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ALBERT RUFUS BAKER & SAMUEL WALTER KELLEY

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ORIGINAL ARTICLES.

ETIOLOGY OF TUBERCULOSIS.

BY D. N. KINSMAN, A. M., M. D., PROFESSOR PRACTICE OF
MEDICINE, COLUMBUS MEDICAL COLLEGE, COLUMBUS, O.

WHEN the history of medicine shall have been written, the conquests of this decade in the realm of the "infinitely small" will not be the least of the recorded victories.

These discoveries are full of promise for the future, for they substitute fact for conjecture and give a rational basis, both for prophylaxis and therapeutics.

It is true nothing has yet been discovered in therapeutics which is specially valuable, but what must be done as prophylaxis is very clear.

The discovery of the bacillus of tuberculosis by Koch has made us acquainted with a new factor in etiology, and grouped in a single class diseases before supposed to be diverse. This discovery has not destroyed or rendered useless anything which was known before. By it our horizon has been enlarged and our knowledge of relations increased, and thus a distinct advance has been made.

In pathology there is need and room for all which is true,

even if it is new, as well as for that which has been tried and found true. Error is no less error because it is gray-headed; nor the new less true because new.

It seems as if the minds of some men were cast in plaster of Paris, and they live and die, singing in medicine as in their theology, "As it was in the beginning so it is now and shall be, world without end."

It is the fashion to call this conservatism in medicine, it is called bigotry in theology. Both are alike unscientific, and would block the wheels of human progress.

There is a class of neoplasms known as *granulomata*. They are all infectious. Each one of the class is characterized by a special micro-organism. In this class we place tubercle, syphilis, lupus, leprosy and glanders. It is probable that tubercle and lupus are caused by the action of the same bacillus, modified by locality. There is now no question of the infectiousness of all these diseases, although less than a score of years ago this was denied in respect to all except syphilis and leprosy.

All these diseases are communicable from man to animals, and in a portion, at least, from animals to men. At a certain stage the inflammatory process is arrested, and retrograde metamorphosis takes place.

Tuberculosis causes one-seventh of the annual mortality in civilized nations, and invades every organ in the body. Most of this fatality depends upon tuberculosis of the lungs. Therein its process is most readily recognized; elsewhere, as in the brain, its localization leads speedily to death.

Is Koch's bacillus the cause of these manifold appearances of tuberculosis? Three principal objections have been urged against this:

1. In a few cases careful examination has failed to reveal the bacillus in those lesions which were manifestly tuberculous.
2. Indifferent substances, such as lycopodium seeds and irritants, as emulsions of croton oil when introduced into the circulation, produce tubercles.
3. Under the theory that the bacillus causes tuberculosis,

it is insisted a suitable soil is necessary for its fructification, and we cannot tell which is the most important in this process, the seed or the soil, and whether after all the bacillus is not a concomitant instead of the cause of tuberculosis. We shall consider these objections in their order.

Are a few negative cases to outweigh thousands of positive observations?

Malassez and Vignal have shown that there is in the life of Koch's bacillus a spore form, which does not react to the ordinary aniline staining. This spore form they have found in tubercles in which the bacillus was not found. These spores will develop into a bacillus. The spores injected into animals will produce tuberculosis, and they say the tubercular manifestations are more prompt upon inoculations with the spores than with the bacilli. In our opinion, these observations are a sufficient answer to the first objection.

The statement in the second objection is granted to be true, *i. e.*, injections made of indifferent substances produce growths, apparently tubercles. These growths are not the result of tuberculosis, but constitute the condition known to-day as pseudo-tuberculosis.

These growths lack the essentials of true tubercles. First, they do not contain bacilli or their spores.

Second, these pseudo-tubercles cannot be inoculated in a series from animal to animal. This disposes of the second objection, for the essential feature of a tuberculosis growth is its infectivity, no matter what its form or its course may be.

Tubercle is like vaccinia or variola. Inoculation takes certainly and uniformly, and its action may be extended in an indefinite series when the soil is favorable. This brings me to the consideration of the third objection.

With us it is not a question of seed *or* soil, but of seed *and* soil. We grant to the fullest extent the influence of diathesis, of telluric and atmospheric causes, and of malnutrition, in fitting the soil for the development of the tubercular seed sown thereon. We know, moreover, there are certain soils which resist for a long time the implantation of tubercles. What we do assert is, that the tubercular bacillus is the

necessary somewhat to be implanted on the soil, or tubercles will not arise, nor is tuberculosis peculiar in its behavior in this.

Smallpox and vaccinia are unquestionably infectious diseases, and no one will claim to-day that they arise *de novo* on any soil, however well prepared, unless the special germ of the diseases is planted therein.

The soil may be so modified that smallpox or vaccinia will no longer grow thereon. I know three persons who have always resisted the action of vaccine virus, and who, after repeated and prolonged exposures to smallpox, failed to take it.

We know that the human organism may be so modified after tubercular infection that its spread is resisted by encapsulating the diseased masses. We know the constitution which offers a favorable soil may be so modified as to offer a lifelong resistance to the implantation of tuberculosis. Are there those who have an original and complete immunity from tuberculosis?

It has been urged, *i. e.*, that "coagulation necrosis" precedes the lodgment of the bacillus. Those who rely upon Zeigler for proof of this should quote what Zeigler has written since Koch made his discovery. Furthermore, it is the opinion of authorities to-day that the bacillus tuberculosis is the sole cause of caseous degeneration.

Tuberculosis is an inoculable disease. Its inoculability does not depend upon the tubercle which has undergone coagulation necrosis—for pure cultures of the bacillus introduced into the eyes of rabbits produce, first, tubercles of the iris and finally general infection. This statement has been so often confirmed by competent operators that there can no longer be any question on this subject. Tuberculosis has been communicated experimentally by the ingestion of tuberculous matter.

Tuberculosis has been communicated experimentally by causing animals to inhale tuberculous matter in fine division.

In what other way than by inoculation with or the inhalation or ingestion of the germs of any contagious dis-

ease does infection ever take place? The bacilli are expectorated from the lungs and discharged from the bowels. They pass from the kidneys with the urine and fall from the surface of tuberculous ulcers wherever located. While these organisms reproduce only at the heat of the human body, they are very tenacious of life and no ordinary heat or cold kills them. They fall upon the soil. They adhere to clothing and every object with which they come in contact. They thus produce an environment for every patient which is competent to act upon all who enter this infected circle.

Tuberculosis in men and animals is the same. Cows feeding in the stalls, where tuberculous cows have fed before them, become tuberculous.

Prisons and barracks produce their yearly harvest of tuberculous cases. In some instances it becomes epidemic, attacking in a series all who come there to live; and the fresh recruits from the country seem to suffer the most. Those who should resist the longest are often soonest attacked. The soldiers who are lodged in the barracks of the Royal Union suffer more from tuberculosis than those who were exposed to the winter storms in the trenches at the siege of Sebastopol. Soldiers exposed to vigils, labors, attacks, exposure, marches, furnish but a fraction of as many cases of tuberculosis as those housed in the best barracks in England. We are convinced that we have seen cases of undoubted contagion, from one member of a family to others. The cases reported by Reich, Weber, Musgrave, Clay, Jacoud and others cannot be easily explained otherwise than by the assumption of direct contagion.

Tuberculosis is a disease of continuous propagation, just as typhoid fever is. Within the memory of living men it has been introduced among the natives of the South Sea Islands, where the disease was unknown until the ships of the northern nations touched their shores.

The landing of the Anglo-Saxons there was, to the natives, like the apple of Eden to our first parents. It gave them a

knowledge of the 'good and evil of civilization—and of its penalty, death, by tuberculosis.

The recognition of the bacillus has become the most satisfactory means of diagnosis of the tubercular process; and it is possible long before changes occur in the lungs, which give rise to definite physical signs, to say a patient is stricken with tuberculosis.

Tuberculosis of the kidney or bladder can no longer escape recognition until the *post-mortem*, when the physician examines his case as he ought to.

We think these conclusions are warranted by our present knowledge upon this subject.

1. The bacillus tuberculosis is the active agent in the production of the disease—because it has been shown the bacillus or its spore is always present in tubercular disease.

2. The disease is infectious, and may be communicated by inoculation, ingestion and inhalation of the bacillus.

3. By assuming the above propositions, we by no means exclude the preparatory influence of depraved nutrition from any cause whatever.

4. Pure cultures of the bacillus tuberculosis produce tuberculosis and nothing else.

5. There is evidence that tuberculosis is a disease of continuous propagation.

6. There is evidence that tuberculosis is transmitted at times in the same way as other diseases denominated contagious.

7. The recognition of the bacillus leaves no doubt as to the diagnosis.

8. All tuberculous products from the lungs, bladder, bowels, or ulcerations, whatever the location, should be disinfected by exposure to boiling water, or other equally destructive agent.