THE WATER WE DRINK.

LECTURE BY PROF. CHANDLER, BEFORE THE AMERICAN INSTITUTE.

Water is the sole product of the combustion of hydrogen. The Hindoos and the Egyptians considered water the element from which all bodies are formed. Among the Greeks, six hundred years before Christ, the opinion was defended that water was the first and fontal element of all matter. Aristotle regarded it as one of the four primal elements, and this idea prevailed for more than a thousand years, and the four elements—fire, air, earth, and water—were supposed to be materials from which all matter was formed. It was supposed, however, that these four elements were, to a certain extent, mutually convertible, and there were certain facts which made this appear very possible, at that date. Heat converted water into steam, which to the ancients was equivalent to air; and the frequent evaporation of water from glass vessels seemed to convert the water into earth; so the four elements were mutually convertible.

This idea of the conversion of water into earth prevailed until about 1770, just one hundred years ago, when Lavoisier, the French chemist, applied the balance to the solution of the problem. It had, however, been known that when water was placed in a retort, and evaporated, there remained behind a small quantity of earthy matter. If the water were poured back and distilled a second time, the quantity of earthy matter increased: so the third time, and this continued until the distillation was complete. Lavoisier provided himself with an alembic which was hermetically sealed, and into this he introduced three pounds of water. He repeated the distillation for a long time, and found that at the end of the operation he had twenty drams of mineral water; but he found that the alembic and the water had the same weight as before. On opening the apparatus he discovered that he had not lost any of the water, but the alembic had lost the twenty drams. Scheele, a Swedish chemist, analyzed the earthy matter left, and proved it to be of the same material as the glass. On repeating the experiment of evaporating water from a silver vessel no earthy matter was produced: so it was clearly proved that the earthy matter came from the vessel and not from the water.

The application of the balance to the chemical investigation, in the hands of Lavoisier, laid the foundation of the present system, not simply of chemistry, but of the sciences based on it. Cavendish proved water to be composed of oxygen and hydrogen.

Water is the most important and remarkable of all compounds. It covers three fourths of the earth's surface, in the form of oceans, lakes, rivers, snow and ice. As vapor, it is ever present in the atmosphere. It occurs in animals, the blood containing seventy-nine per cent, and the muscles seventy-five per cent. In fact, a human body is three fourths water. Plants contain from twenty to eighty or ninety per cent. None of the solid rocks are free from it, and some of them—as gypsum—contain twenty per cent. At 212o Fah., water boils, passing off in the form of vapor, but it evaporates at all temperatures. Water has a great capacity for heat. A cubic mile of water, in cooling one degree, warms 3,076 cubic miles of atmospheric air to an equal extent, and a cubic yard of ice, in melting, cools 1,000 cubic yards of air from fifty to fifty-two degrees Fahrenheit. We have water playing the part of an acid, in combination with a strong base. It is in the condition of acid that it attacks the quick lime and slakes it. We have the water again occurring in the form of watery crystallization, in solid substances, which assume a crystalline form when separating from water, as alum, gypsum, and many other materials. We have it again as a solvent, in which case it exerts a weak affinity for the substances involved. The water dissolves not only waters, but gases; in fact, it is a universal solvent. Natural waters are never pure, owing to solvent properties. Atmospheric waters, the snow, the dew, the fog, take up certain impurities before they reach the earth. They absorb a certain portion of oxygen and nitrogen; they wash out the dust floating in the atmosphere, and near the seashore the waters contain common salt. In some cases we find sulphuric acid, and in others ammonia.

WELLS.

Terrestrial waters are still more impure. When the water reaches the surface it is absorbed by the porous strata. The character of a spring will depend upon the strata through which the water has percolated. Our common wells are simply holes dug down through the strata. Water takes the character of the earth through which it has passed. The earth's crust consists of strata, different kinds of rock, sandstone, limestone, and slate. Some of these are porous, others are impervious to water, so that we may have in different points many different kinds of water occurring in as many different layers. In boring an artesian well, we may come across water characterized by salt. At a still greater depth, we may meet water which is quite pure. The artesian well is simply a boring made down through those different strata to reach water of a desired quality. One of the most celebrated of these wells is at Grenelle, Paris, 1,600 feet, or one third of a mile, in depth. As the water which rises in this well has its source at a remote distance, where the porous strata which bring it are more elevated, the water rises eighty feet above the surface. The yield in that well is ninety cubic feet per minute. The temperature is eighty-two degrees Fahrenheit. The deepest well in Europe—at Rochefort—has a depth of 2,276 feet, or more than one half mile. At Louisville, Ky., a well has been bored 2,086 feet deep, and another at Charleston, S. C., 1,250 feet deep—both of these wells being mineral water.

Attempts have been made to obtain fresh water by boring in some of our Western States. In Columbus, Ohio, a well was bored 2,275 feet deep, but no water would come to the surface. At St. Louis, the deepest artesian well that has ever been bored was 3,881 feet, or nearly two thirds of a mile. It was a failure, however, as the water obtained would not rise to the surface. In many other localities these wells have been exceedingly successful. In oases on the desert they have added greatly to the fertility. In Algiers and other localities, they have been bored with great success, sometimes producing natural and at other medicinal waters. At Tours, in France, the artesian well is sometimes closed by leaves which, when finally brought to the surface, are found to come from a region 150 miles distant, the water having come through subterranean channels.

Owing to the solvent power of water, spring and well waters always contain more or less mineral matter. Where the rocks are chiefly composed of silicious minerals, we have very little impurity. In New England, the waters generally contain nearly three or four grains of impurity to the gallon.

WHAT WATER CONTAINS.

We sometimes find in water organic matter derived from the decay of vegetables, and certain gases, oxygen and nitrogen—in other words, air; but the air which is dissolved in water is richer in oxygen than the atmosphere. This seems to be a wonderful provision of nature for the support of those animals that breathe by the means of gills. Fishes derive their oxygen from this gas, which is dissolved in water; and, although its volume is only one twenty-fifth the volume of the water, still the supply is sufficient to support this animal life. In wells we have also nitrates, and ammonia salts, produced by the decomposition of animal matter in the soil round our dwellings.

We get an approximate idea of the quality of spring water by the density of the precipitates contained in it. Pond, lake, and river water is partly supplied by springs, and partly by water which has simply passed over the surface of the earth, and not through the porous strata. Consequently, this water is purer, generally, than spring water. Some of the purest waters that are known are lake waters. There is a lake in Sweden the water of which is found to contain only one twentieth of a grain of impurity in a gallon. Water which is in motion, as river water, often contains suspended impurities, or mud, which it has no opportunity of depositing; but when the stream becomes quiet, the mud is deposited, and the water becomes clear. The waters of the Mississippi river contain forty grains of suspended impurities in a gallon, and it is estimated that 400,000,000 tuns are carried to the Gulf of Mexico annually. By the Ganges, 3,668,000 cubic feet of earthy matter are carried annually to the ocean. In fact, it is by alluvial matter—mud transported in this way—that the entire State of Louisiana has been formed, by the encroachment of this earthy matter upon the waters of the gulf. We find also living organisms—plants and animals—occurring in greater or less quantities. There is a popular idea that you can find these animals in a drop of any water. This is untrue; but by causing the water to pass through a filter we can obtain them.

The waters from our rivers and lakes, on reaching the ocean, evaporate, leave their saline matters behind, and come back in the form of rain or snow; and every time the water makes its journey to the ocean, it carries with it its little cargo of matter, and in this way the ocean becomes salt. It might be supposed on this account that the ocean would become much more salt in time; but the ratio between the quantity of water in the rivers and the quantity of water which is existing in the ocean, is such that the change must proceed very slowly. It is estimated that thirty-six cubic miles of water flow into the ocean every day, but it would take 30,000 years for all the water in the ocean to make the round once, to go back to the land, and bring its cargo of saline matter. Supposing that each gallon of river water which comes to the ocean bring six grains of impurity with it, it would take 36,000 years for it to be increased in the ratio of six grains to the gallon. The probability is that the solution of saline matter took place much more rapidly in former ages than it does now. It is pretty nearly washed out of its dust now, and carried to the ocean. Inland seas which receive rivers of a considerable size, and at the same time have no outlet, become much more concentrated than sea water, owing to the evaporation. We have saline waters in which common salt predominates, some of the most remarkable of which occur in this State at Syracuse, and in the Onondaga salt reservations we have brine from which enormous quantities of salt are manufactured. Nine million bushels have been manufactured in a single year, the impurity consisting, in this case, almost entirely of salt.

At St. Catherine's, in Canada, we have a water which contains large quantities of chloride of calcium and magnesium. There is through the valley of Saratoga a break in the strata. Below the surface of the earth, many hundred feet, is a porous layer of sandstone. This comes to the surface further north, where it receives pure atmospheric air, and this, passing down through the sandstone, dissolves the saline matter, takes up the carbonic acid, and comes up through the earth.

PURIFICATION.

Where water is used for washing, as in woolen mills, in dyeing, etc., it is extremely important that it should be comparatively pure. Various methods have been resorted to for its purification. [The speaker here exhibited a filter, which he said was now coming into use, in which a sponge is made to do the work.] For domestic purposes, the water of hillsides is always the best. Wells are objectionable, as they serve to collect what soaks from the soil, and in these waters nitric acid and decomposed animal substances are almost always found. It is found that the waters of artesian wells contain no oxygen. To make these waters useful they must be brought into contact with the air. River and lake waters are preferable for city supplies. As to the characteristics of good water, first, it should be of low temperature, not over forty-eight or fifty degrees; it should be free from taste, except, perhaps, a slight saline taste, and a slight pungency from the presence of carbonic acid. Transparency is not so important, as water may be considerably colored, and yet be free from injurious ingredients. It is not so much in the quantity of impurity as the quality. Five or six grains of lime or magnesia in water renders it unfit for cooking. For tea and coffee, however, it is found to be an advantage to have a small quantity of lime in the water. A person of delicate taste can detect the presence of lime salts in water when it exists in the proportion of only two grains to the gallon. Certain waters in almost every region acquire a special reputation as tea waters. Old inhabitants in New York remember the famous tea pumps, one of which was situated in Franklin street, where a boy was kept pumping tea water for the neighboring inhabitants. Another was at the corner of Reade and Center streets.

ORGANIC IMPURITIES.

It is the animal organic matter in water which is objectionable, not the vegetable. In many cases living vegetables are our great safeguards. Many lives have been saved by the action of vegetation destroying decomposing animal substances. Soakage from the neighboring dwellings adds organic matter to the water, which has germs of disease. Analysis hardly detects it. Sudden outbreaks of dysentery are produced by this cause. Before New York was supplied with Croton water, it was visited by epidemics believed to have been caused by defilement of the wells then in use. Cholera, although it does not originate from this cause, is chiefly disseminated by impure supplies of water. During times of its prevalence it has been noticed that where fresh water is abundant, no deaths of any consequence occur.

The evil from which we are most likely to suffer is from impregnation of the water from lead. There is hardly any kind of water but has some effect upon lead. Pure distilled water attacks it rapidly; water containing some lime salts attack it less rapidly. When Croton was first introduced, owing to the aqueducts being freshly built, the water was much more impure than at present, and it was then noticed that it had but little effect upon lead, but as the water becomes purer, we are in more danger of its contamination. Several other materials have been suggested as a substitute for lead pipe. Galvanized iron pipes are open to some objections. Glass pipe has been suggested, but the inconvenience of introducing it is a serious objection. The best pipe is that made of tin, surrounded by lead, the water being entirely protected from the lead.

The lecture was illustrated by numerous experiments.

Why Soup is Wholesome.

Physiologically, soup has great value for those who hurry to and from their meals, as it allows an interval of comparative rest to the fainting stomach before the more substantial beef and mutton is attacked, rest before solid food being as important as rest after it. Let a hungry and weary merchant or lawyer rush *in medias res*—plunge boldly into roast beef, and what is the result? The defeat is often as precipitate as was the attack. When the body is weary the stomach must be identified with it, and cannot therefore stand the shock of some ill-masticated, half-pound weight of beef. But if a small plateful of light soup be gently insinuated into the system, nourishment will soon be introduced, and strength will follow to receive more substantial material.

Burns and Scalds.

S. B. Judkin, M. D., of Cuba, Ohio, writes to the *Journal of Materia Medica*:

"I have treated a good many cases of burns and scalds, and to my entire satisfaction. I dissolve white lead in flax seed oil, to the consistency of milk, and apply over the entire burn or scald every five minutes. I have been in the habit of using a soft feather to apply the liniment. I have used this preparation a great many times in the fifteen years of my practice, and have never been disappointed; it gives relief sooner and is more permanent in its effects than any preparation I am acquainted with.

I think that any one testing it will be satisfied. It should be applied often, and a full dose of an opiate will be advantageous if the burn is deep."

Singular Mode of Detecting Fraud.

A lawyer in Providence, R. I., was recently, on behalf of the heirs of an estate, contesting a will which he believed to have been forged. His clients were confident of the justice of their claims; but the instrument was apparently all correct, and the prospect of setting it aside looked very dubious. The pretended will was written under the date of 1855, and bore the stamp, "A. P. Co.—Superfine." No paper but that of the Agawam Company of Mittineague bears this mark. The lawyer conceived the idea of writing to the officials of the Agawam Company for information in regard to the paper, and had the satisfaction of learning that their first paper with that stamp was made and sold in 1860, which proved that the fraudulent will must have been written at least five years after its date. Of course this discovery settled the matter.

THE curious fact, that a needle or other steel wire inserted in a living body will immediately become oxidized, while, if the body be dead, no oxidation will take place, was recently brought to light by Dr. Laborde, of Paris. This is a simple test as to whether death has taken place, and will be available in cases of trance or catalepsy.