Relation of Bacteria to Disease with Tuberculosis as a Type.

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The scientific study of bacteria may be said to have originated as early as the latter part of the seventeenth century but until recent years the progress in this branch of science has been exceedingly limited. which is probably due in a certain degree to the minuteness of the micro-organism with which one must deal in order to make any further discoveries.

Bacteria as well as animals may be divided into different races and species. and just as the progeny of a certain species of animals under varying conditions tend to become different, so do the descendants of one bacterial species differ. Hence, bacteria do not grow equally well on every culture media or do not always find the body of the same animal always equally suitable. This becomes much more noticeable when bacteria are grown on artificial culture media. for many bacteria are very sensitive to slight chemical changes and also variations in temperature. It

has been found that for each variety of organism there are special conditions necessary for growth and that certain temperatures, the amount of light, supply of oxygen and other conditions suitable for one may be entirely destructive to the growth of another organism. And again two organisms grown together may so alter conditions as to make it unsuitable for the growth of either bacteria. There are some species which find it impossible to grow in the living body but are found in the air, water and soil. These bacteria therefore do not produce infectious diseases. Again there are micro-organisms which cannot grow at all except upon certain portions of the body as for example we have the diphtheria bacilli which grow upon the mucous membrane of the respiratory tract, but cannot grow in the blood or other tissues. The tetanus bacillus develops in the wounds of the sub-cutaneous tissues, but will not grow on the body surface or in the blood. The bacilli of tuber

culosis may be found in the apex of a lung or a gland for years, although at any time it may invade many tissues of the body.

A prominent scientist has made the following classification of bacteria according to their relation to disease.

I. Strict saprophytes, or bacteria which grow readily in suitable dead organic material, but not in the body under ordinary conditions.

(a) Bacteria which in their growth produce no substance which are poisonous to the body, or at least none capable of absorbtion.

(b) Bacteria which produce in their growth in dead organic matter sufficient poisons to cause sickness if they are absorbed into the animal body.

II Facultative saprophytes - These are bacteria which can develop either as parasites or saprophytes. The different varieties vary as to the amount of poison which they produce. Some grow luxuriantly in dead organic material under very diverse

conditions. In the body they also vary, some grow extensively in the blood while others are limited to one or more tissues, some being widely distributed throughout the body, while others are localized in or upon a certain portion of it.

III. Strict parasites, or bacteria which so far as we know, grow only in the living animal or vegetable organism. These again vary in the amount of poison which they produce and in the local or general infection they give rise to.

Under this last division will be classified the specific pathogenic disease upon which the remainder of the discussion will be based.

In studying the endless variety of diseases we find there are a great many which physicians call infectious and it has been determined in the last few years that the sole agent which causes a portion of these diseases is some form of bacteria and moreover, each disease has its definite form of

bacteria and without which the disease could not under any possible means exist.

The germ causing consumption or tuberculosis was discovered by a prominent scientist, Professor Koch, in 1882, and it is called the bacillus tuberculosis. Of all the pathogenic bacteria there are none which cover such a large area as the micro-organism causing tuberculosis. Not only is it important as a germ infesting the human body but it is also attracting much interest among agriculturalists as it is one of the most dreaded diseases to be contended with among cattle.

The micro-organism producing this well known disease has been known to science but of recent date, it having been discovered about twenty years ago. It appears most commonly in a slender rod-like body about .2 to .4 μ in diameter and 1.5 to 4 μ in length. It has not the power of motion and never forms chains

although a few may frequently be seen together.

It is thought by some who have made a thorough study of this germ that it is probable this bacillus contains spores since all active bacteria are quite easily destroyed by a moderately low temperature and only spores can withstand a high temperature; it has also been determined that the tubercle bacillus will often resist high temperatures, it may even be brought to the temperature of the boiling point without producing any disasterous effects, and such resistance is only expected of spores.

Another statement which seemingly might help to give this theory a firmer basis is that the micro-organism may become dried out and yet remain alive for considerable length of time. There are other points which are somewhat uncertain causing some doubt as to whether this organism really belongs to the true bacteria. Of recent years

the discovery has been made that under certain conditions the rods are seen to produce branches and if this is true, it suggests that it is not the true bacillus, but belongs to a different group of fungi.

In order to determine whether certain micro-organisms were the direct cause of disease Koch has given four conditions which must be fulfilled by an organism in order to prove that it is the cause of the disease.

(a) The organism must be demonstrated in the circulation or tissues of the diseased animal.

(b) The organism thus demonstrated must be cultivated in artificial media outside the body, and successive generations of a pure culture of that organism must be obtained.

(c) Such pure cultures must, when introduced into a healthy and susceptible animal, produce the specific disease.

(d) The organism must be found and isolated from the circulation or tissues of the inoculated animal.

There are many diseases which fulfil a portion of these conditions but not all, while with tuberculosis there is little doubt but that the micro-organism (tubercle bacilli) which causes this disease will produce the above named effects or conditions.

In studying the existence of this minute organism it is very natural for us to ask ourselves the question, How does this germ come in contact with the body? In the first place we would mention the subject of heredity. By this we mean the transference of the specific virus of the disease from the mother to the child. This has in the past been a well accepted theory but of later years it seems to be loosing its firm hold. It is quite evident there may be a condition of the body which renders it quite

favorable for the growth of this micro organism, hence we may call it a predisposition to the disease but this does not necessarily infer that one will finally become diseased as this condition may be overcome by proper precaution.

It is quite true that ones occupation in life may predispose to tuberculosis, for instance, sitting in cramped positions as that of book-keeper, stenographer and many other positions where one does not take the proper exercise, also exposure to dampness and cold may bring about diseased lungs which weakens them and gives the tubercle bacillus a better opportunity for development. Besides predisposition, there is the condition in which one actually comes in contact with the germ causing the disease. It seems strange how the body may become infected when the bacilli will not grow except at the body temperature and

also when they are attempted to be grown artificially with other bacteria they are overpowered in the struggle for existence, hence we must necessarily look for some means whereby they may be transmitted from one host to another. It has been found that the food is a good means for the transportation of the micro-organism. It is a well known fact that tuberculosis of cattle is a very common disease, therefore it is quite evident that the germ might be easily transmitted from the animal to man simply by the use of uncooked meat or milk, provided that it is the same germ which causes the disease in cattle as in man, but Professor Koch has recently made the announcement of his conclusion in regard to the matter and that is, that the bovine tubercle bacillus is different from the human tubercle bacillus and that the disease consequently cannot pass from cattle

to man. If this is true it will greatly decrease the danger of infection. It has been questioned by scientists as to milk being regarded as a source of infection, some think it should not be since milk is taken directly into the stomach; if it gave rise to tuberculosis one would naturally expect that the seat of the disease would be in the intestinal tract; but it is, however, a well known fact that in mankind the lungs are the most common seat of infection, therefore it would scarcely seem probable that drinking milk would be the likely cause of pulmonary tuberculosis; moreover, the number of bacilli which a person would swallow with a drink of milk would commonly be rather small, and the human individual has a considerable power of resistance against the disease. The argument is also brought forth that while bovine tuberculosis has been increasing, human tuberculosis has

been on the decline of recent years and the decline has been equally great in those countries that use milk raw and in those countries that sterilize the milk before drinking it.

Great care should be taken in regard to eating meat which can by any possible means be likely to be infected; although there is also much argument against the possibility of one becoming infected through the use of flesh of tuberculosis cattle. The danger naturally arises from eating flesh which contains the bacillus, but since the infection of cattle is principally through the lungs, intestines and lymphatic glands and so rarely are the muscles affected, and since they are the portion used for food this greatly lessens the danger of infection. The fact that the flesh is cooked before it is eaten is another great preventive as the application of a moderate quantity of heat in cooking will destroy the bacteria.

But since it is quite evident that the

lungs are the principal location of the tubercle bacillus one would naturally suppose that the great majority of persons become infected through the air inhaled. This is said to be the most common method of infection since the patient is continually throwing out thousands of these germs every time they expectorate, the discharge becomes dry and is ground up with the dust and is then ready for distribution to the passer-by. Professor Cornet of Berlin, has been able to find the living virulent bacilli where dust has lodged upon the walls in consumptive wards in hospitals, also in the dust in private houses and hotels containing consumptive patients. But he found this to be true only in instances where there was no care taken to disinfect or destroy the sputum and where it was allowed to lodge upon the furniture or floor and then become ground up with the dust and carried to all parts of the room by the air and lodged on

the furniture which was not reached in dusting.

When the tubercle bacillus enter the body there is an action takes place in the cells which is similar in its effect to that which would be produced when some irritant was at work. The connective tissue cells surrounding the bacilli become enlarged and undergo a division, the resultant cells then become distinguished by their large size and pale nuclei (Giant cells.)

In tissues the tubercle bacilli produce the small nodules, or what may better be termed tubercles and before they have taken any degenerate form they are gray and translucent in color, the average size being about that of a millet seed and of a hard consistency.

One of the great questions now facing the public is to devise some means by which the prevalence of this disease may to a greater or less

degree be prevented, since it is one of the most widely spread and dreaded diseases known to mankind. Since it is a well known fact that a principal source of infection is the sputum of those having the disease a complete suppression of the disease might be attained if some means were devised whereby the tubercle bacilli might be rendered innocuous. If the following principles were enforced upon the general public it would tend to improve the general conditions by the destruction of the micro-organism causing the disease.

First, the sputum of the patient should be received in a small paper cup and then be disposed of, or else receive it in some dish containing water so that there is not an opportunity for it to become dry and converted into dust. By no means should the handkerchief be used to receive the expectoration

as it would soon become dry and then would be carried out in the air with dust particles. After the care of the patient has been considered, the room should have attention by cleaning quite frequently with some kind of a moist material to prevent the conversion into dust of any possible escape of sputum upon the furniture or floor.

Finally, to be on the safe side one should never drink milk or eat meat that has not beforehand been thoroughly boiled in order to destroy the germ which might possibly be concealed therein.

After considering the fatality among tuberculosis patients and since it is a world wide spread disease and that it affects peoples of all races, color and social standing alike we should exert our every energy in the suppression and prevention of it.

In order that this may be accomplished there must be strict sanitary laws enforced concerning the proper care of milk, meat, sputum and disinfection and in addition to this establish hospitals for consumptive patients and last but not least strive to improve the home life by better preparation of food, the dwelling place and the general condition of the people, and if this is accomplished it will result, to a vast degree, in decreasing the mortalities in patients suffering with the disease; since it will tend to build up an individual resistance to the disease.

It will probably take many years for the public to become sufficiently educated to know the great need of cooperating with the sanitary authorities in carrying on the hygienic laws which are necessary for the eradication

of the tuberculosis germs, but it is being carried out to a certain extent so we have reason to entertain great hopes that in some future time the tubercle bacillus will be entirely under control.