THE CHEMICAL AND BIOLOGICAL EFFECT OF WATER FILTRATION

ORGANISMS IN EARTH AND WATER AND THEIR FUNCTIONS—EFFORTS TO ELIMINATE PATHOGENIC BACTERIA IN WATER BY FILTRATION—THE FILTER FILM AND ITS WORK—AUXILIARY CHEMICAL TREATMENT—EXTREME PURIFICATION DANGEROUS

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MUCH argument has taken place as to whether bacteria are a form of plant or animal life. One of the lowest forms of plant life, known to the botanical microscopist as oscillariae, possesses similar characteristics to the types of organisms called bacteria.

The chief difference is the presence of chlorophyll in oscillariae, or the green coloring matter which enables the plant to derive nourishment from such simple foods as it can procure from the air and soil, in which it is present. It is the absence of chlorophyll in bacteria which forces them to live on more complex foods. Both have the power of motility, the same form, the same method of thread and spore formation, and may both be considered as true plants.

The simplest forms are typical of bacteria, spherical, cylindrical or spiral. They are so minute that their diameters range from 0.000012 to 0.0003 inches. A coating of some gelatinous membrane seems to envelop most species, serving as a cement to keep them together. Their internal structure of protoplasm has never been definitely decided on, and is still much a matter of conjecture.

When massed into clusters bacteria are known as zoogloea, which differ from a colony in that the latter is formed when a single bacterium is cultivated in some mass which presents too much resistance for the separation of the bacteria to any distance. Varying species form different characteristics in their colonies, which serve as a means of identification when under examination.

Bacteria multiply very rapidly, unless in unsuitable conditions, by the simple process of dividing in two, a process which can go on indefinitely until as many as 16,000,000 are produced in twenty-four hours. In addition to this simple method of propagation, some species produce spores. These are round or oval pieces of bacteria protoplasm, which develop until they finally break out of the original organism. When the original germ cannot exist, the spores are still to be found resisting very adverse conditions, and acting as a means of perpetuating the species.

A means of motility is supplied to many species, which have stringy membranes attached to them, sometimes one, two, or many, sometimes at one end, and sometimes at both. By lashing these membranes back and forward, a means of propulsion is supplied, which is very active when the germs are immersed in liquids.

The food of bacterial organisms is secured from the dead bodies of animals or plants, and their excretions, which they rapidly decompose in their operations for assimilation. Probably the rapidity of multiplication is due to not having to manufacture food, as in the case of other plants. In effecting the decomposition of substances, many chemical and physical changes are wrought, extensively made use of in the maceration industries.

The manufacture of linen, jute, hemp, fibre, leather, sponges, and the products of fermentation, is chiefly dependent on the action of various forms of bacterial life. In still more important functions are bacteria necessary for the continuity of life, and the preservation of mankind. For the purpose of showing this some digression is allowable for consideration of other plants and their mode of existence.

No life could exist if the earth were littered with dead matter, but bacteria, acting as scavengers, and putrefactive changes prevent such a happening. The earth's surface has been the producer of the countless years of life. Plant life has extracted food from its soil and air without apparently diminishing the food supply.

The animal kingdom breathes oxygen and exhales it as carbon dioxide, which the vegetable kingdom inhales and returns as free oxygen to complete the cycle. Plants also consume nitrogenous food from the soil, in the form of nitrates, in combination with gaseous products of the air and other elements. These solar energy transforms into starches, proteids, sugars, fats, etc., to supply animal life with nutrition.

Carbonic acid and water are returned by the animal in the assimilation of its food, to be again absorbed by plant life, but nitrogenous food is not returned in total. Most of the nitrogen consumed by animal life is turned into albumens and the balance excreted. Even when the animal dies, the nitrogen is too complex in its compounds to form plant food, when recovered by disintegration.

The bacteria of decomposition and putrefaction now set to work to reduce most of the nitrogen compounds into suitable feeding material for the plant, leaving the balance as nitrites, which in turn are too simple for plant food.

The soil abounds with organisms called nitrifying bacteria which unite these nitrites with oxygen and transpose them into the nitrates necessary for the existence of the vegetable world. In decomposing, dead animal life frees a proportion of nitrogen which passes into the air, thus reducing the supply of nitrogenous food returned to the soil. More is lost in excretions taken direct to the sea in the form of sewage, while many of the chemicals used in the manufacture of explosives and other articles of commerce consume a large amount.

The farmer makes up this deficiency by the application of chemical fertilizers to the ground, but were the same soil freed from all plant life, and exposed to the air