

## WATER.

ITS VARIOUS RELATIONS TO ANIMAL AND VEGETABLE LIFE, AND ESPECIALLY TO MANKIND WHEN LIVING IN LARGE NUMBERS ON LIMITED AREAS ON THE EARTH'S SURFACE.

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The more modern researches of physiologists and chemists, aided by modern scientific instruments, develops the fact that by *weight* man, and in fact nearly the whole of the animal life throughout the globe, consists of about eighty per cent. of *water* and twenty of other matter, mainly carbon and lime, and the investigations of the students of natural history that it (water) is the mother's womb from which has developed the whole range of animal and vegetable life, from the simplest nomad to the most complex organism. It performs a countless variety of functions in the material world in combination with other substances. By its aid the coral insect has built the foundations of our continents; to its great solvent powers is due the whole of the limestone formation, the most abundant on the globe. Mountains have been lifted to their astonishing height by volcanic action *generated* by its combination with sulphuret of iron, and then torn down again and carried into the sea by its mechanical force, thus laying the foundation for new and fertile continents when the old ones are worn out by man's profligacy. In fact only for water and the law of its crystallization (*viz.*, that it expands in the act of crystallizing), the whole surface of our globe would be to-day a barren rock. A substance so intimately connected with our physical well-being will repay some study. In their primitive condition human beings were distributed over a large area of the earth's surface compared with their numbers. Assuming that the family relation always existed, yet primitive man was pastoral, and consequently the number of human beings and their domestic animals did not exceed one hundred to the square mile, which is a greater number than exist to-day, in a very large area of our own continent. Their habits were simple; they had no chemical or other factories which now pollute the natural streams. Nature had provided for the natural conditions as they existed, and men and animals were supplied with pure and wholesome water from nature's springs and rivers. The pure rain-water rendered impure by coming in contact with *effete* material on the earth's surface, became purified by percolation downward through the earth by means of the roots of growing vegetation. That which flowed into the rivers was purified by the growing animal and vegetable life, with which the rivers abounded. The smaller forms of aquatic life instead of dying, were eaten alive by the larger and by aquatic birds, and these in turn died in the larger streams at or near the ocean; and the ocean being saline, the decaying animal and vegetable matter was rendered innocuous by the action of chloride of soda with which the ocean abounds; the pure water being separated by evaporation, to again be carried over the earth by the air, and again fall in the form of pure rain-water. Such was the condition of the habitable world when according to the Bible, mankind reached the extreme age of one thousand years.

Had the primitive condition continued, no farther effort on the part of mankind would have been required, than to provide for their ordinary necessities; but under an immutable law of nature (*viz.*, the law of aggregation), men built hamlets, towns and cities, thus aggregating a dense population on a small area. Then began the various devastating diseases known as plague, cholera, typhus and typhoid fevers, with all their types, from yellow fever down to malarial. We need only refer to the terrible devastations of these diseases throughout all Western Asia during the last three thousand years to verify this statement. Babel, Nineveh, Babylon and Palmyra, ruined and formerly lost cities, attest the truth of our statement, to say nothing of the lost and ruined cities of ancient Greece, or Bagdad, which still remains to tell annually the mournful story of a want of proper sanitary conditions. If the towns and cities of this country or Europe were to-day dependent on a local supply of water for domestic purposes, they would be annually devastated by epidemic diseases, the penalty for our neglect in the matter of sanitary precautions. When men and other animals congregate together and live in dense masses, the *effete* matter resulting from such conditions becomes so abundant that vegetation and the lower forms of animal life fail to appropriate it, and consequently the earth in and about cities becomes saturated with it, contaminating the pure rain water with its noxious qualities, which, when drawn from our wells and taken into the stomach, produces the various epidemic diseases which carry us to a premature grave. It follows, that if the foregoing is true (and the investigations of the learned men of the world prove it to be so), that in densely populated communities, *well water* whether obtained from driven or open wells or springs, is liable to be unhealthy, and consequently that the supply of water for potable and culinary purposes should not be obtained from the ground on which these communities dwell. From whence then shall communities derive their supplies? Fortunately *science and art* supply the means of determining this question, science (which is only the result of observation and experience reduced to a system) pointing out the way, and art following the directions. The science of geometry has measured the earth's *surface*, and has also given us a knowledge of its general as well as detailed conformation. The science of geology has given us a knowledge of its structure *below the surface*. The science of chemistry has given us a knowledge of its elementary combinations, while botany and zoology give us a knowledge of the natural history of its plants and animals. The subject of the natural history of aquatic plants and animals, and their relation to the subject matter of this article has already been touched upon. It is therefore only necessary to enquire, in the light of the foregoing, from whence the supply of water for potable and culinary purposes, for towns and cities should be derived? Plainly not from the ground on which they are built, but from the sparsely populated hills and valleys of the country; in a word from the source of our rivers which empty into the ocean. In applying the foregoing to that part of the State of New Jersey lying between the mountains and Staten Island Sound, and the Passaic and Raritan rivers, it follows that the only healthy source of water supply for the towns and cities located within these boundaries is the two rivers before mentioned, and the three rivers emptying into the sound at Rahway, in which may be included a small stream at Elizabeth and one at New Brooklyn. The water of these streams is pure and healthy when taken from them and immediately used. Nature is wise: she has provided perfectly for the health and well-being of the whole range of animal and vegetable life; but when her conditions are changed by artificial means, then begin the troubles of which we so much complain. If we take the pure and healthy water of her rivers, toeming with the lower forms of animal and vegetable life, *enjoying the sunlight* from twelve to sixteen hours per day during summer (in the temperate zone), and under ordinary *atmospheric pressure* of say fifteen pounds per square inch, and, by means of mechanical force, force it into several miles of dark pipes (water mains) under a pressure of from fifty to one hundred pounds per square inch, the violent change of condi-

tion kills the delicate organisms, decomposition ensues, and the water becomes almost as unhealthy as if pumped from the immediate neighborhood of our sinks and cesspools. Hence it follows that the delicate and low forms of aquatic life should be kept out of our water mains. This can only be done by a filter. No water-works is complete, nor can wholesome water be obtained from them, without one that will keep the lower forms of aquatic life out of the mains between the first of March and the first of December, within the temperate zone.

The foregoing may be supplemented by the following statement, which will add to it that practical force which is so highly prized by most people.

The writer took charge of the Railway water-works on the first of June, 1879. The pumping station is on the north branch of the Railway river, which furnishes a minimum supply of ten million gallons of water every twenty-four hours. The works have no reservoir or stand pipe, but pump directly against the mains. Two duplex compound engines are used alternately month about, each engine being capable of pumping one and one-half millions every twenty-four hours. The daily consumption of the city is about five hundred thousand, but the amount for short periods occasionally runs up to one million gallons. The water remaining in the reserve pumps and mains always became grossly offensive at the end of three or four days after the stoppage of the pumps. In June, 1880, a sand filter was placed between the works and the river. The result was that the water remaining in the idle pumps and mains at the end of a month was sweet and palatable.