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THE AIR WE BREATHE.

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Having already discussed the subjects, "The Water We Drink," and "The Food We Eat," we now propose to consider "The Air We Breathe." Water plays quite an unimportant part as an animal reconstructive, save as it acts as a diluent for the food we eat.

An analogy exists between water and the atmosphere in the fact that both consist practically of two gases: water, oxygen, and hydrogen; and the atmosphere of oxygen and nitrogen, and yet in all nature pure specimens of these compounds cannot be found. Both contain what are called impurities; *e. g.*, water contains various salts, ammonia, and other matters absorbed from the atmosphere and surrounding nature. The atmosphere contains at all times and places watery vapor, carbonic acid, earth-dust, germs, and the exhalations of vegetable matter. Therefore it seems that in speaking of water and air we should use the term "normal," and yet this would not be scientifically correct, as both are subject to ever-varying circumstances in the case of the atmosphere, such as elevation, temperature, barometric pressure, the amount of gaseous and solid constituents contained in a given locality, besides various magnetic and electric phenomena.

If we remember rightly, the atmosphere we breathe is said to form a great envelope around the earth, supposed to reach about forty-five miles above its crust; its density, all things being equal, decreases as the squares of the distances increase, and it exercises a pressure at the surface of the earth of fifteen pounds to the square inch.

We remarked that there was an analogy between water and air; there is this difference, however, in the case of water, the two gases, oxygen and hydrogen, are held together by intimate chemical union, but in the case of the atmosphere not only oxygen and nitrogen, but hydrogen, carbonic acid gas, and all other contained gases, are governed by what is known as "the law of the general diffusion of gases," a law not yet understood and not at all scientifically accurate in its operations.

In the case of the atmosphere its elements exist in a state of admixture, and not strictly in chemical union. This admixture, however, is not always the same in a given locality, although governing circumstances being the same it may be said to be approximately so. Carbonic acid, *e. g.*, is much heavier than oxygen, and obeying the laws of gravity may seek a home in the valleys, well or cellar; while hydrogen, being fourteen times lighter than oxygen, may seek a higher locality. Thus we see that the law governing the general diffusion of gases cannot be said always to be perfect in its operations.

The composition of the atmosphere is again affected by particular localities. In a large city, for instance, a large amount of oxygen gas is inhaled, and carbonic acid gas exhaled by the animal life they contain, while the reverse obtains in large wooded districts where carbonic acid is inhaled by the leaves; chemical decomposition takes place by the agency of sunlight, the carbon is appropriated for the formation of woody fiber and oxygen exhaled.

Again, the large manufacturing interests of cities notably affect the atmosphere by the large amount of oxygen their fires consume, and the various gases eliminated and thrown off from the consumed fuel. Therefore we find the quantity of oxygen at the minimum in densely inhabited localities, and the reverse in rural districts.

Again, not only do we find that vegetable matters absorb a large proportion of carbonic acid, and relinquish it in their decomposition, but they also absorb nitrogen, and appropriate it to their constitution and growth.

We therefore find that if what we arbitrarily term normal air be essential to the existence and comfort of animal life, various agencies become necessary to effect this much-to-be-desired end. These agencies are to be found in the air currents which are constantly circulating, bringing to cities the mountain and ocean breezes, and as it were sending out to sea their vitiated atmosphere. Sunlight, heat, the vast expanses of oceans, and plains, of mountain heights, and valleys' depths, are important agencies in this consummation. Sunlight affects the constitution of the atmosphere by its power under certain conditions of decomposing carbonic acid gas.

Temperature 60° F. may be said to be the average breathing temperature. In summer the temperature may reach 80° or 90°, when 100 volumes at 60° would reach 103,84; or 100 volumes at 80° would contain a per cent. of oxygen equal only to 19,194, as compared with 21.0 per cent. at 60°. Again, in winter, when the thermometer is at freezing point, 32° F., 100 volumes of air at 60° becomes 94.5, the oxygen at 32° being increased to an amount equal to 22.13 per cent. instead of 21 as at 60° F.

Again, in high latitudes, as the arctic regions, in the inhabitable portions of which the thermometer often falls 50° below zero, the proportion of oxygen is increased to an amount equal to 25.85 per cent., as compared with 21 per cent. at 60°.

Thus we find that not only seasons but latitudes influence the constitution of the atmosphere; nature thus merely, as in the case of foods, ministering to man's necessities according to his accidental locations. Oxygen being one of the essential elements in the production of animal heat would of necessity be more imperatively demanded in northern than in southern latitudes; and this is the more especially the case since in extreme cold we find the vital actions more or less defective, usually tending to torpidity. The breathing qualities of the air is also greatly affected by altitude and consequent pressure; the law being that the air expands in geometrical ratio as the height increases in arithmetical ratio, 100 volumes of air at the sea level would by expansion reach 200 at an elevation of say four miles. This law is, however, to a certain extent qualified by the ever-varying temperature levels.

Oxygen is the great food furnished by the atmosphere for the maintenance of animal life, and its necessity is absolute and never ceasing, subject, however, in quantity to the variations of seasons, climates, and corresponding animal necessities. In our article upon "The Food We Eat," we stated the well-known function which oxygen performs in the production of animal heat by combining with the carbonaceous elements of the food. Therefore, where the necessity for a large consumption of carbonaceous food exists, an increased amount of oxygen in the atmosphere will be imperative, and *vice versa* in southern latitudes where animal heat is not so rapidly radiated. The proportion of oxygen in average air has been assumed by Liebig and others to vary 20.9 to 20.99.

Nitrogen as a constituent of respirable air seems to act alone as a diluent or vehicle for oxygen. It is not supposed to enter into any chemical combination inside the bodies of animals, and, as Edward Smith aptly expresses it, is the "water in the glass of toddy." It is colorless, tasteless, and inodorous; is utterly incapable of sustaining life, and when breathed in its undiluted state causes death by suffocation.

The dilution of the oxygen gas is rendered necessary to prevent its too stimulating and violent action in the system. This dilution nitrogen accomplishes, and when it has carried the oxygen into the lungs, from which it is absorbed into the blood, nitrogen has still another office to perform by becoming the common carrier to unload the carbonic acid and other effete matters from the circulation, with which it is itself expelled from the system by respiration. Experiments have proved that as the relative quantity of oxygen gas inspired is increased, so the relative quantity of carbonic acid expired is increased. It is possible to dilute the oxygen with other gases—for instance, with hydrogen—temporarily with virtually the same effects, yet such dilution would be tolerated but for a short time, as not being in the course of nature. Atmospheric air at a temperature of 60° F., and with the barometer at 30 inches, contains in every 100 parts by volume about 79 parts of nitrogen.

Carbonic acid gas exists in variable proportions in all known specimens of the air we breathe, and is thus to a certain extent a normal constituent, yet owing its presence to the oxidizing effects or combustion carried on in nature by its associate constituent oxygen. The normal proportion of carbonic acid usually found in respirable air does not exceed three per cent, and when found in excess of this amount indicates impurities, and its increase usually indicates a proportionate decrease in oxygen. The great sources from which carbonic acid are derived is the natural decay of vegetable and organic nature, the combustion of fuel in cities, etc. Thus in large towns and dense forests we find the proportion of carbonic acid relatively increased, and because of its comparative heaviness as compared with air we find it existing in greater amount in valleys and lowlands than in more elevated localities. We thus find it often in wells and mines in such quantities as to render the air utterly irrespirable. In closed rooms when charcoal combustion is taking place death often results from its accumulation, and the air crowded into unventilated rooms is often greatly contaminated by that thrown off by the respiration of their inmates.

Ozone.—In 1840 Schönbein gave us the first satisfactory account of this substance, which from the drift of recent current medical literature is destined at no distant day to play an important *rôle* in the treatment of disease and the hygiene of the world.

Ozone is said to be oxygen in an allotropic state, in which three volumes are condensed into two, one of the volumes sustaining a different polar relation to the other two. Its density as compared with common oxygen is as 1½ to 1. At a temperature of 450° to 500° F., it decomposes rapidly, resolving itself into common oxygen. It is only slightly soluble in water, and not at all in acid or alkaline solution. Its presence manifests itself to us by a peculiar odor resembling that of phosphorus. This substance may be obtained in various ways. 1. By electrical agency, either by the passage of a current from a machine through the air or dry or moist oxygen; 2. By the slow combustion of phosphorus, of ether, and the volatile oils; 3. It is found in the oxygen eliminated by the action of light upon growing plants; 4. It is said to be produced by aromatic plants and flowers; 5. It is said to be produced in the processes of fermentation, putrefaction, combustion, and processes of recent action. As found existing in free air it is the result of electrical conditions produced by storm-clouds.

According to Howzean, the maximum quantity found in the atmosphere never exceeds one seven hundred thousandth of its bulk, and is more plentiful after a thunder-storm and upon warm, damp, and foggy days, than at any other time. More is found on the sea-coast and in the country than inland and in cities. More is found in high than low attitudes. More in winter than in summer, at night than in the day, and it is said more frequently to be an accompaniment of western than eastern winds. It is more frequently found among the branches of trees, owing to the greater facilities offered for oxydation at the surface of the ground. Marignac and De La Rive, Andrews, Odling, and Lovet, all bear evidence to its highly oxidizing power. It oxidizes rapidly the compounds of ammonia, phosphorus, sulphur; rapidly corrodes metals and organic substances, and seems to be nature's great destroyer of all forms of vegetable and animal putrefaction and decay.

It has also been demonstrated by Lea, of Philadelphia, to be utterly destructive of germ and fungoid life.

With these facts in view, our townsman, Dr. J. D. Plunkett, recommended to the fourth session of the American Public Health Association its utilization in the disinfection of public sewers and the destruction of other mephitic gases. He proposed to effect this by running an interrupted wire through the whole extent of the sewer, and attaching this either to a Rumerkorff coil and battery, or by the agency of steam and proper electrical apparatus to supply the electric spark at each interruption of the wire. In view of all the facts, it occurs to us that this is a feasible suggestion and deserves more than a passing recognition.

With a more thorough knowledge of the nature and effects of this agent, there is no telling what possibilities may be opened up by its use to the profession, particularly in the destruction of germ and fungoid life, in all the great avenues of public and private disinfection. In regard to its action upon the human economy, it is assumed that aozonized air is made a better vitalizer, as it is more readily absorbed and distributed by the red blood corpuscles than simple oxygen. Again, it is argued by Smith that "it is not the fresh and invigorating air which contains ozone in abundance, but the oppressive and electrical atmosphere in which vital changes are rather diminished than increased." In a concentrated form it is irrespirable, producing great irritation of the mucous membrane, suggesting that some probable relation might exist between epidemics of influenza and highly ozonized conditions of the atmosphere. It is claimed that its use lessens the number of respirations and the strength of the pulse, and lowers the animal temperature from 5° to 8° F. It is to be hoped that future researches will give us a better knowledge of this strange substance contained in the air we breathe.

We will now enumerate some of the solid impurities found in the air. These are ever-varying in character, quality, and quantity. Those who have noticed a sunbeam, even in the calmest condition of the air, have been struck with the innumerable atoms of matter floating in it. Again, the hurricane will take up and transport large bodies of matter for hundreds of miles. It has been suggested that the steppes of China and Asia, and our great American plains, may have been formed by the winds taking up earthly matters and desepositing them in those localities. Pompeii