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THE EXTERMINATION OF INFECTIOUS DISEASES.*

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Many of the infectious diseases have already been exterminated or have died a natural death.

Others are only held in check, but the time of their disappearance is probably not far away. I should place among these cholera, small pox, and typhus fever.

The extermination of others has been but just begun. Typhoid fever and tuberculosis are on this list.

Still others are yet laying waste the land, and the way of their extinction has not yet been clearly shown Scarlet fever and diphtheria are the worst of these, and it is to ask if we may not at least hope that these too will some time follow in the footsteps of the others that I have chosen to bring this subject before you in my paper.

These two diseases are now endemic over a great part of the world, and the task of getting rid of them does look mighty indeed. But that it can be done and will be done in time I have no doubt. They should at least be driven

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back to some isolated quarter of the globe, as we hope that cholera will be driven back upon India by the advance of sanitary civilization, there to be another penalty of sloth, ignorance, carelessness, and fanaticism.

In a general way we know how *all* infectious diseases might be exterminated. For example, if we could take every case of a certain one of them and keep it from every direct or indirect infectious communication with another individual susceptible to it until it became no longer infectious, and then could disinfect absolutely after it, we should then and there extinguish that disease. To do this would be easier in some of the infectious diseases than in others. In typhoid fever, cholera, and tuberculosis, for example, we have only to guard our citadel from attack at one or, at most, two gates. Thus it has been said that if every person would boil his milk and drinking water before taking it, typhoid fever would end with the cases then in existence.

The same might be said perhaps of cholera.

If also we could disinfect all tubercular sputum, how long before tuberculosis would be a curiosity ?

In the case of small-pox, if everybody were vaccinated and revaccinated carefully at regular intervals, this vile disease, too, would soon cease to exist.

But for the unabated continuance of those other infectious diseases, scarlet fever and diphtheria, there are many reasons.

Foremost among these reasons is the probability that their infectious principles are more viable—are more resistant to unfavorable environment—than are those of many of the other infections. The germ which caused the plague, for instance, has become practically extinct, probably because it requires for its growth such excessive conditions of filth and bad hygiene and great depression of the

resistant powers of the individual from famine and privation as now no longer exist.

The germ of typhus fever also undoubtedly thrives best under similar conditions. So that our improved sanitary life and our methods of isolation and disinfection are sufficient to keep it in check. But these influences have not yet become strong enough to prove too much for the viability of the poisons of diphtheria and scarlet fever.

It may not be out of place to consider here for a moment the nature of the infectious principles of these diseases. If we look first at diphtheria in the light of our latest knowledge, we find that it is caused by a specific bacillus; that this bacillus is present only in the infected mucous membrane and in the discharges from it; that actual contact of this bacillus with the unhealthy or broken mucous membrane of a susceptible individual is necessary to infection; and that if the discharges are disinfected infection of others can not occur.

In regard to the insusceptibility of healthy mucous membrane, Dr. Jacobi says that "healthy unbroken mucous membrane will resist the invasion of diphtheria"; and Dr. Thorne says, "I have a strong impression that diphtheria never attacks a healthy throat."

In regard to safety obtained by disinfection of discharges, Dr. Welch says, "there is no evidence that the breath itself is infectious"; McCullom says that "actual contact with the patient or with the discharges from the mouth and nose is necessary in order to contract diphtheria"; and Mason says that "of twenty-three doubtful cases admitted to the diphtheria ward, although isolation was only limited, not one of the number contracted diphtheria."

Would it not be possible to question if scarlet fever also is not transmissible only in the same way, by the excretions and by the added agency of the exfoliating epi-

dermis? Is there evidence to show that in this disease the breath, by itself, is infectious? If it is not so, then the air of a room containing a scarlet fever patient would only be dangerous from the likelihood of its containing in its dust bacilli from material, dried and comminuted, which had been coughed up, or otherwise scattered about, or from flying epidermal scales. And if we could disinfect all these excretions and prevent the dissemination of the epidermal scales, could we not also prevent the transmission of the disease?

May I venture to suggest that the longer exposure to typhus fever, usually necessary for its transmission, may be due to the fact that in this disease there is no especial discharge from the mucous membranes and no desquamation of the epidermis to carry the infection? If we assume that expired air alone can not carry infection, it must probably come, in this disease, from the ordinary secretions of the mucous membranes accidentally disseminated, and perhaps from the discharges from the bowels.

In measles a contrary condition—that is, an increased secretion from the mucous membranes, freely scattered by coughing and sneezing—may account for its greater contagiousness.

A similar course of reasoning would explain the statement that whooping-cough is only contagious during a paroxysm.

My object in making these speculations is to show that, if the breath by itself alone can not carry infection, our mind makes of infection a much more material and seizable conception. It is no longer that of a deadly and noxious gas or vapor rising from the patient's breath, but that of a diffusion of small but material particles mingled with the dust, which diffusion and mingling we should be able to entirely prevent. It ought to do away with the feeling of

powerlessness against an impalpable essence of infection exhaling from the infectious patient. Infection should be considered something that we can and must catch and kill.

If you have ever watched a person speaking, standing in a ray of sunlight such as shows us so plainly the particles of dust in the air of a room, you must have noticed the very fine particles of saliva that are constantly thrown out by the moving lips and tongue. You can not fail to have noticed the abundant spray from a cough or sneeze. Nothing of this occurs during breathing alone. We can readily understand, therefore, how in this way a talking, singing, coughing, or sneezing person might scatter infection, who would not do so when simply quietly breathing.

A lesson to be learned from this would be to keep an infectious patient as much as possible from talking, and to hold a cloth before the nose and mouth during coughing and sneezing.

But to resume the consideration of the reasons for the perpetuation of scarlet fever and diphtheria, let me take up the one which I consider as perhaps the most active and important of all—namely, that these are diseases of childhood particularly, and therefore circumstances are especially favorable to their spread from mild and unrecognized cases in schools. Thus Cummings shows that in Boston, during five years, in vacation time, there was a marked decrease in the number of cases of diphtheria—a circumstance we may perhaps have usually attributed to the influence of season alone. The confined air of most schoolrooms, the use of cloth-covered books, infected clothing, unwashed drinking cups, the licking of slates, the transfer from child to child, often from mouth to mouth, of toys and other articles, and the child's natural dislike of cleanliness, all help to make schools the chief, perhaps, of the causes of infectious perpetuations.

Schoolrooms in which infectious diseases have occurred may even themselves become a continuous source of infection; as, for example, in a reported case where, in a certain schoolroom, case after case of scarlet fever arose at intervals for a long time, culminating in a severe epidemic following the opening of the room after the floor had been torn up and its infectious dust scattered about.

Dr. Thorne Thorne, in a very recent lecture before the London Sanitary Institute, shows that the mortality from diphtheria in London during the past twenty years has nearly trebled, in spite of enormous advances in sanitation. He attributes this, in part, at any rate, to compulsory education bringing children together in schools, and he cites many very interesting examples of the influence of schools on the incidence of diphtheria.

A belief in the spontaneous origin of diphtheria from bad drainage and other unsanitary conditions has probably had a deterring influence on efforts to exterminate it. This is a belief which I think we can no longer hold. Dr. William H. Welch kindly writes me in answer to my inquiry that "the evidence is altogether in favor of the view that bad hygienic conditions alone can not cause diphtheria."

Dr. Park also writes, in answer to a similar inquiry: "All the evidence that we obtain tends more and more to make us believe that every case of diphtheria has come in a direct, or perhaps very indirect, way from another case."

Dr. Thorne says that there is no direct connection between bad sewerage and diphtheria.

Dr. Thorne, however, makes the following striking statements: "That all forms of sore throat are apparently infectious, and that there is sometimes seen during prevalence of sore throats, as the disorder passes from person to person, a progressive infectiousness, finally resulting in an

outbreak of diphtheria." I understand this to mean that, by successive cultivations in the human throat, an infectious principle, causing at first only clinical forms of sore throat, may end by causing clinically true diphtheria.

Such an occurrence needs bacteriological study, but is quite inexplicable, it would seem, if we suppose late accidental infection with the specific bacillus.

He also thinks that diphtheria has not yet become a stable disease, like scarlet fever and measles, and that we ought to take speedy measures to prevent its becoming so.

Lastly, it may be said that we have no proof that specific diphtheria exists in cats or other animals except as a result of inoculation. One can suppose that cats could be inoculated accidentally from a human case and carry infection in that way or by particles of expectoration or dust in their fur. But we have no evidence to show that cats or other animals need be feared as sources of infection in any other way.

The diphtheria of pigeons and fowls is not caused by the Klebs-Loeffler bacillus. Klein's assertion that the milk of cows which have been inoculated with diphtheria may contain the *Bacillus diphtheriæ* has failed to be verified by experiments which others have made.

I must here again refer to Dr. Thorne's most recent statement, which is somewhat at variance with those given above.

He traces many apparently obscure outbreaks of diphtheria to infected milk, giving as the most frequent cause of this the existence of a disease in the cow itself; which disease is characterized by a rise of temperature and by the formation of vesicles and pustules upon the udder.

He also thinks that a large number, if not indeed the great majority, of our specific diseases come to us through the lower animals, or have come from them in the past.

Want of time prevents further reference at this point to the many other causes which influence the spread of scarlet fever and diphtheria.

We come now to consider the means we must use in our fight against those infectious diseases.

Our efforts must be directed to the repression of the great causes of their continuance, and it seems to me that the first essential for the successful accomplishment of such a work is thorough organization. As a means for such organization there might be suggested the formation of a society; a society for the prevention or extermination of infectious diseases, or simply a health society, if you choose, whose chief aim should be what is expressed in the longer title.

I am of the opinion that much good could be done by such an organization.

Even if we come to have a national bureau of public health, the work of a society would still be valuable as an aid to its work, and until we do have an efficient national bureau I see no method of widely organizing sanitary work, except by the aid of a powerful society.

It is implied, if not stated, that in the carrying out of the measures presently to be mentioned the aid of such a society would be of the utmost value.

One of the first works to be undertaken and one of the great essentials in this, as in all matters in which the whole public is concerned, is the education of the public—education by the reiterated statement in every possible way of the facts that we know about the infectious diseases. I think we neglect the public too much in the matter of its medical education, and leave it to be the victim of those mercenary gentlemen whose quasi-scientific statements fill so many columns of our newspapers.

The education of the public should begin, for example,

by the printing and distributing to every family in the city, in the State, in the country, of circulars telling the things that should be known about scarlet fever and diphtheria; that they are preventable diseases, because every case comes from one before it; that everybody who has to do with a case is responsible that through him no other case arise; and that, by continual watchfulness and faithfulness, every one may help to the great end of extermination; emphasizing the vast importance of schools in spreading infection, the great need for care before allowing the return to school of children who have had infectious diseases, or even sore throats, or any other illness not absolutely known to be not contagious, and the increased susceptibility of persons with disordered mouths and throats.

These circulars could be sent out yearly or oftener, repeating the same things, reporting discoveries of importance, new methods, and the work done during the year.

Lectures on these subjects could be furnished for schools and societies and other educational or popular institutions.

Such education could very properly be made part of the regular course in schools and colleges, and teachers themselves should be well instructed in these principles. Perhaps it is from the universal and systematic education of teachers, and through them of children, that we have most to hope in the future. We have something to hope, too, from the improving standard of education of medical men and sanitary officers.

Judicious publications could be systematically made in the newspapers and periodicals, and even a special popular health journal established.

The early discovery of infectious cases is of the greatest possible importance, and I know of no way of accomplishing this except by the regular visits of inspectors and the enforcement of severe penalties on persons found at-

tempting to conceal such diseases. For example, in addition to the usual methods of reporting such cases, there should be trained inspectors, young physicians, possibly medical students, or others, who should regularly, perhaps once a week, visit every tenement and lodging house in a city and report all suspicious cases. This would also act as a check on those physicians who are not in the habit of reporting their contagious cases, and they, too, should be subject to severe penalties.

Dr. Gihon says: "The sanitary inspector is destined to become the most important agent of civic administration," referring to this officer in a general way.

I believe that immediate removal to hospital of all contagious cases is an absolute necessity to surely prevent their spread.

G. H. M. Rowe, superintendent of the Boston City Hospital, says: "Not removing a person with an infectious disease to a hospital or to some place securing absolute isolation should be held as a punishable offense against society."

We need more hospitals for scarlet fever and diphtheria, and it would be advisable to have in a town like this, for example, a number of small hospitals in different convenient parts of the city. Preferably these should be near the river or outskirts, away from habitations and where land is reasonably cheap, and they should be of severely plain and simple, even temporary, construction. Each of these hospitals should have an ambulance, and every case of scarlet fever and diphtheria should be immediately taken by them to the hospital. A possible exception might be made of cases occurring in private houses, where the inspectors were satisfied of the ability and willingness of the people to carry out proper precautions under the direction of the inspector. His power to remove should be absolute

in all cases, except that dwellers in private houses should have right of appeal to a higher health officer.

It might be well also to have a special hospital for patients who could pay for their care.

Wherever the cases are treated and wherever they have been, insects of all kinds should be as far as possible excluded. The danger from insects is apparently well shown by a report by Dr. Biggs of twelve cases of cholera occurring in 1892 in the neighborhood of New York, in which seven of the cases arose in the families of butchers and, of the remaining five, all but one were in persons connected with some business of food supply.

Cats, dogs, and other animals should also be excluded, for they, too, may carry infection.

With regard to the treatment of cases, when once in a proper hospital, I have nothing to say. That may be regarded as perfected so far as the further spread of the disease is concerned.

A further necessity to prevent the dissemination of these diseases would be the removal to a place of quarantine detention of all persons known to be exposed to the affection. This would certainly be an immense undertaking at first, but it is one which would be, I think, absolutely essential to success. It would necessitate the use of an island or large grounds, where all exposed persons could be kept during the period of quarantine.

With the rapid reduction in the number of cases which, it might be reasonably hoped, would follow such radical measures, the number of persons to be quarantined would also rapidly diminish.

The next step in the management of these cases would be disinfection of the premises, the clothing, and other infected articles. The details of this work have been so nearly perfected that it is only necessary for me to refer

you to such works as Nuttall's *Hygienic Measures in Relation to Infectious Diseases*, or Dr. Seibert's report to the Academy on Disinfection during Cholera in Berlin and Hamburg (*N. Y. Med. Jour.*, Dec. 10, 1892), and to a paper by Dr. Biggs published in the *Medical Record*, July 22, 1893. Only there should be mentioned the advisability of medical inspection of the work of disinfection, as perhaps the ordinary employees of health boards are too apt to do their work perfunctorily; and also the need of plenty of disinfecting stations of the latest design and full equipment.

I might further mention the total destruction of old infectious centers and the use of a mixture of paraffin and turpentine for treating infected floors.

In country districts and small towns the execution of the above-mentioned measures would be difficult on account of the almost invariable absence of proper places to which contagious cases can be taken. Possibly, sometimes, there is a miserable pest house, but usually even that is absent. In the past two years I have been obliged in my small town to treat two cases of small-pox in their homes.

Two other cases occurring in my practice show well the evil that may come from lack of isolating hospitals in the country. Both were cases of diphtheria. In the first case the rich lady, whose coachman was the patient, bundled him off to the city by the way of a public hack, the railroad train, and the elevated cars. The second went from her boarding house to the city on the trolley and the elevated railways.

The cost of the string of cases of diphtheria that may have started from these two can only be guessed at.

It should be part of the duty of the health society or of the national bureau to have local officers or branches in small towns for the purpose of stirring up local officials and of educating the sentiment of the people to the point of

providing and maintaining isolating hospitals—for the hospital service of any town is far from complete without a department for isolating any infectious disease—or the society or the government might advance money for this purpose, as suggested by Thorne.

Once let the diminution of these diseases begin to be perceptible and it would proceed with ever-increasing rapidity under a thoroughly organized and widespread system of sanitary work and an educated popular feeling.

I wish I could refer in detail to the good work done, showing the possibility of limiting outbreaks of infectious diseases by proper measures, in Massachusetts, in Michigan, in Italy, and in some English towns, but want of time forbids. I can only refer you to the reports of the health boards of these States, to Dr. Thorne's *Diphtheria ; its Natural History*, etc., and to a report to the Italian Government, by Dr. Panizza, in which he shows a diminution of 43·17 per cent. in infectious disease in five years as a result of the sanitary awakening in that country.

The prevention of the dangers arising in schools is a point of greatest importance, to which I wish to direct your attention for a moment.

The often-suggested plan of daily inspection of the children's throats is the first I have to mention. The usually proposed method might be modified in the following manner: It should be a part of the education required of teachers to learn how to examine throats and to know a normal throat from an abnormal one. It should then be the duty of every teacher to examine the throat of every child in her department each morning, using to depress the tongue, if necessary, a piece of thin wood, fresh for each scholar. Probably children would soon learn to show their throats without a tongue depressor, and the education of their throats thus acquired would be valuable help in al-

lowing easy local treatment in case of contagious throat disorder at any time arising.

All cases in which the teachers should find the least suspicion of sickness should be sent to a special room to await the regular morning visit of a physician, who could determine the character of the illness and whether the child should return to school, to its home, or to the hospital. A physician could thus visit several schools in a very short time. Or, better, each school should have a different physician, living in its immediate neighborhood, whose duty it should be to visit the school at the opening hour and examine all cases sent to him by the different teachers.

Both teachers and physicians would soon become experts at this work; little time would be required for the daily examination, if each teacher had only to look at the children of her own room, and little of the physician's time would be taken up. And yet I think it would be most efficient in preventing the spread of contagion in schools. It would become a matter of pride with each teacher not to let a case of infectious disease be found undetected in her room.

It might be well also, on account of the persistence of the infectious agents of scarlet fever and diphtheria in patients and their clothes, to fix a long, arbitrary time of absence from school after recovery—as long as three months perhaps—for scarlet fever may desquamate as long as that, and tonsillar follicles and recesses of the nasal cavities may hold the *Bacillus diphtheriæ* probably long after bacteriological examination of the throat might fail to demonstrate them.

Dr. Thorne, whose words I have so often quoted, says that no child who is suffering from any form of sore throat should be allowed at school, nor even any one from the house in which that child resides.

The sanitary condition not only of schools but of all public assemblage rooms should be regulated more carefully by law in regard to plumbing, ventilation, light, cleanliness, and the character of the furnishings.

It is not so very absurd to suggest that all public assemblage rooms should be built, as has been suggested for schoolrooms, with as strict attention to facilities for cleaning and ventilating as are our modern operating rooms.

A similar suggestion has been made in respect to hotels, steamboats, and other places of public accommodation.

In regard to the possibilities of the distribution of infectious diseases through our public means of transportation, there is little need for argument. That the elevated and surface cars of our city are prolific spreaders of disease is, I think, undeniable. The way of remedy is plain. We should have ampler and cleaner public transportation; no crowded, steaming elevated cars, no filthy mats, but floors so built that they could be cleaned daily by flushing with water, or, if mats are an unfortunate necessity, their frequent cleaning and disinfection by steam.

We may hope to gain something in time from an improvement in our class of tenement houses, a tendency to which is becoming certainly more evident. Among other points, the advisability of making the height of tenement houses certainly not greater than the width of the street should be considered.

Many of our tenement streets are also too narrow; but this and all other causes of street unsanitariness pale in insignificance before our elaborate and costly system of how not to clean streets.

Till these are cleaned, as in the best foreign cities, by daily flushing with volumes of clean water, I do not believe we shall approach a proper sanitary condition in cities. I see no other way to effectually and safely clean our streets

of the filthy slime, the filthy snow, the decomposing animal and vegetable refuse, the wet or dry powdered horse manure, the tuberculous sputum, and the germs of a dozen different infections that defile them, except by flushing with water.

If the millions spent every year in running dust scattering brushing machines, carts, and dumping stations were put into the building and maintaining of pumping works scattered along the water fronts of our cities, or if some other source of supply were found to furnish water to flush them, we should then have a method of street cleaning that does clean streets.

All sources of public food supply should be subject to inspection. I would like to emphasize this particularly in regard to milk, because in numerous instances epidemics of scarlet fever and diphtheria have been traced directly to this article. I think all persons who furnish milk for the public market should be required to have a license, and their farms and animals be subject to regular inspection; that retailers of milk should do so only under a license, and that they should be required to be able to tell at any time from what source any given sample of their milk was brought. If it is right and necessary to inspect any man's business for the protection of the public it is right to inspect a milk supply. We do inspect boilers and elevators, but we peacefully allow ourselves and our children to be supplied with diluted cultures of the bacilli of typhoid fever, scarlet fever, or diphtheria.

There are many other sources of contaminated food supply. For instance, I know of a cesspool containing typhoid bacilli, from which a scavenger draws tankfuls of sewage and sells it directly to a market gardener, who uses it to fertilize his lettuce, cabbage, spinach, and celery which he sends to you in the city.

I have merely touched upon this great subject, as great

as any that doctors have to handle. I hope I have not been presumptuous.

As we look back over the matter, we may ask ourselves these questions:

Would it be worth while to try, at so great cost, to fight these foes to a finish?

We have but to look at our published mortality tables to see the infinitely greater cost we are bearing all the time.

Is it possible for us to win the fight?

My answer is, that it is simply a question of education, of organization, and of faithfulness.

How shall the fight be fought?

The answer to this I hope can be found in the feeble words with which I have tried to express my thoughts, and in the words of the multitude of writers on this subject whose works are springing up like blades of grass in springtime.

In conclusion, I wish, in self-support, to quote the words of Dr. Fischer, who asks the question, "Can we exterminate these infectious and contagious diseases?" and answer, "I believe we can"; of Dr. Adams, who says, "Our aim should be the ultimate extinction of all germ diseases"; and the grand words of Dr. Thomas, as true as they are inspiring: "Were I offered to-day by some great power the accomplishment of one wish, I think that I would select the destruction of the process by which alcohol is created. . . . I would select as the wish nestling closest to my heart the abolition of alcohol. If this were denied me, I would choose the power of stamping out forever those contagious diseases which fill our graves with curly heads and dimpled cheeks and our homes with sorrow that knows no comforting. I would destroy those terrors of the household—scarlatina, diphtheria, and the

host of contagious maladies which go hand in hand with them. The first of these wishes is impossible of attainment. But what of the second? Gentlemen, the way to its accomplishment is open to every man with willing hand, determined mind, and intelligent brain who stands before me now. Surely it is not too sanguine a prediction that the next century may see the extinction of contagious diseases."