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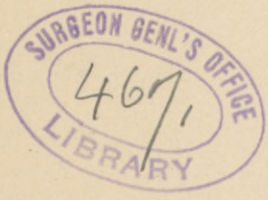

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THE ELEMENT OF CONTAGION IN TUBERCULOSIS.*

The two great achievements in medicine which especially mark the decade now closing are the gaining of precision in our knowledge of the cause of infectious diseases, and directly based upon this the discovery that, in a degree scarcely dreamed of before, these diseases are preventable.

The medical world was all ready for Dr. Koch's announcement, when it came early in 1882, that tuberculosis was caused by a living germ whose life history he then made known. It is a small rod-like germ, very persistent in the maintenance of its form and life, but so sensitive in its growth and reproduction that it has no breeding places in Nature outside of the bodies of those men and animals in which it has lighted up disease. Finding lodgment in this congenial soil, it may grow, stimulating and poisoning, as it does so, the tissues where it lies, so that, sooner or later, the tendency is for the new tissue which is formed and the old which is robbed of life to disintegrate, and if favorably situated be by degrees cast off from the body together with more or less of the virulent germs.

While the tubercle bacillus does not grow in Nature outside the bodies of warm-blooded animals, and while its life is destroyed by a few moments of boiling, by contact with many chemical agents, and by prolonged exposure to the sunlight, it yet may retain its vitality and virulence during

* Read before the Section in Hygiene of the New York Academy of Medicine, January 21, 1892, as the introduction to a discussion on the prevention of tuberculosis.

months of drying and the ordinary exposure to the weather, and may be found alive after long burial in the earth.

The places outside of the bodies of living beings in which the bacillus of tuberculosis is to be especially found under ordinary conditions with us are in the flesh and milk and discharges of tubercular cattle and in the excretions of tubercular persons, especially of those who are the victims of tuberculosis of the lungs. But by far and away the most common and abundant lurking place of this germ is the sputum in pulmonary tuberculosis.

When the tubercle bacilli are cast off from the body in the sputum, they are closely imbedded in a moist, tenacious, albuminous material from which they can not escape so long as moisture is maintained, no matter where they lodge or what air currents may blow over them. So that, so far as specific contamination of the air is concerned, this can not occur while the sputum stays moist. This same tenacious envelope also prevents such ready access of disinfectants to the bacilli in the sputum as would assure their easy destruction. When the sputum dries, the bacilli are still firmly held in place so long as the desiccated mass remains intact. But let this once be pulverized by the foot on floor or carpet, by rubbing between folds of cloth or in any other way, and these virulent particles can mingle at once with other dust and become subject to the same physical laws of transport and diffusion.

It is to be distinctly understood that the breath of consumptives, apart from solid particles which may now and then be cast off in coughing, conveys no germs.

It is not necessary for me to go over the story of research and experiment which have led to the universal conviction that the tubercle bacillus stands in an absolute and direct causal relationship to tuberculosis, and that in this relationship it stands alone.

That there are many contributory factors in the acquirement of this disease—vulnerabilities of the individual, both hereditary and acquired, predisposing vicissitudes of environment—one can not, it seems to me, deny, nor should he measure lightly. But the one thing without which tuberculosis can not come to man or beast is the living tubercle bacillus. All the vulnerabilities and predispositions and fa-

voring vicissitudes which we either know or can conceive of can not without this particular germ light up this particular disease. It is not a vapor in the air, it is not a mysterious miasm, it is not an inscrutable enzym which does this thing, but a definite physical body which we can see and measure with our lenses, which we can cultivate and handle and kill.

Precision in our conception of the nature of the disease tuberculosis, definiteness in our knowledge of its cause—these were the first fruits to ripen in this newly opened field.

But then came the question, If tubercle bacilli are cast off alive from the bodies of its victims or can be consumed in the meat and milk of tubercular cattle, are not these cast-off or consumed germs the sources from which new disease is propagated? If this were true, then tuberculosis is a communicable disease. I will not weary you, full as it is of practical significance, with the oft-told tale of Cornet's convincing researches, nor with a summary of other studies which at last have proved beyond a doubt that living virulent tubercle bacilli are present in the dust of the air of places in which uncleanly consumptives live, and that close attendance upon and association with such persons, without intelligent precaution, frequently involves acquirement of the disease. The evidence of the communicability of tuberculosis finds a most dramatic index in the yearly death roll of its victims.

Slowly but surely we have learned that what once was thought to be hereditary transmission of the disease is often only household poisoning, or, at most, an entailed vulnerability in the presence of the germs derived from whatever external source. The possibility of extremely infrequent direct hereditary transmission of the tubercle bacillus need have no serious consideration here, in view of the immediate practical purpose which calls us together. The main point is that tuberculosis is a communicable disease, and that the chief element in its conveyance is the uncared-for sputum of the victims of pulmonary tuberculosis. This possibility was distinctly foreshadowed in Dr. Koch's first communication on this subject, and has since been steadily growing into a fixed conviction among intelligent physicians.

And yet well-nigh ten years have gone without that persistent and concerted action on the part of medical men in this country which both intelligence and humanity would seem to make imperative. The varied reasons for this apathy we need not here discuss.

But now, at last, when all seems ready for decisive measures, we must not forget that our own ideas of the danger to be met must be precise and definite, in order that we may by individual counsel, as well as by public urgency, make plain and comprehensible to all the thing we strive to do. There should be among ourselves none of the old indefiniteness of conception regarding the exact meaning of such terms as infection, infectious disease, contagium, contagiousness, and the like.

The meaning of these terms was of necessity uncertain and hazy when the things themselves which they were intended to specify were largely matters of speculation and conjecture. It were well, perhaps, if they were dropped wholly from our speech and replaced by new words coined in the new light. But as this may not be, the next best thing is to remodel the meaning, and with this to reinvest the words.

I think I do not err in saying that those who can justly speak most authoritatively in this matter are agreed that in the light of to-day an *infectious disease* is one which is caused by the invasion and reproduction within the body of pathogenic micro-organisms; not necessarily an invasion by bacteria, because in one case at least—malaria—the invading pathogenic micro-organism is not a bacterium, but belongs to a wholly different class. The invading micro-organisms which we must assume to cause the exanthemata are wholly unknown to us, but the nature of these diseases justifies us in grouping them with those infectious diseases whose causative agent is definitely known. *Infection* is the condition produced by the entrance and multiplication of pathogenic micro-organisms within the body.

The word contagious no longer covers infinite possibilities in the unknown, or carries with it the mysterious terrors of the unknowable. The *contagium* in any infectious disease is for us to-day the particular pathogenic micro-organism itself, whose advent in the body ushers in those

reactions of the body cells which we call disease. The contagium of an infectious disease is a particulate thing, which has length and breadth and thickness and weight and the varied powers of lowly forms of life.

An infectious disease is contagious when its contagium —that is, the micro-organism which causes it—under the ordinary conditions of life, can be freed from the body of a diseased person and, by whatever means, conveyed to the body of another in a condition capable of lighting up the disease anew. The old indefinite distinction between infection and contagion, by which one strove to express, among other things, a fundamental difference between the conveyance of disease by personal contact and by aerial transmission, has become impracticable and valueless now, because we know to-day that the differences in the mode of communicability of infectious disease are largely dependent upon the physical qualities of the contagia, upon the places and ways in which these are freed from the body, and upon the places and ways in which they enter the bodies of new victims.

The moment we know exactly what we mean when we speak of a contagium, the moment we have learned to follow the movements of these particulate contagia as they leave the bodies of their victims—in one case in the stools, in another from the skin, in others from the mucous membranes—and can trace their diffusion and life stories in earth or air or water: the moment, I say, we can bring the light from these varied factors to bear on the clinical stories of infectious disease, we are not only in a condition to talk intelligently about degrees of contagiousness, but to study the conditions under which degrees of contagiousness may vary in nature or be varied by art.

It is an unfortunate circumstance that the most common notion of a contagious disease is derived from those which are most dreaded and most liable to spread—from such diseases as small-pox and scarlet fever—so that the common conception of a contagious disease is of one which necessarily taints the air about the victim—surrounding him, so to say, with an infectious atmosphere. But this notion is wholly groundless in any disease common with us outside of the exanthemata, and is apparently reasonable here only be-

cause the contagia of these diseases are unknown to us and are probably largely cast off through the skin, and so easily diffused.

The fact is that such infectious diseases as typhoid fever, diphtheria, and tuberculosis can be highly contagious or made scarcely at all so, depending upon the care or lack of care which is taken by the victims or their attendants in the disposal of their varying exudates or discharges.

How contagious tuberculosis actually is under the conditions which prevail to-day, it is not within the scope of my theme to consider now. But I do not see why it should not continue just as ominous, or become even more so, if the present unsanitary habits continue in public and private places. If the vile and increasing practice of well-nigh indiscriminate spitting goes on unchecked in nearly all assembling places and public conveyances; if the misguided women who trail their skirts through the unspeakable and infectious filth of the street are to be admitted uncleansed into houses and churches and theatres; if theatres and court-rooms and school-houses and cars are to remain the filthy lurking-places of contagia which their ill ventilation and their mostly ignorant and careless so-called cleaning necessarily entail; if in sleeping-cars and hotel bedrooms the well are to follow consumptives in their occupancy without warning or even the poor show of official disinfection; if in ill-ventilated and ill-cared-for dwellings the well must breathe again and again the dust-borne seeds of tuberculosis; if no persistent warning is to be given to the ignorant of the dangers which lurk in uncleanliness—then our task will be most complex as well as difficult in limiting the contagiousness of tuberculosis.

The task of reform is not less than colossal at best, nor is it by anything less than long-continued and well-directed labor that substantial good can come. It will not do for physicians to say that people will not follow their directions when the danger to the well is not individually more imminent than this of the acquirement of tuberculosis, and so stand idle. Nor will it answer to hold our hands because, under the most favorable conditions, all will not be reached. Every little helps much when, as here, each victim of tuberculosis may be discharging thousands, if not

millions, of virulent germs every day upon our ill-kept streets and in places where the well must go.

It is not logical and it is not humane to do nothing because we may not accomplish all.

How the sputum in tuberculosis can be best rendered harmless it does not fall within the scope of my theme to discuss, nor is the question of tubercular meat and milk upon my list.

But this seems certain: that whatever public and private measures for the prevention of tuberculosis we may decide upon as wise must be so conceived that education will go hand in hand with the law. Tuberculosis is contagious; wise teaching can show that its degree of contagiousness depends largely upon the comportment of the victims themselves.

For humanity's sake the stricken must be made to know that the necessary measures of reform in this matter do not involve ostracism, do not entail isolation.

To make our way between the rigors of necessary legislation on the one hand and the demands of the humanities on the other is a task requiring tact as well as wisdom and large knowledge withal of the daily ways of the world as it goes on outside of laboratories. But, wisely choosing thus the way with caution, let us not forget that death meanwhile holds carnival.