of them as being "mountains of water." But their sublime aspect and their tumultuous state of agitation have contributed much to deceive superficial observers as to their real height. Scientific men have measured the height of the waves.

Not many years ago a vessel, while crossing the Atlantic, was overtaken by a violent storm. The sea rose in its might; the good ship reeled under the combined influence of wind and waves. While the majority of the passengers sought refuge from the driving spray in the cabin, one eccentric old gentleman was seen skipping about the deck with unwonted activity—now on the bulwarks, now on the quarter-deck, and anon in the rigging; utterly regardless of the drenching sea and the howling wind, and seeming as though he were a species of human stormy petrel. This was the celebrated Dr Scoresby; a man who had spent his youth and manhood in the whale-fishing; who, late in life, entered the Church, and, until the day of his death, took a special delight in directing the attention of sailors to Him whose word stilled the tempest and bade the angry waves be calm. Being an enthusiast in scientific research, Dr Scoresby was availing himself of the opportunity afforded by this storm to *measure the* *waves*! Others have made similar measurements, and the result goes to prove that waves seldom or never rise much more than ten feet above the sea-level. The corresponding depression sinks to the same depth, thus giving the entire height of the largest waves an elevation of somewhere between twenty and thirty feet. When it is considered that sometimes the waves of the sea (especially those off the Cape of Good Hope) are so broad that only a few of them occupy the space of a mile, and that they travel at the rate of about forty miles an hour, we may have some slight idea of the grandeur as well as the power of the ocean billows. The forms represented in our illustration are only wavelets on the backs of these monster waves.

Waves travel at a rate which increases in proportion to their size and the depth of water in which they are formed. Every one knows that on most lakes they are comparatively small and harmless. In some lakes, however, such as Lake Superior in North America, which is upwards of three hundred miles long, the waves are so formidable as to resemble those of the ocean, and they are capable of producing tremendous effects. But the waves of the sea, when roused to their greatest height, and travelling at their greatest speed, are terrible to behold. Their force is absolutely irresistible. Sometimes waves of more than usually gigantic proportions arise, and, after careering over the broad sea in unimpeded majesty, fall with crushing violence on some doomed shore. They rush onward, pass the usual barriers of the sea-beach, and do not retire until horrible devastation has been carried far into the land.

Maury gives the following anecdote from the notes of a Russian officer, which shows the awful power of such waves.

"On the 23rd of December 1854, at 9:45 a.m., the shocks of an earthquake were felt on board the Russian frigate *Diana*, as she lay at anchor in the harbour of Simoda, not far from Jeddo in Japan. In fifteen minutes afterwards (10 o'clock) a large wave was observed rolling into the harbour, and the water on the beach to be rapidly rising. The town, as seen from the frigate, appeared to be sinking. This wave was followed by another; and when the two receded, which was at fifteen minutes past ten, there was not a house, save an unfinished temple, left standing. These waves continued to come and go until half-past two p.m., during which time the frigate was thrown on her beam-ends five times; a piece of her keel, eighty-one feet long, was torn off; holes were knocked in her by striking on the bottom, and she was reduced to a wreck. In the course of five minutes the water in the harbour fell, it is said, from twenty-three to three feet, and the anchors of the ship were laid bare. There was a great loss of life; many houses were washed into the sea, and many junks carried up—one two miles inland—and dashed to pieces on the shore. The day was beautifully fine, and no warning was given of the approaching convulsion: the sea was perfectly smooth when its surface was broken by the first wave."

Monster waves of this kind occur at regular intervals, among the islands of the Pacific, once and sometimes twice in the year;

and this without any additional influence of an earthquake, at least in the immediate neighbourhood of the islands, though it is quite possible that earthquakes in some remote part of the world may have something to do with these waves.

One such wave is described as breaking on one of these islands with tremendous violence. It appeared at first like a dark line, or low cloud, or fog-bank, on the sea-ward horizon. The day was fine though cloudy, and a gentle breeze was blowing; but the sea was not rougher, or the breaker on the coral reef that encircled the island higher, than usual. It was supposed to be an approaching thunder-storm; but the line gradually drew nearer without spreading upon the sky, as would have been the case had it been a thunder-cloud. Still nearer it came, and soon those on shore observed that it was moving swiftly towards the island; but there was no sound until it reached the smaller islands out at sea. As it passed these, a cloud of white foam encircled each and burst high into the air. This appearance was soon followed by a loud roar, and it became evident that the object was an enormous wave. When it approached the outer reef, its awful magnitude became more evident. It burst completely over the reef at all points, with a deep, continuous roar; yet, although part of its force was thus broken, on it came, as if with renewed might, and finally fell upon the beach with a crash that seemed to shake the solid earth; then, rushing impetuously up into the woods, it levelled the smaller trees and bushes in its headlong course; and, on retiring, left a scene of wreck and desolation that is quite indescribable.

"Storm-waves," as those unusually gigantic billows are called, are said to be the result of the removal of atmospheric pressure in certain parts of the ocean over which a storm is raging. This removal of pressure allows the portion thus relieved to be forced up high above the ordinary sea-level by those other parts that are not so relieved.

The devastating effects of these storm-waves is still further illustrated by the total destruction of Coringa, on the Coromandel Coast, in 1789. During a hurricane, in December of that year, at the moment when a high tide was at its highest point, and the north-west wind was blowing with fury, accumulating the waters at the head of the bay, three monstrous waves came rolling in from the sea upon the devoted town, following each other at a short distance. The horror-stricken inhabitants had scarcely time to note the fact of their approach, when the first wave, sweeping everything in its passage, carried several feet of water into the town. The second swept still further in its destructive course, inundating all the low country. The third, rushing onward in irresistible fury, overwhelmed everything, submerging the town and twenty thousand of its inhabitants. Vessels at anchor at the mouth of the river were carried inland; and the sea on retiring left heaps of sand and mud, which rendered it a hopeless task either to search for the dead or for buried property.

We have spoken of waves "travelling" at such and such a rate, but they do not in reality travel at all. It is the undulation, or, so to speak, the *motion* of a wave, that travels; in the same manner that a wave passes from one end of a carpet to the other end when it is shaken. The water remains stationary, excepting the spray and foam on the surface, and is only possessed of a rising and sinking motion. This undulatory motion, or impulse, is transmitted from each particle of water to its neighbouring particle, until it reaches the last drop of water on the shore. But when a wave reaches shallow water it has no longer room to sink to its proper depth; hence the water composing it acquires *actual* motion, and rushes to the land with more or less of the tremendous violence that has been already described.

Waves are caused by wind, which first ruffles the surface of the sea into ripples, and then, acting with ever-increasing power on the little surfaces thus raised, blows *them* up into waves, and finally into great billows. Sometimes, however, winds burst upon the calm ocean with such sudden violence that for a time the waves cannot lift their heads. The instant they do so, they are cast down and scattered in foam, and the ocean in a few minutes presents the appearance of a cauldron of boiling milk! Such squalls are extremely dangerous to mariners, and vessels exposed to them are often thrown on their beam-ends, even though all sail has been previously taken in. Generally speaking, however, the immediate effect of wind passing either lightly or furiously over the sea is to raise its surface into waves. But these waves, however large they may be, do not affect the waters of the ocean more than a few yards below its surface. The water below their influence is comparatively calm, being affected only by ocean currents.

The tides of the sea—as the two great flowings and ebbings of the water every twenty-four hours are called—are caused principally by the attractive influence of the moon, which, to a small extent, lifts the waters of the ocean towards it, as it passes over them, and thus causes a high wave. This wave, or current, when it swells up on the land, forms high tide. When the moon's influence has completely passed away, it is low tide. The moon raises this wave wherever it passes; not only in the ocean directly under it, but, strange to say, it causes a similar wave on the opposite side of the globe. Thus there are two waves always following the moon, and hence the two high tides in the twenty-four hours. This second wave has been accounted for in the following way: The cohesion of particles of water is easily overcome. The moon, in passing over the sea, separates the particles by her attractive power, and draws the surface of the sea away from the solid globe. But the moon also attracts the earth itself, and draws it away from the water on its opposite side thus causing the high wave there, as represented in the diagram, *figure 1*.

The sun has also a slight influence on the tides, but not to such an extent as the moon. When the two luminaries exert their combined influence in the same direction, they produce the phenomenon of a very high or spring-tide, as in *figure 2*, where the tide at *a* and *b* has risen extremely high, while at *c* and *d* it has fallen correspondingly low. When they act in opposition to each other, as at the moon's quarter, there occurs a very low or neap-tide. In *figure 3* the moon has raised high tide at *a* and *b*, but the sun has counteracted its influence to some extent at *c* and *d*, thus producing neap-tides, which neither rise so high nor fall so low as do other tides. Tides attain various elevations in different parts of the world, partly owing to local influences. In the Bristol Channel the tide rises to nearly sixty feet, while in the Mediterranean it is extremely small, owing to the landlocked nature of that sea preventing the tidal wave from having its full effect. Up some gulfs and estuaries the tides sweep with the violence of a torrent, and any one caught by them on the shore would be overtaken and drowned before he could gain the dry land. In the open sea they rise and fall to an elevation of little more than three or four feet.

The value of the tides is unspeakable. They sweep from our shores pollution of every kind, purify our rivers and estuaries, and are productive of freshness and health all round the world.

The gentlemen here referred to are agreed as to the fact of systematic arrangement of currents, though they differ in regard to some of the causes thereof and other matters.

Chapter Four

The Gulf Stream—Its Nature—Cause—Illustration—Effect of Small Powers United—Adventures of a Particle of Water—Effect of Gulf Stream on Climate—Its Course—Influence on Navigation—Sargasso Sea—Scientific Efforts of Present Day—Wind and Current Charts—Effects on Commerce—Cause of Storms—Influence of Gulf Stream on Marine Animals

Of the varied motions of the sea, the most important, perhaps, as well as the most wonderful, is the Gulf Stream. This mighty current has been likened by Maury to a "river in the ocean. In the severest droughts it never fails, and in the mightiest floods it never overflows. Its banks and its bottom are of cold water, while its current is of warm. It takes its rise in the Gulf of Mexico (hence its name), and empties into the arctic seas. Its current is more rapid than the Mississippi or the Amazon, and its volume more than a thousand times greater."

This great current is of the most beautiful indigo-blue colour as far out as the Carolina coasts; and its waters are so distinctly separated from those of the sea, that the line of demarcation may be traced by the eye. Its influences on the currents of the sea, and on the climates and the navigation of the world, are so great and important, that we think a somewhat particular account of it cannot fail to interest the reader.

The waters of the Gulf Stream are salter than those of the sea; which fact accounts for its deeper blue colour, it being well known that salt has the effect of intensifying the blue of deep water.

The cause of the Gulf Stream has long been a subject of conjecture and dispute among philosophers. Some have maintained that the Mississippi river caused it; but this theory is upset by the fact that the stream is salt—salter even than the sea—while the river is fresh. Besides, the volume of water emptied into the Gulf of Mexico by that river is not equal to the *three thousandth part* of that which issues from it in the form of the Gulf Stream.

Scientific men are still disagreed on this point. They all, indeed, seem to hold the opinion that *difference of temperature* has to do with the origination of the stream; but while some, such as Captain Maury, hold that this is the *chief* cause, others, such as Professor Thompson, believe the trade-winds to be the most important agent in the matter. We venture to incline to the opinion that not only the Gulf Stream, but *all* the constant currents of the sea are due chiefly to *difference of temperature and saltness*. These conditions alter the specific gravity of the waters of the ocean in some places more than in others; hence the equilibrium is destroyed, and currents commence to flow as a natural result, seeking to restore that equilibrium. But as the disturbing agents are always at work, so the currents are of necessity constant. Other currents there are in the sea, but they are the result of winds and various local causes; they are therefore temporary and partial, while the *great* currents of the ocean are permanent, and are, comparatively, little affected by the winds. Every one knows that when a pot is put on the fire to boil, the water contained in it, as soon as it begins to get heated, commences to circulate. The heated water rises to the top, the cold descends. When heated more than that which has ascended, it in turn rises to the surface; and so there is a regular current established in the pot, which continues to flow as long as the heating process goes on. This same principle of temperature, then, is one of the causes of the Gulf Stream. The torrid zone is the furnace where the waters of the ocean are heated. But in this process of heating, evaporation goes on to a large extent; hence the waters become salter than those elsewhere. Here is another agent called into action. The hot salt waters of the torrid zone at once rush off to distribute their superabundant caloric and salt to the seas of the frigid zones; where the ice around the poles has kept the waters cold, and the absence of great heat, and, to a large extent, of evaporation, has kept them comparatively fresh. In fact, the waters of the sea require to be stirred, because numerous agents are at work day and night, from pole to pole, altering their specific gravity and deranging, so to speak, the mixture. This stirring is secured by the unalterable laws which the Creator has fixed for the carrying on of the processes of nature. The currents of the sea may be said to be the result of this process of stirring its waters.

It is curious and interesting to note the apparently insignificant instruments which God has seen fit to use in the carrying out of his plans. The smallest coral insect that builds its little cell in the southern seas exercises an influence in the production of the Gulf Stream. It has been said, with some degree of truth, that one such insect is capable of setting in motion the entire ocean! The coral insect has, in common with many other marine creatures, been gifted with the power of extracting from sea water the lime which it contains, in order to build its cell. The lime thus extracted leaves a minute particle of water necessarily destitute of that substance. Before that particle can be restored to its original condition of equality, every other particle of water in the ocean must part with a share of its superabundant lime! The thing *must* be done. That bereaved particle cannot rest without its lime. It forthwith commences to travel for the purpose of laying its brother-particles under contribution; and it travels far and wide —round and round the world. Myriads upon myriads of coral insects are perpetually engaged in thus robbing the sea water of its lime; shells are formed in a similar manner: so that our particle soon finds itself in company with innumerable other particles of water in a like destitute condition. It rises to the surface. Here the sun, as if to compensate it for the loss of its lime, bestows upon it an unusual amount of heat; and the surrounding particles, not to be outdone, make it almost unlimited presents of salt. Full to overflow with the gifts of its new companions, it hastens to bestow of its superabundance on less favoured particles; joins the great army of the ocean's currents; enters, perchance, the Gulf of Mexico, where it is turned back, and hastens along with the Gulf Stream, with all its natural warmth of character, to ameliorate the climate of Great Britain and the western shores of Europe. Having accomplished this benevolent work, it passes on, with some of its heat and vigour still remaining, to the arctic seas—where it is finally robbed of all its heat and nearly all its salt, and frozen into an icicle—there for many a long day to exert a chilling influence on the waters and the atmosphere around it. Being melted at last by the hot sun of the short arctic summer, it hurries back with the cold currents of the north to the genial regions of the equator, in search of its lost caloric and salt, taking in a full cargo of lime, etcetera, as it passes the mouths of rivers. Arrived at its old starting-point, our wanderer receives once more heat and salt to the full, parts with its lime, and at once hastens off on a new voyage of usefulness—to give out of its superabundance in exchange for the superabundance of others: thus quietly teaching man the lesson that the true principles of commerce were carried out in the depths of the sea ages before he discovered them and carried them into practice on its surface.

Perchance another fate awaits this adventurous particle of water. Mayhap, before it reaches the cold regions of the north, it is evaporated into the clouds, and descends upon the earth in fresh and refreshing rain or dew. Having fertilised the fields, it flows back to its parent ocean, laden with a superabundant cargo of earthy substances, which it soon parts with in exchange for salt. And thus on it goes, round and round the world; down in the ocean's depths, up in the cloudy sky, deep in the springs of earth; ever moving, ever active, never lost, and always fulfilling the end for which it was created.

All ocean currents are composed of water in one or other of the conditions just described;—the hot and salt waters of the equator, flowing north to be cooled and freshened; the cold and fresh waters of the north, flowing south to be heated and salted. The Gulf Stream is simply the stream of equatorial hot water that flows towards the pole through the Atlantic. Its fountain-head is the region of the equator, *not* the Gulf of Mexico; but it is carried, by the conformation of the land, into that gulf and deflected by it, and from it out into the ocean in the direction of Europe. This stream in the Atlantic is well defined, owing to the comparative narrowness of that sea.

The Gulf Stream, then, is like a river of oil in the ocean,—it preserves its distinctive character for more than three thousand miles. It flows towards the polar regions, and the waters of those regions flow in counter-currents towards the equator, because of the fixed law that water must seek its equilibrium as well as its level, thus keeping up a continuous circulation of the hot waters towards the north and the cold towards the south. There are similar currents in the Pacific, but they are neither so large nor so regular as those of the Atlantic, owing to the wide formation of the basin of the former sea.

The effect of the Gulf Stream on climate is very great. The dreary fur-trading establishment of York Factory, on the shores of Hudson's Bay, is surrounded by a climate of the most rigorous character—the thermometer seldom rising up so high as zero during many months, and often ranging down so low as 50 degrees below zero, sometimes even lower, while the winter is seven or eight months long: the lakes and rivers are covered with ice upwards of six feet thick, and the salt sea itself is frozen. Yet this region lies in the same latitude with Scotland, York Factory being on the parallel of 57 degrees north, which passes close to Aberdeen! The difference in temperature between the two places is owing very much, if not entirely, to the influence of the Gulf Stream.

Starting from its caldron in the Gulf of Mexico, it carries a freight of caloric towards the North Atlantic. Owing partly to the diurnal motion of the Earth on its axis, its flow trends towards the east; hence its warm waters embrace our favoured coasts, and ameliorate our climate, while the eastern sea-board of North America is left, in winter, to the rigour of unmitigated frost.

But besides the powerful influence of this current on climate, it exerts a very considerable influence on navigation. In former times, when men regarded the ocean as a great watery waste—utterly ignorant of the exquisite order and harmonious action of all the varied substances and conditions which prevail in the sea, just as much as on the land—they committed themselves to the deep as to a blind chance, and took the storms and calms they encountered as their inevitable fate, which they had no means of evading. Ascertaining, as well as they could from the imperfect charts of those days, the position of their desired haven, they steered straight for it through fair weather and foul, regarding interruptions and delays as mere unavoidable matters of course.

But when men began to study the causes and effects of the operation of those elements in the midst of which they dwelt, they soon perceived that order reigned where before they had imagined that confusion revelled; and that, by adapting their operations to the ascertained laws of Providence, they could, even upon the seemingly unstable sea, avoid dangers and delays of many kinds, and oftentimes place themselves in highly favourable circumstances. Navigators no longer dash recklessly into the Gulf Stream, and try to stem its tide, as they did of yore; but, as circumstances require, they either take advantage of the counter-currents which skirt along it, or avail themselves of the warm climate which it creates even in the midst of winter. There is a certain spot in the Atlantic known by the name of the Sargasso Sea, which is neither more nor less than a huge ocean-eddy, in which immense quantities of sea-weed collect. The weed floats so thickly on the surface as to give to the sea the appearance of solid land; and ships find extreme difficulty in getting through this region, which is rendered still further unnavigable by the prevalence of long-continued calms. This Sargasso Sea is of considerable extent, and lies off the west coast of Africa, a little to the north of the Cape Verd Islands.

In former years, ships used to get entangled in this weedy region for weeks together, unable to proceed on their voyage. The great Columbus fell in with it on his voyage to America, and his followers, thinking they had reached the end of the world, were filled with consternation. This Sargasso Sea lies in the same spot at the present day, but men now know its extent and position. Instead of steering straight for port, they proceed a considerable distance out of their way, and, by avoiding this calm region, accomplish their voyages with much greater speed.

The ocean currents have been, by repeated and long-continued investigation, ascertained and mapped out; so also have the currents of the atmosphere, so that, now-a-days, by taking advantage of some of these currents and avoiding others, voyages are performed, not only in much shorter time, but with much greater precision and certainty. As it was with ocean currents long ago, so was it with atmospheric. Navigators merely put to sea, steered as near as possible on their direct course, and took advantage of such winds as chanced to blow. Now they know whither to steer in order to meet with such winds and currents as will convey them in the shortest space of time to the end of their voyage. The knowledge necessary to this has not been gained by the gigantic effort of one mind, nor by the accidental collocation of the results of the investigations of many ordinary minds. But a few master-minds have succeeded in gathering within their own grasp the myriad facts collected by thousands of naval men, of all countries, in their various voyages; and, by a careful comparison and philosophical investigation of these facts, they have ascertained and systematised truths which were before unknown, and have constructed wind and current charts, by the use of which voyages are wonderfully shortened, commercial enterprises greatly facilitated, and the general good and comfort of nations materially advanced.

The truth of this has of late been proved by incontestable facts. For instance, one year particular note was taken of the arrival of all the vessels at the port of San Francisco, in California; and it was found that of 124 vessels from the Atlantic coast of the United States, 70 were possessed of Maury's wind and current charts. The average passage of these 70 vessels, on that long voyage round Cape Horn, was 135 days; while the average of those that sailed *without* the charts (that is, trusted to their own unaided wisdom and experience) was 146 days. Between England and Australia the average length of the voyage out used, very recently, to be 124 days. With the aid of these charts it has now been reduced to 97 days on the average.

The saving to commerce thus achieved is much greater than one would suppose. At the risk of becoming tedious to uninquiring readers, we will make a brief extract from Hunt's "Merchants' Magazine" of 1854, as given in a foot-note in Maury's "Physical Geography of the Sea."

"Now, let us make a calculation of the annual saving to the commerce of the United States effected by these charts and sailing directions. According to Mr Maury, the average freight from the United States to Rio Janeiro is 17.7 cents per ton per day; to Australia, 20 cents; to California, also about 20 cents. The mean of this is a little over 19 cents per ton per day; but, to be within the mark, we will take it at 15, and include all the ports of South America, China, and the East Indies.

"The sailing directions have shortened the passage to California 30 days; to Australia, 20; to Rio Janeiro, 10. The mean of this is 20; but we will take it at 15, and also include the above-named ports of South America, China, and the East Indies.

"We estimate the tonnage of the United States engaged in trade with these places at 1,000,000 tons per annum.

"With these data, we see that there has been effected a saving for each one of these tons, of 15 cents per day for a period of 15 days, which will give an aggregate of 2,250,000 dollars (468,750 pounds) saved per annum. This is on the outward voyage alone, and the tonnage trading with all other parts of the world is also left out of the calculation. Take these into consideration, and also the fact that there is a vast amount of foreign tonnage trading between these places and the United States, and it will be seen that the annual sum saved will swell to an enormous amount."

Before the existence of the Gulf Stream was ascertained, vessels were frequently drifted far out of their course in cloudy or foggy weather, without the fact being known, until the clearing away of the mists enabled the navigators to ascertain their position by solar observation. Now, not only the existence, but the exact limits and action of this stream are known and mapped; so that the current, which was formerly a hindrance to navigation, is now made to be a help to it. The line of demarcation between the warm waters of the Gulf Stream and the cold waters of the sea is so sharp and distinct, that by the use of the thermometer the precise minute of a ship's leaving or entering it can be ascertained. And by the simple application of the thermometer to the Gulf Stream the average passage from England to America has been reduced from upwards of eight weeks to little more than four!

But this wonderful current is useful to navigators in more ways than one. Its waters, being warm, carry a mild climate along with them through the ocean even in the depth of winter, and thus afford a region of shelter to vessels when attempting to make the Atlantic coast of North America, which, at that season is swept by furious storms and chilled by bitter frosts. The Atlantic coasts of the United States are considered to be the most stormy in the world during winter, and the difficulty of making them used to be much greater in former days than now. The number of wrecks that take place off the shores of New England in mid-Winter is frightful. All down that coast flows one of the great cold currents from the north. The combined influence of the cold atmosphere above it, and the warm atmosphere over the Gulf Stream, far out at sea, produces terrific gales. The month's average of wrecks off that coast has been as high as three a day. In making the coast, vessels are met frequently by snow-storms, which clothe the rigging with ice, rendering it unmanageable, and chill the seaman's frame, so that he cannot manage his ship or face the howling blast. Formerly, when unable to make the coast, owing to the fury of these bitter westerly gales, he knew of no place of refuge short of the West Indies, whither he was often compelled to run, and there await the coming of genial spring ere he again attempted to complete his voyage. Now, however, the region of the Gulf Stream is sought as a refuge. When the stiffened ropes refuse to work, and the ship can no longer make head against the storm, she is put about and steered for the Gulf Stream. In a few hours she reaches its edge, and almost in a moment afterwards she passes from the midst of winter into a sea of sunnier heat! "Now," as Maury beautifully expresses it, "the ice disappears from her apparel; the sailor bathes his limbs in tepid waters. Feeling himself invigorated and refreshed with the genial warmth about him, he realises out there at sea the fable of Antaeus and his mother Earth. He rises up and attempts to make his port again, and is again, perhaps, as rudely met and beat back from the north-west; but each time that he is driven off from the contest, he comes forth from this stream, like the ancient son of Neptune, stronger and stronger, until, after many days, his freshened strength prevails, and he at last triumphs, and enters his haven in safety—though in this contest he sometimes falls to rise no more, for it is terrible."

The power of ocean currents in drifting vessels out of their course, and in sweeping away great bodies of ice, is very great; although, from the fact that there is no land to enable the eye to mark the flow, such drifts are not perceptible. One of the most celebrated drifts of modern times, and the most astonishing on account of its extent, was that of the *Fox*

Конец ознакомительного фрагмента.