Robert Koch, "The Aetiology of Tuberculosis" (1882)

Abstract

In this article, Robert Koch (1843–1910) investigates the development of tuberculosis. He introduces tuberculosis as one of the most widespread infectious diseases and emphasizes the importance of learning more about its progression and transmission. Koch goes on to present the results of microscopic studies in which he made the tubercle bacteria visible. Finally, he discusses the significance of tuberculosis bacilli, for whose discovery Robert Koch received the Nobel Prize for Medicine in 1905.

Source

The Aetiology of Tuberculosis
(According to a paper read before the Physiological Society in Berlin, March 24, 1882)

By Dr. Robert Koch, Government Advisor in the Imperial Health Office

Villerain's discovery that tuberculosis is transmissible to animals has, as is well known, found varied confirmation, but also apparently well-grounded opposition, so that it remained undecided until a few years ago whether tuberculosis is or is not an infectious disease. Since then, however, inoculations into the anterior ocular chamber, first performed by Cohnheim and Salomonsen, and later by Baumgarten, and furthermore the inhalation experiments done by Tappeiner and others have established the transmissibility of tuberculosis beyond any doubt, and in the future tuberculosis must be classed as an infectious disease.

If the number of victims which a disease claims is the measure of its significance, then all diseases, particularly the most dreaded infectious diseases, such as bubonic plague, Asiatic cholera, etc., must rank far behind tuberculosis. Statistics teach that one-seventh of all human beings die of tuberculosis, and that, if one considers only the productive middle-age groups, tuberculosis carries away one-third and often more of these. Public hygiene has therefore reason enough to devote its attention to so destructive a disease, without taking into any account that still other conditions, such as the relations of tuberculosis to *Perlsucht,* engage the interest of public health.

Since it is part of the task of the *Gesundheitsamt* to investigate infectious diseases from the point of view of public health, that is, primarily as regards their aetiology, it seemed an urgent duty to make thorough studies on tuberculosis particularly.

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Under the microscope all constituents of animal tissue, particularly the nuclei and their disintegration products, appear brown, with the tubercle bacilli, however, beautifully blue. With the exception of leprosy bacilli, all other bacteria which I have thus far examined in this respect assume a brown color with this staining method. The color contrast between the brown-stained tissue and the blue tubercle bacilli is so striking that the latter, which are frequently present only in very small numbers, are nevertheless seen and identified with the greatest certainty.

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In several respects the bacteria made visible by this process exhibit a characteristic behavior. They are rod-shaped,

and they belong to the group of *bacilli.* They are very thin and one-fourth to one-half as long as the diameter of a red blood-corpuscle, although they may sometimes reach a greater length, up to the full diameter of an erythrocyte. In shape and size they bear a striking similarity to leprosy bacilli. They are differentiated from the latter by being a bit more slender and by having tapered ends. Further, leprosy bacilli are stained by Weigert's nuclear stain, while the tubercle bacilli are not. Wherever the tuberculous process is in recent evolution and is rapidly progressing, the bacilli are present in large quantities; they usually form, then, densely bunched and frequently small braided groups, often intracellular; and they present at times the same picture as leprosy bacilli accumulated in cells. In addition, numerous free bacilli are found. It is particularly at the margin of larger caseous foci that there occur practically only shoals of bacilli which are not enclosed in cells.

As soon as the height of tubercle-development is passed the bacilli become rarer, and occur only in small groups or quite singly, in the margin of the tuberculous focus and side by side with weakly stained and sometimes hardly recognizable bacilli which are presumably dying or dead. Finally, they may disappear completely; but they are but seldom entirely absent and, if so, only in such places in which the tuberculous process has come to a standstill.

If giant cells occur in the tuberculous tissue the bacilli are by predilection within these formations. In very slowly progressing tuberculous processes, the interior of giant cells is usually the only place in which bacilli are to be found.

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If we ask further what significance belongs to the results gained in this study of tuberculosis it must be considered a gain for science that it has been possible for the first time to establish the complete proof of the parasitic nature of a human infectious disease, and this of the most important one. So far such proof was established only for anthrax, while in a number of other infectious diseases in human beings, for example, relapsing fever, wound infections, leprosy, gonorrhea, it was only known that parasites occur simultaneously with the pathological process, but the causal connection between the two has not been established. It may be expected that the elucidation of the aetiology of tuberculosis will provide new viewpoints for the study of other infectious diseases, and that the research methods which have stood the test in the investigation of the aetiology of tuberculosis will be of advantage for the work in other infectious diseases. Quite particularly may this hold true for studies of those diseases, which, like syphilis and glanders, are most closely related to tuberculosis, and form with it the group of infectious tumors.

How far pathology and surgery can utilize the knowledge about the properties of the tuberculosis parasite it is not my duty to define. It remains to be seen whether, for example, the demonstration of tubercle bacilli in the sputum can be used for diagnostic purposes, or whether the certain diagnosis of many localized tuberculous affections will be of influence in their surgical treatment, and whether therapy may profit from further experiences about the living conditions of the tubercle bacilli. My studies have been done in the interest of public health, and I hope that this will derive the largest profit from them.

Tuberculosis has so far been habitually considered to be a manifestation of social misery, and it has been hoped that an improvement in the latter would reduce the disease. Measures specifically directed against tuberculosis are not known to preventive medicine. But in the future the fight against this terrible plague of mankind will deal no longer with an undetermined something, but with a tangible parasite, whose living conditions are for the most part known and can be investigated further. The fact that this parasite finds the conditions for its existence only in the animal body and not, as with anthrax bacilli, also outside of it under usual, natural conditions, warrants a particularly favorable outlook for success in the fight against tuberculosis. First of all, the sources from which the

infectious material flows must be closed as far as this is humanly possible. One of these sources, and certainly the most essential one, is the sputum of consumptives, whose disposal and change into a harmless condition has thus far not been accomplished. It cannot be connected with great difficulties to render such phthisical sputum harmless by suitable procedures of disinfection, and to eliminate thereby the largest part of the infective tuberculous material. Besides this, the disinfection of clothes, beds, etc., which have been used by tuberculous patients, must certainly be considered.

Another source of infection with tuberculosis is undoubtedly tuberculosis of domestic animals –in the first rank, *Perlsucht.* Herewith, too, is indicated the position which public health has to assume in future on the question of the danger of meat and milk from animals with *Perlsucht. Perlsucht* is identical with tuberculosis in man, and is therefore a disease transmissible to man. It must therefore be treated exactly the same way as other diseases transmissible from animals to man. Be the danger of meat and milk from animals with *Perlsucht* ever so great or ever so little, it is present, and it must therefore be avoided. It is sufficiently known that anthrax-infected meat has been eaten by many persons, and often for a long time, and without any ill effects, and still no one will conclude therefrom that the trade in such meat should be permitted.

In regard to milk from cows with *Perlsucht*, it is noteworthy that the extension of the tuberculous process to the mammary gland has been observed not rarely by veterinarians, and it is therefore quite possible that in such cases the tuberculous virus may be mixed directly with the milk.

Still further viewpoints might be mentioned in regard to measures which could serve to limit the disease on the basis of our present knowledge of the aetiology of tuberculosis but the discussion here would lead too far. When the conviction that tuberculosis is an exquisite infectious disease has become firmly established among physicians, the question of an adequate campaign against tuberculosis will certainly come under discussion and it will develop by itself.

Source of English translation: Robert Koch, "The Aetiology of Tuberculosis;" a translation from the German of the original paper announcing the discovery of the tubercle bacillus, read before the Physiological Society in Berlin, March 24, 1882, and published in the *Berliner klinische Wochenschrift*, 1882, xix, 221, specially prepared for *The American Review of Tuberculosis*, March, 1932. New York: The National Tuberculosis Association, 1932, pp. 15–18, 38–40.

Source of original German text: Dr. R. Koch, "Die Ätiologie der Tuberkulose," *Berliner klinische Wochenschrift*, 1882, 19. Jg., pp. 221–30. Available online at: https://hdl.handle.net/2027/mdp.39015020075001