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A HOME COURSE IN AGRICULTURE

XI--Bacteria--How They Affect the Farmer

By C. V. GREGORY

Agricultural Division Iowa State College

We hear a great deal about bacteria, or germs, as they are more popularly called, but few people know what they really are. Although they are so small that it would take several thousand together to make a spot large enough to be seen with the naked eye, yet their importance to the farmer is not measured by their size.

Bacteria are tiny plants, each composed of a single cell. These cells are of various shapes and sizes. Some are round, some long and some shaped like a corkscrew. Some are found singly and some in groups. Some cannot move at all, some move by twisting themselves about, and still others have long, tail-like flagella by which they move themselves along.

Bacteria are made up of a clear, jellylike material called protoplasm. This protoplasm is surrounded by a harder cell wall. There is a great difference in the thickness of these cell walls, and on this thickness depends to a large extent the ability of the germs to withstand unfavorable conditions. Those with thin cell walls can be killed easily, while the thicker walled kinds are very difficult to exterminate.

Bacteria propagate themselves by dividing. One cell divides into two. Each of these two grows to full size and divides again, and so on. Under favorable conditions this process may be repeated every half hour. At this rate the descendants of one germ would in ten hours number more than a million.

At times the part of the protoplasm of a germ will gather into a round, comparatively hard mass, called a spore. The rest of the cell then crumbles away. This spore is inactive, but possesses much greater powers of resistance than when in the active state. These spores often remain alive to start the infection afresh after the active bacteria have all been killed by disinfection.

Bacteria, like higher plants, have definite requirements for growth. One of the most important of these is moisture. Drying will not kill bacteria, but it will stop their multiplication. Another essential to bacterial growth is warmth. Cold, like dryness, will not kill them, but it will stop them from multiplying. This is the reason that the souring of milk or the spoiling of meat, which is caused by bacteria, goes on much more slowly or not at all when they are kept in a cold place.

One of the principal foods of bacteria is nitrogen. Without it they cannot live. Because of this fact sugar and lard, which contain no nitrogen, never spoil. Bacteria also require oxygen, though only certain species are dependent on the air for their supply. One of these is the kind that causes meat and vegetables to decay. This is why canned fruit and vegetables do not spoil. The bacteria have been killed and the oxygen driven off by heating. The few germs that do get in before the can is sealed up cannot develop for lack of air. If the can is not air tight, however, some oxygen will find its way in, the germs will multiply, and the contents will spoil.

Not all bacteria are injurious. Although some of man's most deadly enemies are found among these invisible micro-organisms, yet many of them are his best friends. We have already learned about the bacteria that live on the roots of legumes and change the nitrogen of the air into a form in

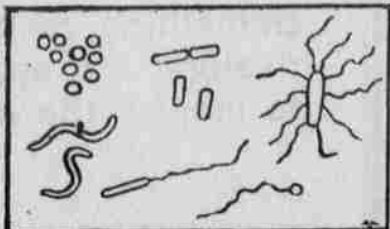


FIG. XXI--SOME TYPES OF BACTERIA, which it can be used by plants. The rotting of manure and trash to make humus and of humus to make the elements of plant food available is also due to the action of bacteria. In this way bacteria, by making animal wastes available for plant food, complete the circle of plant and animal life.

The putrefying bacteria, or those which cause rotting, are more beneficial than harmful. By their action dead animals and other refuse matter are quickly reduced to the elements from which they were made. Even the odor given off during the process is also beneficial as a reminder that the matter of burying or burning has been neglected.

Other micro-organisms in the form of yeast are a necessary help in bread-making. The yeast plants, growing in the dough, set free considerable amounts of carbon dioxide. This gas in trying to escape fills the dough with holes and spaces, making it "rise."

The bacteria which cause milk and cream to sour are also useful. Butter made from sweet cream is lacking in flavor, and there is not so much of it, since the globules of butter fat do not collect as readily as in sour cream. But, while the germs that cause milk to sour are harmless, there are others

often found in milk that are not. The first variety will always be plentiful enough anyway, and the others should be kept down to as small a number as possible.

One of the most important methods of doing this is by cleanliness. The milk pails and strainers and the separator should be thoroughly cleaned every time they are used. Mere rinsing with cold water is not enough. Following the ordinary washing by scalding with boiling water is the only sure way of killing all the germs. In cleaning dishes a brush is much better than a rag, since it can be more easily cleaned itself. A dish rag remains damp for a long time after it has been used and furnishes an excellent place for bacteria to grow. The "dish rag flavor" caused by these can often be detected in butter.

After the dishes have been scalded they should be placed in the sun for several hours. There should be as



FIG. XXII--HOW SPORES ARE FORMED. much sunshine as possible in the milk room and cow stable also. Sunlight, which is so necessary to the growth of the higher plants, is fatal to bacteria.

The stable where the milking is done should be cleaned and aired every day. A coat of whitewash should be applied occasionally, as in addition to being a good germ killer it also makes the stable much lighter. Hay should not be fed immediately before milking, as the dust from it is covered with bacteria. The udders and flanks of the cows should be kept perfectly clean. A little dirt falling from them into the milk will take with it thousands of germs. The milk should not be left in the barn after it is drawn, but taken immediately to the milk room.

Many creameries and city milk dealers practice pasteurization. This simply consists in heating the milk to as high a temperature as possible without scalding it. This kills most of the germs, and the few that are left will not develop rapidly enough to do much harm. In creameries a starter--that is, a portion of milk which contains a particular kind of bacteria--is added after pasteurization and the cream then "ripened" for twelve hours or so. By thus supplying germs which are known to produce desirable flavors and killing the others butter of very high quality may be made.

There are bacteria everywhere--in the soil, in the air and in the water. By far the greater number of these are harmless. Even disease germs are unable to obtain a foothold in a perfectly healthy animal or person. The secretions of the mouth and the digestive organs are fatal to many of them. Even if they succeed in getting into the blood they are not yet out of danger. The blood contains large numbers of white corpuscles, which seem to have no duty to perform but to seize and destroy these invaders. It is only when an animal becomes weakened from one cause or another that these corpuscles fail to do their duty and the germs begin their destructive work.

The first step in avoiding infection by disease producing bacteria, then, is to keep the animals healthy by proper feed, exercise and shelter. The next point is to do everything possible to prevent the germs from getting into the animal's body.

In case a contagious disease of any sort appears the sick animals should be shut up by themselves as far as possible from the rest of the herd. Disinfectants, such as coal tar dips and bichloride of mercury (one part of the chemical, two parts salt and 1,000 parts water), should be used freely. Care should be taken not to carry the germs from the sick animals to the well ones while caring for them.

Wounds, such as wire cuts, need especial care to prevent infection. Ordinary disinfectants are too irritating, yet something must be done to keep the bacteria from attacking the raw surfaces. Keeping the wound bound up tightly and sprinkling daily with powdered iodoform is one of the best ways of insuring rapid healing.

The germ problem, like the problem of weeds and insects, is easily solved if it is gone at in the right way. Cleanliness, sunlight and disinfection will do much to hold the injurious ones in check, and the others need no encouragement to continue doing their invisible though none the less real work to help us. There is no especial reason why the germ problem should be made a matter of constant uneasiness on the part of the farmer. It requires a scientist to discriminate between bacteria that are injurious and those that are necessary, and in the meantime it is sufficient for the ordinary agriculturist to be diligent in trenching himself behind cleanliness. Thus fortified he will have little occasion to make a special study of bacteria. Let the scientists do that.

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