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Bacteria in relation to every day life.

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"BACTERIA IN RELATION TO EVERY DAY LIFE."

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"It is to be noticed that if there be any marshy places, certain animals breed there, which are invisible to the eye and yet getting into the system through the mouth and nostrils cause serious disorders."

This quaint observation is taken from a manuscript written over two thousand years ago, showing that bacteria even if not seen, were living and active. Latin writers of about the same time recorded a relation between insects and malaria which has but lately been proved and explained. The infectious character of leprosy has long been recognized, since the ancient Hebrews caused the isolation of the afflicted. The laws of Moses point to some knowledge of the nature of infections: "This is the law, when a man dieth in a tent; all that come into the tent, and all that is in the tent shall be unclean for several days. And every open vessel which has no covering upon it shall be unclean."

DISCOVERY:- Men sought to explain the phenomena of infectious diseases by supposing the body to have been penetrated by minute parasitic worms. About 1675, Leewenhock, the son of a linen draper of Delph Holland saw in a drop of stagnant water, minute moving forms. These he described with such singular accuracy that scientists became interested and studied them. The drawings which were made show the same forms which would be found today under similar conditions. It was decided that these organisms were spontaneously generated, since no living matter had been placed in the liquids.

The processes of putrefaction and fermentation gradually attracted public attention. Investigations were made to discover their caude. For years the general belief was that oxygen was the agent, and even today the house-wife will say that a can of fruit spoiled "because the air got into it." The bacteria which caused the changes could not be discovered until the compound miscroscope made visible the life which pervades all fermenting and putrifying matter. Although invented in the early part of the seventeenth century, it was not until seventy years ago that the microscope was brought to its present effective but simple form.

To Louis Pasteur must be ascribed the honor of laying the corner-stone of bacteriology, since he first attempted to cultivate bacteria and yeasts. About twenty years later Rober Koch after repeated experiments built the germ theory of disease when he declared and proved that bacteria were the cause of disease and were not the effect as many had thought them to be. Then in rapid succession followed the discovery of the bacillus of tuberculosis, typhoid fever and Asiatic cholera.

LIFE PROCESSES:- Bacteria (from a Greek word meaning a little stick) are extremely minute, uncellular plants, which have no chlorophyll, the substance which gives plants their green color and enables them to make their own food. A single bacterium is not seen with the naked eye although great numbers of them taken together may form a plainly visible mass of growth. Observed under a powerful microscope these little micro-organisms are seen to have no roots, stems or leaves like the higher plants. They appear as little round, rod shaped or curved bodies, the ordinary length being from 1 to 10 microns. Their size would seem to indicate that they were insignificant, but they more than make up in energy and work and numbers any deficiency in size. It is estimated that in the space occupied by a grain of sugar, there may be packed six hundred millions of bacteria and still not be crowded. Is it difficult to understand why the surgeon must wash his hands with disinfectants,using vigorous brushing for fifteen minutes or more when we learn that the wrinkles in the skin of our hands are to the bacteria like ditches six or eight feet deep ?

The prime factors to be considered in the growth of bacteria are foof supply,moisture, temperature and light. In general,bacteria require food similar to that used by man. They are chiefly found living on the complicated organic substances which form the bodies of dead plants and animals, or which are excreted by the latter while they are yet alive. Some of them can exist on inorganic food, but most require organic material. When the food supply of a bacterium fails, it degenerates and dies. The presence of water is also necessary for the continued growth of all bacteria. For every species of bacterium there is a temperature at which it grows best. This is usually the temperature of he habitat of the organism. For example, those species living in water or in ordinary putrifying material, require a temperature of from 14 degrees to 20 degrees Centigrade. The bacteria inhabiting animal tissue must have a higher degree of heat from 35 degrees to 39 degrees Centigrade.

Direct sunlight is found to have a very inimical effect on bacteria particularly on the kinds living in dark, damp places. Even so short a time as two hours exposure to sunlight has been found to destroy them. The great need for airing and sunning our houses and wearing apparel is thus apparent.

REPRODUCTION:- All bacteria reproduce by simple division of the parent into halves, a process called fission. In some species, these daughter cells remain attached to one another forming chains, cubes or sheets. The rapidity with which they reproduce depends upon the conditions of life and growth, that is the food supply, warmth and moisture. If these three things be favorable, they will multiply with almost infinite rapidity, since under the best conditions a new generation in some species is born oftener than every half hour. If this rate of increase is continued for a day, one bacterium might become ancestor of over sixteen million descendants. When for any reason there are adverse situations, such as lack of food, warmth or moisture, some bacteria have the power of contracting their bodies into smaller space, possibly drawing them all into one end or into both ends from the middle. This is called the spore stage. These spores are capable of resisting great extremes. Some can be boiled, others frozen, and still retain life. They receive no food. Chemicals seem to have little effect on them. Given what it needs in the form of moisture, warmth, and food, the spore grows again and continues its life as before.

WHERE BACTERIA ARE FOUND:- There are no other plants or animals so universally found in Nature as bacteria. Wherever there is a lodging place for dust, they will be found. It is this universal prescence with their great powers of multiplication which renders them of so much importance. They exist almost everywhere on the surface of the earth. They are found in the water of rivers and lakes and in the ocean. They appear in the soil down to a depth of several feet. They float in the air except at extremely high altitudes. Nansen found bacteria on the ice of the Polar sea. Flies have them in their feet; bees in their hair. On the surface of the higher animals and the human body, they cling in great quantity. They are attached to the clothes, under the nails, among the hairs, in every possible crevice or hiding place in the skin and in all secretions. They are also found in the mouth, stomach and intestines in great numbers.

KINDS OF BACTERIA:- Fortunately for us there are two distinct kinds, the disease producing or pathogenic bacteria, and those which do not produce disease or the non pathogenic. The vast majority are non pathogenic and entirely harmless so far as we are concerned, and many of them are indispensable.

Non pathogenic bacteria are very important. This is due to their power of producing chemical changes in their food. The products which arise as the result of their breaking down or decomposing everything which they use as food, makes them essential agents in some of our industries and natural industries as well.

RESULTS OF BACTERIAL ACTIVITY:- The pathogenic bacteria produce disease by their presence and by poisonous substances formed by their vital activities. However, this rapid multiplication of pathogenic bacteria is checked from a lack of suitable food or by the accumulation of their own excretion or secretion which act as poison to them..

Very few animal or vegetable substances are able to resist the softening influence of some bacteria, and his power is relied upon in many great industries. No method of separating the linen fibres in the flax from the wood fibres has yet been devised, which dispenses with the aid of bacteria. The same process is used in the manufacture of jute, hemp and cocoanut fibre and in preparing sponges for the market.

The continuance of life upon this earth would be impossible if bacterial action were checked for any considerable length of time. These tiny organisms act as savengers keeping the surface of the earth in the proper condition for plant and animal growth. A large tree in the forest dies and falls to the ground. For a while the structure remains just as it fell. Then the bark becomes softened and loosened and falls from the wood. The wood begins to decay and becomes a soft, brownish powdery mass which crumbles and sinks into the soil and if overgrown by other plants. The tree has disappeared. In the same way the body of a dead animal undergoes the process of the softening of the tissues by decay.

The solid body mass of the plant and animal have decayed and decomposed. Where have they gone ? What has become of them ? Part of them has dissipated into the air in the form of gases and vapour; part of them has become incorporated into the soil. Thus they become again food for plants and they in turn for animals. Were there no such decomposing agents to rid the surface of the earth of the dead bodies of animals and plants, it may readily be seen that long since the earth would have been uninhabited. It would have been so covered with the accumulated bulk of plants and animals of past ages to allow of no room for further growth of plants and animals.

But the latter by no means ends here. Plants and animals both require food, animals depending wholly on plants, therefore how has food been provided for these countless generations of plants ? Why has not old mother earth become sterile in nourishing her children ? How could the soil continue to support plants year after year for millions of years and yet remain fertile as ever ? The simple explanation is that the same food is used over and over again, first by the plant and then by the animal, and then again by the plant, and there is no necessity for any end to this process so long as the sun furnishes energy to keep the circulation continuous. Plants use as foof carbon, hydrogen, oxygen and many other less important salts. Animals in their respiration consume oxygen and exhale it again in combination with carbon as carbon dioxide. On the other hand, plants use as food the carbon dioxide, and exhale superfluous oxygen as free oxygen. There is thus an endless round of oxygen passing from plant to animal, and from animal to plant. The animals take in the complex plant products and water and give off as wastes due to their activities, carbonic acid and water, which being dissipated into the air are brought back at once into such shape that they can serve again as plant food. The nitrogenous wastes of the animals are not reduced to the condition in which plants can feed upon them.

Part of the nitrogen is stored up in the tissues of the body of the animal, and when it has died, the body contains nitrogen compounds of great complexity. Plants cannot use these compounds. In order that this material may be utilized by plants it must be broken down or reduced to a simpler condition. This is the work of bacteria. The decomposition or putrefactive bacteria break down these compounds into others which are often too simple for plants to make use of them as a source of nitrogen.

Through the agency of another class of micro-organisms these compounds are changed into nitrates which the roots of the plant can take up and assimilate. Without bacteria there could be no plant life since there would soon be no nitrogen in the soil. Soil which is incapable of nourishing, on examination is usually found to be lacking in bacteria. Certain plants have the power of assimilating these peculiar bacteria and a crop of these legumes as they are called will often rectify any deficiency.

BACTERIA AS RELATED TO FARM LIFE:- Thus the farmers' life is in the most intimate association with bacteria. They are his best friends and his worst enemies. He must depend upon them to insure the continued fertility of the soil and the production of good crops. He must depend upon them to replenish his stock of nitrogen. He must depend upon them to turn into plant food all the refuse from his house and farm. He must depend upon them for the peculiar flavors of his butter and cheese. Yet he must constantly guard against them. They may produce disease in his cattle. They may cause his fruits, vegetables, meats, and eggs to decay. They may cause the decay of the seeds which he has planted. The most successful farmer of the future will be the one who intelligently handles bacterial activity, who aids them in destroying or decomposing everything which he does not wish to preserve and who prevents their destroying the organic materials which he wishes to keep for future use.

FERMENTATIVE BACTERIA:- The whole of the great fermentive industries is based upon the judicial aid of chemical decompositions produced by bacteria and yeasts. They assist in the production of beer, the formation of vinegar and the curing of tobacco. The yeasts are also plants and produce alcoholic fermentations. The prescence or absence of certain bacteria may retard or assist in this fermentation. The commercial importance of the manufacture of vinegar, though large, does not compare in extent with that of alcoholic fermentation.

VINEGAR:----- The best quality of vinegar is made from fruit juices;cheaper qualities are made from malt, grains, sugar refinery wastes and other sources. These cheaper kinds are often colored and sold as cider vinegar.

There are two important changes which take place in the conversion of fruit juice into vinegar: First, the sugar in the juice is converted into alcohol. This fermentation is caused by a vegetable ferment or enzyme which is produced by ordinary yeast. Cells of this plant are so abundant and widely distributed that under ordinary conditions great numbers get into the apple juice. If the fruit be dirty many other micro-organisms will enter and may retard the action of the yeast cells. The rapidity of the transformation of sugar into alcohol depends upon the temperature and the preence of yeast.

It has been demonstrated that fresh juice to which yeast has been added, if kept at a temperature of from 65 to 75 degrees Fahrenheit, will convert cider into alcohol in less than half the time taken by the ordinary process. The second change takes place when a group of micro-organisms called acetic acid bacteria commonly called mother attack the alcohol and convert it into acetic acid. What ia known as the "mother" of vinegar is a dense mass of bacteria. In order to facilitate the process of forming acetic acid, some of the mother may be introduced into the alcoholic fermentation and by this means the conversion of the cider into vinegar is much more rapid. The bacteria causing acetic acid fermentation are called aerobes (or bacteria requiring air in order to live and work) consequently the shutting off of the air from the liquid, retards or prevents the growth of the organism and thus also the formation of the acid. After the acetic acid has been formed, the air must be shut out in order to prevent organisms from attacking the vinegar and making it weaker or entirely worthless. Vinegar left uncorked has been known to become alkaline.

CANNING:- As agents of decomposition, bacteria will of course be harmful whenever they get into a material which it is desired to preserve and it is necessary to count upon their attacking any fermentable substance which is exposed to air and water. This fact has caused the development of one of our most important industries. Canning meats or fruits consists in bringing them into a condition in which they will be preserved from an invasion of these micro- organisms. The method is extremely simple, being nothing more than the heating of the material to be preserved to a high temperature and then sealing it hermetically while it is hot. The heat kills all bacteria which may chance to be lodged in the fruit and the sealing prevents other bacteria f rom obtaining access. The reason that the housewife so often fails in this preserving process is that she does not use proper care. She may sterilize her fruit and sterilize her cans and then expose both to the germ-laden dust before sealing. Her most frequent lapse, however, is the using of a dish cloth or towel which has not been sterilized and which being damp is a breeding place for germs, in order to dry her "Switzerland cans.

MILK:- Next to the farmer the dairyman is more closely concerned with bacteria and their activities than almost any other class of persons. Modern dairying, apart from the matter of keeping the cow, consists largely in trying to prevent bacteria from growing in milk or in stimulating their growth in cream, butter and cheese. As it is drawn from the udder, milk is nearly free from bacteria. Could it be kept in this condition it would be many hours before any perceptible change would take place. The first bacteria enter during the time of milking and are naturally derived from the cow and her surroundings. The manipulation of the udder works off hair,particles of skin and in many instances particles of manure that adhere to the hair and udder. All of this material finds its way into the milk pail and carrieswith it great numbers of bacteria. The warm temperature and the presence of suitable food supply cause these bacteria to multiply very rapidly and unless something is done to check their growth, souring or other effects of decomposition will take place in a few hours. The work of milking should be performed in such a way thatfew bacteria will find their way into the milk. All his of course leads to the conclusion that the cow should be thoroughly cleansed. All the surroundings also need attention. The air in the milking place must be free from dust of all kinds, whether it be that which the animals have stirred up or that formed from the food. Not only this, but the condition of the hands and clothes of the milker is of great importance. White clothes kept white and clean, white-washed walls and a smooth clean floor will usually insure clean milk.

Not all of the bacteria which find their way into milk come from the cow or the barn. Often milk pails, strainers, cans and other utensils used for handling milk are the source of bacteria. Faulty construction of these vessels is very common. There should be no hidden, inaccessible places in milk vessels. Every rough place is a hiding place for innumerable bacteria. Wooden vessels cannot be kept clean. Thus attention to the cleanliness of vessels applies to the individual consumer the same as it does to the dairman.

The proper washing of milk utensils is something that is often misunderstood. All milk should be rinsed from the surface of the tin before it comes in contact with boiling water, as the heat will cook the milk on the surface forming a coating very difficult to remove. If this coating is not removed it furnishes food and place for bacterial growth. For scrubbing all milk vessels a good brush should be used. Nothing can be more objectionable than a cloth that has been used for washing the dishes or pots and pans. The final rinsing of these vessels should be in boiling hot water. If the vessels are allowed to remain in the water for a time he heat will reach every part and kill all life. The vessel should not be dried with a cloth but should be drained and if possible placed in the sun so that its rays will reach every part of the inside. Most species of bacteria cannot in the direct rays of the sun. So much for the preparation and the care of milk. Milk which has been treated in the proper way may be examined and found to contain numerous pathogenic bacteria. It is an established fact that diptheria bacilli thrive and multiply with particular rapidity in milk, and when we consider the numerous opportunities offered for the infection of milk by persons handling it who are suffering from the disease or who are in diptheria surroundings, we can easily understand how milk becomes a carrier of the first order. Scarlet fever may be spread in the same way. There is a striking instance of milk in distributing typhoid germs. In a small American city a few years ago, 386 cases of typhoid fever occurred in six weeks, and of this number over 97 per cent occurred among families obtaining their milk from the same dairy. A careful inspection revealed the fact that the milk cans had been rinsed with water from a shallow well contaminated with typhoid dejecta.

The various diseased to which cattle are subject have their effect on milk. The general public is hardly aware of how widespread tuberculosis is among cattle; and the general activity and effects of its bacilli is a subject which is now attracting universal attention.

STERILIZING:- Since it is extremely costly to secure and handle milk in a strictly antiseptic fashion, some manner of destroying the bacteria which gather must be found.

The application of heat to milk is in fact the only advisable and reliable method for rendering it free from germs but a great deal depends upon the manner in which the heat is applied to secure the cleanly condition the milk employed. The difficulties which have to be overcome in producing efficiently sterilized milk are due first to the remarkable power of resisting heat which characterizes some disease germs and, secondly to the sensitiveness of milk to heat as exhibited by its alternation in tastes and other respects through exposure to high temperature. The best method discovered up to the present is the process known as Pasteurization.

BUTTER:- In making butter, the bacteria are valuable allies. Cream is taken from the milk and allowed to stand and "ripen." This ripening is due to the presence and development of bacteria. The cream becomes soured, curdled and acquires a peculiar taste and aroma foreign to fresh cream. It is then churned. Part of the bacteria collect in the butter and part of them are washed off.. Most of those leftin the butter soon die, since conditions are unfavorable; but some live and become agents in the changes by which butter becomes rancid. The flavor of the butter depends upon different species of bacteria which are present in the ripening of cream at different seasons of the year. The species of bacteria in June cream are different from these in January cream. In order that the cream may have the same flavor all the year, bacteria are cultivated and added to the cream. These cultures are known as "starters." Cheese is made from the casein of milk and is most valuable as a food. The change of liquid milk to a solid curd is a chemical change but the ripening is brought about by by bacteria and it is to innumerable species of bacteria and moulds that we are indebted for the many flavors of cheeses.

Pure cultures of bacteria are now used for cheese ripening and therefore cheeses, which have hitherto been imported because the species of bacterium necessary was not native to this country,are being produced in the United States.

BACTERIA IN WATER:- When rain leaves the clouds it is pure, but in falling through the air, it washes down large quantities of dust so that the first fall of anyshower is very dirty. When rain-water is used for drinking purposes, he first fall should be allowed to waste. Cisterns must be kept clean but if in juxtaposition to any sewerage vats or underground air currents the water should not be used, since it will always carry bacteria. The water of lakes,rivers and the ocean always contain a large number of certain species of bacteria. The ordinary bacteria are harmless, but water also carries disease germs commonly those of typhoid fever and Asiatic cholera. The relative amount of bacteria found in ice depends upon the water from which it is made. Freezing does not apparently affect the water nor does it diminish the activity of the bacteria when they are released. They are more or less reduced in number but not in virulence. Impure water may be purified from all germs by boiling rapidly for half an hour. Such water having lost the air dissolved in it, tastes insipid. Air may be restored by pouring from one vessel to another in a place where there is as little dust as possible. Most filters simply strain out visible suspended particles or comparatively large animals and vegetable forms. A filter in order to be effective muststrain through a very fine medium, slowly in order that the bacteria may be collected. Any suspected water should be boiled and placed in sterilized vessels before using.

BACTERIA ON VEGETABLES:- Vegetables upon examination show numbers of bacteria and there is great menace to the health of all who consume such articles as lettuce, radishes, celery and other vegetables which are not first cooked before being placed on the table. The bacteria come from the water which is used by the plants. Tubercle infected sewerage poured over soil in which radishes were growing showed that after eighty-eight days the bacilli were alive and virulent on the radishes and could readily become the source of infection.

It will therefore be seen that bacteria as our friends play a vastly more important part in nature than they do as our enemies. Without them, we should not have epidemics, but without them we should not exist. It is true that bacteria by producing disease occasionally cause the premature death of an individual or their authorities may bring death to thousands of individuals. But it is equally true that without them plant and animal life would be impossible.

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