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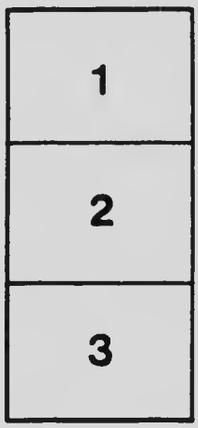

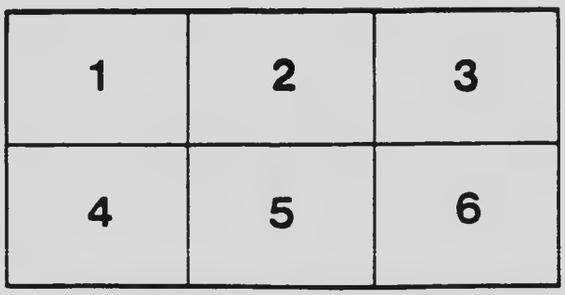

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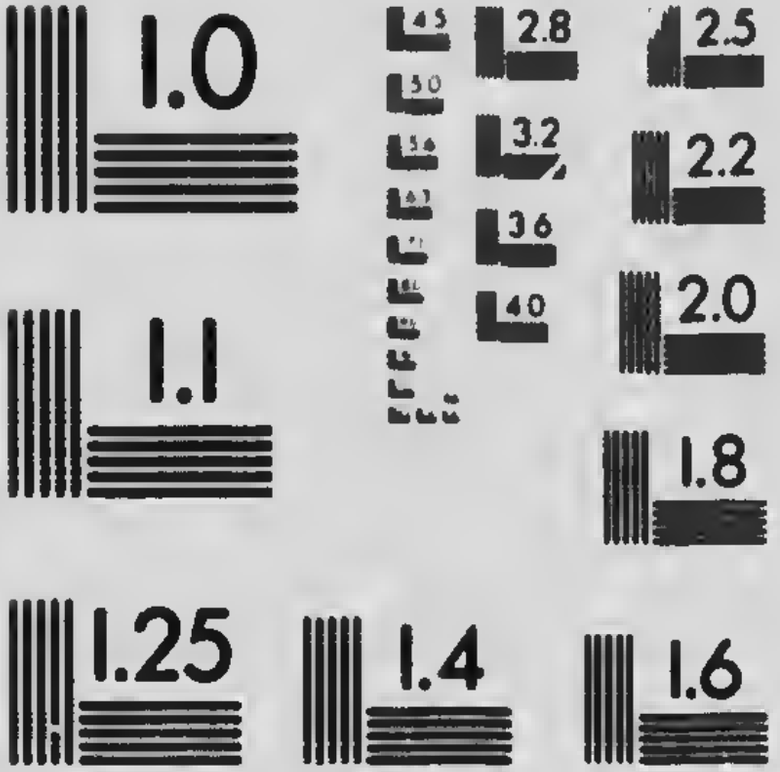

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THE NEW PUBLIC HEALTH

The New Public Health and Tuberculosis

By

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THE NEW PUBLIC HEALTH

TENTH PAPER

THE NEW PUBLIC HEALTH AND TUBERCULOSIS

By H. W. Hill, M.B., M.D., D.P.H.

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Previous articles have outlined the general principles which govern modern public health efforts. The present article will show the specific applications of these principles to one specific infectious disease, namely, tuberculosis. This disease is selected because the same principles that apply to all other infectious diseases apply to it and because it is the most important of all the diseases now recognized as really *preventable*, with the possible exception of the venereal diseases.

Tuberculosis, of all forms, is due to the growth, somewhere in the body, of a certain germ, exactly as diphtheria and typhoid are due to the growth, in the body, of certain germs. There are many very definite individual differences, in the size, shape, manner of growth, etc., of the three different germs of these three different diseases, and these differences make it perfectly possible to distinguish each germ from the others, just as any farmer can distinguish oats, corn, and potatoes from each other.

But just as there are different varieties of potatoes, so there are at least two varieties of

tuberculosis germs which affect human beings. One variety is what is known as the human tuberculosis germ proper. The other is found chiefly in cattle and is therefore called the cattle tuberculosis germ (the bovine tuberculosis germ), and this name is given to this variety even when it is found in the human, as it sometimes is.

HUMAN TUBERCULOSIS

A most important difference that the germs of human tuberculosis, of diphtheria, and of typhoid fever show amongst themselves is not a difference in size, shape, etc., but in the parts of the body each selects. Thus the diphtheria germ flourishes chiefly in the nose and throat, and the typhoid germ flourishes chiefly in the intestine and perhaps the blood; while the human tuberculosis germ will flourish almost anywhere in the body, glands, bones, joints, intestine, kidney, brain, lungs. This selection is no mere accident, although we do not know how it comes about. All three germs enter the body chiefly by the mouth, conveyed thereto chiefly by the *hands*, but also more or less through food and milk, and, in the case of typhoid fever, through water and flies. On entering the mouth, all three germs, which are of course far too small to taste or feel, are swallowed in the food, milk, etc., in which they happen to be present, or merely in the saliva, if, as is most usual, they reach the mouth directly or indirectly from the fingers. Once swallowed, all three pass into the stomach, where many are killed by the acid there present, the survivors, if any, passing on into the intestine. On the journey from mouth to intestine, some are left, of course, by the wayside, stranded on the tonsils, throat, gullet, etc. Here at once is

shown their respective peculiarities. Of all the diphtheria germs that are thus swallowed, practically only those that are stranded in the throat, will flourish; those diphtheria germs which pass on into the stomach or intestine are destroyed or pass out harmlessly. On the other hand, typhoid germs, if stranded on the throat, do not flourish there, nor do those which reach the stomach flourish in that organ. It is only those typhoid germs which survive the journey until the intestine is entered that can succeed in producing typhoid fever. The human tuberculosis germ has a still longer road to go. Not only must it pass mouth, stomach, and intestine, but it must be also absorbed from the intestine into the blood, as the food is; but it does not grow in the blood. The blood is only a river, by which it can be carried to a favorable developing ground. We do not know at all why human tuberculosis germs entering the blood thus, should elect to settle and grow in a joint in one person, in a lung in another, in a kidney or a gland or a bone in another. However, this is the way in which these different forms of human tuberculosis develop. The old idea that human tuberculosis of the lung (consumption) is contracted chiefly by breathing the germs directly into the lungs, has been definitely upset. The lungs are infected from the blood-stream chiefly, just as are the other internal organs, bones, and joints.

Another and, from the public health standpoint, an even more important difference exists. Diphtheria germs developing in the throat, and typhoid fever germs developing in the intestine, can readily escape from the body: in the case of diphtheria, through the mouth and nose dis-

charges, in the case of typhoid fever through the bowel, and sometimes the bladder, discharges. It is the escape by these channels of these germs from the body which makes these diseases "catching" or "infectious" or "communicable," for if they could not escape from the body they could not reach other persons and therefore could not be "catching." But in human tuberculosis, most of the places where it develops,—bones, glands, joints, etc.,—are not connected with any opening of the body by which the germs may leave the body. These forms of tuberculosis have no great highway to the outside lying at their doors to carry the germs out to other persons. Practically only in human tuberculosis of the lungs are such highways provided for the human tuberculosis germs, although sometimes in bladder, kidney, and intestinal tuberculosis. But in the latter forms, the germs do not, as a rule, pass out by the highways provided for them in such condition or such numbers as to be of serious importance in propagating the disease. In human lung tuberculosis, on the other hand, the windpipe, throat, and mouth form a highway, along which the germs may escape from the affected lung in such enormous numbers that twenty-four billion per day have been detected in the discharges (sputum) from the lung of a single advanced case, although the average number from the average case is usually "only" four or five billion daily.

Thus it comes about that human tuberculosis of the lungs is the only common form of human tuberculosis which is much to be feared as infectious. Practically all the other forms of human tuberculosis are derived from the sputum of cases of human lung tuberculosis, carried

chiefly by mouth-spray and on the hands, and if cases of human lung tuberculosis did not act to spread infection to other persons, all forms of human tuberculosis would disappear.

Moreover, even human lung tuberculosis is not very infectious in the early stages, i. e., when the germs are growing in the lung tissue, but have not yet reached the air-passages, because, until then, the germs cannot escape into the windpipe and so by the throat to the mouth. When in the later stages the germs reach the air-passages the way for the escape of the germs to the outside and so to other mouths is "open." Persons in this stage of tuberculosis are called "open" cases, and it is therefore only the "open" cases that are seriously to be feared as infections.

THE ABOLITION OF CATTLE TUBERCULOSIS IN THE HUMAN

Although the cattle tuberculosis germ differs from the human tuberculosis germ somewhat in size, shape, etc., the most important public health difference is this: the cattle tuberculosis germ seldom produces lung tuberculosis in the human. It produces bone, gland, joint, etc., tuberculosis, but lung tuberculosis hardly ever. Consider how important this fact is. It means that *cattle tuberculosis existing in a human can very seldom be conveyed from that human to another human.* In other words, cattle tuberculosis may be transmitted from cattle to man, but practically is not further transmitted from man to man. To prevent cattle tuberculosis in the human, we do not need to take into account existing cases of cattle tuberculosis in the human, but only existing cases of cattle tuberculosis in cattle. If we free our cattle of cattle tuberculosis, we shall free our humans of cattle tuberculosis also; and this is the

only practical way that cattle tuberculosis in the human can be abolished unless and until the human race abandons the use of raw cow's milk.

THE ABOLITION OF HUMAN TUBERCULOSIS

How can we abolish human tuberculosis? Exactly as we can, and some day shall, abolish any and all other infectious diseases, by killing off the germ that causes it, exactly as we have almost abolished the race of buffalo by killing off the existing buffalo. We know well enough that when the last buffalo is dead, no man, however wise, no government, however powerful, could ever produce another buffalo. So once the existing diphtheria or scarlet fever or tuberculosis germs are all dead, there is no way under heaven by which these particular germs could be produced again. Those which exist now are not evolved from dirt any more than are buffalo or roses. Those which are living today are simply the descendants of those which existed yesterday and so on, just as in the case of buffalo or roses, back to the dawn of history. Once any race or plant or animal is wiped out, it can never be redeveloped; and the tuberculosis germ, just as well as the germs of diphtheria or typhoid fever, can be abolished exactly as the megatherium or dinosaur has been abolished, i. e., by the killing of the existing individuals.

"But consider the enormous numbers and the tiny size of germs and that they are present *everywhere*,—in air, water, food, milk, dust; in and on everything we touch or taste or handle. It is quite impossible to kill them all."

True, *germs* are everywhere but *not disease germs*. We know some fifteen hundred or more species of germs and hardly fifty of these produce disease, while only two, already mentioned,

produce tuberculosis in the human. That these are very small and cannot be slaughtered individually like buffalo, is true, but it is also true that their very minuteness means that billions can be slaughtered in one operation, if they are only kept together. As to tuberculosis germs being everywhere, all over, outdoors and indoors—this is *not* true. No more important fact in public health has ever been formulated than this, due to that keen leader in public health, Chapin of Providence: *The germs that produce disease* are *not* ubiquitous, *not* in dust everywhere, water everywhere, milk everywhere. They are chiefly, almost wholly, *in the bodies* of a few (relatively) people, or animals; and when they escape from those bodies, where alone they find the peculiar food, high temperature, abundant moisture, and darkness which they need, they promptly die or become harmless. Even in water, milk, food, etc., into which they may be introduced from infected persons, their lives are short, and they must quickly reach a new living victim, or die.

To abolish any one race of disease germs is far easier than to destroy some much larger things. Thus to abolish flies means not only killing all flies, indoors in all houses everywhere, in all stables everywhere, in and around all dwellings everywhere, but also throughout all fields and forests, mountains and valleys everywhere, because flies are hardy outdoor beings as well as indoor beings. They can breed and flourish almost anywhere, where any kind of food, even in vanishing quantity, is to be had. Moreover, they can move of their own volition with promptness and despatch, have quick eyes and quicker wings to escape designing enemies, and in a thousand ways can take care of themselves.

Disease germs, in contrast with the fly, are very tiny and helpless particles of protoplasm, having no eyes to see an enemy, no nose to smell him, no means of running away from him. They cannot flourish on almost any food, but need the living tissues of the human body; they cannot grow at almost any temperature, but must have the heat of the human body. In brief, they are not merely indoor plants: they are incubator plants and cannot grow, thrive, or reproduce themselves in nature, except in the incubators—our bodies, or, in a few cases, animal bodies, provide them. Hence if we were able to take a visual census of all the living tuberculosis or scarlet fever or diphtheria germs in the world we should see them, not in the dust everywhere, the water everywhere, the food everywhere, etc., but in a very few places only, and those places would be, in almost all cases, the bodies of humans (or animals).

Indeed, we can foretell just about what the census of tuberculosis germs in Minnesota, or in any other district of the temperate zone, would show. It would show about one person in every seven hundred of the population carrying a large number of active, living, growing germs in the lungs,—germs that were escaping to the outside and reaching other persons' mouths. It would show also a number of other persons in whom the germs were present in joints, bones, glands, etc., but not escaping to others; and it would show a number of persons affected in the lungs, and, later, likely to develop to the point where the germs could escape, but practically harmless to others so far. Beyond this, hunt high, hunt low, search garbage barrels, manure heaps, dead animals, dusty streets, sewage, water, foods,

milk, etc., and human tuberculosis germs, alive, growing, capable of producing the disease, *would not be found.* True, in the immediate neighborhood of the "open" cases the sputum they throw out, their mouth-spray, and their hands would show the germs, and things they spit into, mouth-spray into, or touch, would show for a short time a few; but these would be dying or already dead, holding out danger to other persons only during the short time which elapses between leaving their happy homes in the human lung and death outside from starvation and drying. This applies, not to tuberculosis germs alone, but practically to all the germs of the ordinary infectious diseases, anthrax and tetanus forming two chief exceptions, both rare diseases here.

No person energetic enough to advocate the abolition of flies should hesitate a moment to advocate the far simpler, smaller, easier, and far more important work of abolishing the germs that alone can make the fly a danger.

In brief, the method, and, I believe, the only rapid, complete, effectual method of abolishing human tuberculosis, is this: find the "open" cases and prevent the spread from them of the germs they alone throw out in numbers and condition to be feared. That means, find the one person in every seven hundred whose infection threatens all the rest, and supervise him just enough to keep his discharges from entering other people's mouths.

How is this one person in every seven hundred to be found? Not without hunting, not without ingenious, skillful, deliberate, sagacious, well-trained hunters, epidemiologists as devoted and persistent in their work as the average insurance agent is in his,—men who devote themselves to

the abolition of tuberculosis as whole-heartedly as any merchant does to making money.

And how? Where shall we begin? Must we canvass the whole popula. or one by one? True, that would do it, but epidemiology has found a simpler, keener, more scientific, far more economic plan, illustrated for typhoid fever in a previous article of this series (No. 3). Begin with the known cases and search the zones of infection surrounding each for mild, unrecognized, and concealed cases. (In tuberculosis the search for carriers is probably unnecessary, certainly at the present time.)

"But why not concentrate on the incipient lung case, the case that may be cured, and by preventing this case from going on to the "open" infectious stage get rid of danger to others thus, instead of by attention to the open case?" For several reasons, the abolition of tuberculosis through care of incipient lung cases only cannot at present be accomplished:

1st. Because incipient cases, in the truly incipient "non-open" stage, are discovered, perhaps are discoverable, in a very small percentage only of their total number.

2nd. Because a large proportion of the incipients so found would *not* go on *in any case*, whether found or not, to the open stage; and the time and money and efforts spent in finding and supervising them would have been relatively wasted.

3rd. Because a certain proportion of the incipients so found *would* go on, *in any case*, to the open stage, and thus become infectious cases, despite all efforts. In these alone would the efforts expended be of service in preventing new cases. The trouble is that, in the incipient stage,

it could not be determined whether or not the case would so develop.

4th. Because the time and attention devoted to incipients, to prevent them becoming open cases, would imply, as it has, alas, so far implied, neglect of the advanced "open" cases, in which the danger of infection is so immensely greater.

5th. Because if all the incipient cases were discovered they would form a mass of persons so great as to be beyond handling properly by any at present even dreamed of force of attendants, etc. If, as at present, only a very small proportion were found the actual situation would not be materially changed.

"Would you then cease the care of incipient cases in sanatoria, such as that at Walker, Minn., and concentrate wholly on the advanced case?"

No. First, because the tuberculosis sanatoria, intended though they are for incipient cases, really handle very many "open" cases, and to that extent prevent new infections; secondly, because the tuberculosis sanatoria do, in a measure, fulfill their proper function of cure for incipients and even early "open" cases to some extent and hence save life. But as a means of *abolishing* tuberculosis, the ordinary tuberculosis sanatorium for incipient cases is quite hopeless.

The thing to do first is, find the recognized "open" cases, whether they be in early, advanced, or late stages, and place *them* where *they* can spread the disease no further. Then search the "zones of infection" surrounding them, i. e., their relatives and associates, for mild, unrecognized or concealed cases, and also for incipients, handling all "open" infectious cases thus found, in the same manner. This system would begin at

the right end by stopping further infections, and would incidentally find those early "open" and "non-open" incipient cases wherein sanatorium treatment would be of most avail.

SUMMARY

Tuberculosis is a typical infectious disease, and it must be handled on the same principles as any other infectious disease; hence, by blocking the routes of infection, but chiefly by finding the *sources* and preventing spread thence.

Of the five great routes of infection,—water, food, flies, milk, and contact,—human tuberculosis travels chiefly by contact, through sputum, mouth-spray, and hands, directly, or almost directly, from patient to prospective patient. Practically, it is spread exactly as scarlet fever or diphtheria is spread. Public flies and public food supplies are comparatively insignificant conveyors. Public water supplies are almost negligible, and public milk supplies act chiefly in conveying cattle tuberculosis to man, although, if the milk be handled by tuberculous humans, it may convey human tuberculosis also.

It is evident, then, that blocking of routes, since the chief one is contact, involves chiefly the far more important measure of finding the source, just as in scarlet fever, or diphtheria, etc., and if these sources are found and prevented from access to the routes, the routes may be disregarded. The measures for finding the human sources, practically the "open" cases of *lung* tuberculosis in the human, are epidemiological and have already been discussed in principle before (Article 3).

The measures necessary for finding the animal sources (infected milch cows) are the well-

known tuberculin test of herds, with proper repetitions, and the elimination of the tuberculous animals. Serious enough as cattle tuberculosis in the human is, its prevalence, nevertheless, is so much less than that of human tuberculosis and its infectiveness in the human is so nearly negligible, if our efforts were concentrated wholly on human tuberculosis more cases and more deaths would be prevented, in a year's work, than efforts on bovine tuberculosis, however successful, could possibly achieve in many years.