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THE  
**Prevention of Infection**

IN  
**Public Vehicles.**

BY

**ALFRED GREENWOOD, M.D., Ch.B.,**  
D.P.H., L.R.C.P., L.R.C.S.,

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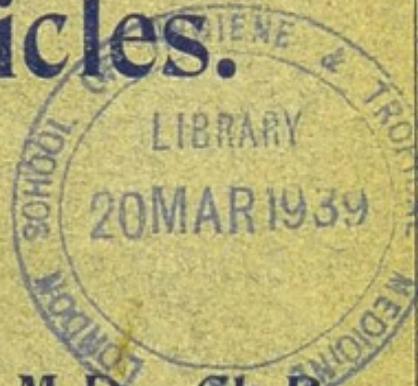
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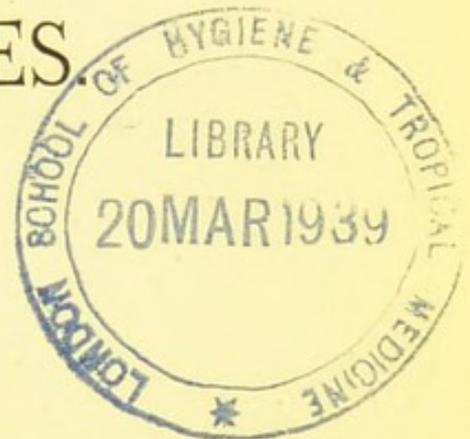
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THE PREVENTION OF INFECTION IN  
PUBLIC VEHICLES.



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THE  
PREVENTION OF INFECTION  
IN  
PUBLIC VEHICLES



BY  
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PREVENTION OF INFECTIOUS DISEASES

PUBLIC HEALTH

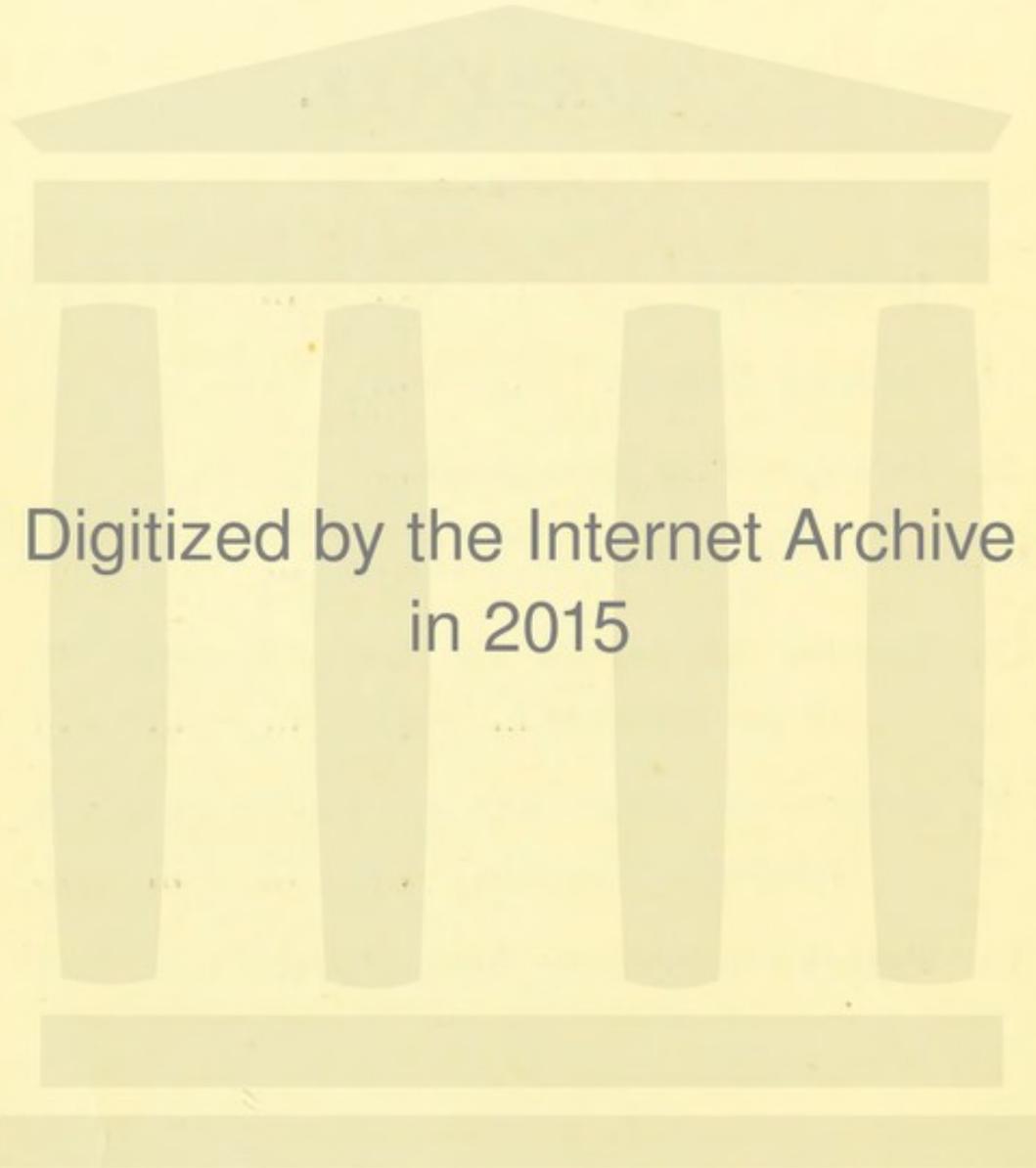
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## INTRODUCTION.

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THE great desirability for the adoption of legal measures for the systematic cleansing and disinfecting of the interiors of public vehicles is a matter of urgent public importance calling for the attention of the Legislature.

On many occasions prominence has been given to this subject in the Press, notably in the valuable columns of *The Sanitary Record*, which is largely read by the general public, as well as by those who are engaged in sanitary work altogether. And papers were read on this subject by Hamilton and Cecil at the Congress of the Royal Institute of Public Health held at Aberdeen in August, 1900. Also it may be within the recollection of some readers that the author read a paper on "The Need for Legislation in the Cleansing and Disinfecting of Railway Carriages" before a similar congress held at Eastbourne in July, 1901, which resulted in the following very important resolution being carried unanimously:—"That the attention of Government be called to the danger to public health caused by the lack of frequent wet cleansing and disinfecting of railway carriages, tram-cars, and omnibuses."

That this subject aroused great interest may be seen from the fact that all the leading medical and sanitary journals, and upwards of fifty of the leading newspapers in England, Scotland, and Ireland, gave prominence to the question at the time of the Eastbourne Congress.

No apology is needed for bringing forward this subject again, for much more may be said and accomplished yet before public vehicles are reasonably safe to travel in. So far as I have been able to ascertain, no book has been written on this subject hitherto, and I have attempted to amplify and accentuate what has been said already, with the sincere hope that the interest which now has been roused in this subject will not be allowed to diminish, but will increase, and result in much practical good.

The object of this little work has been to describe the conditions at present existing in public vehicles which tend to spread disease, and to make certain recommendations which, if carried out, would improve these conditions materially, and would result in diminishing many risks of injury to health.

With reference to the spread of infectious diseases from the inhalation of the dust of public vehicles, my remarks will be confined to Tuberculosis, as this is the disease which has been more studied in this connection, and concerning which we have more data, than in the cases of other infectious diseases. But it should

be remembered that other diseases, such as Diphtheria and Influenza, the bacilli of which are contained in the sputum, may be contracted in like manner; also Scarlet Fever may be contracted from the dust of public vehicles which have become contaminated by the germs of that disease.

Regarding the arrangement of the subject matter of this work, Chapter I. contains a few general remarks on the spread of Tuberculosis from dust. Chapter II. shows how Tuberculosis may be the result of house infection. Although this does not bear directly upon the subject of infection from public vehicles, it was thought desirable to consider that point in order to show, from a few known examples, how disease may be contracted from breathing the dust of closed places. Thus I have taken the broader class first, and have dealt in Chapter III. with a smaller variety of closed places, viz., public vehicles. It was necessary to do this in order to indicate how disease may be spread from inhalation of the dust from these vehicles, especially railway carriages. Moreover, owing to the difficulty in eliminating all other sources of infection, it is impossible to point to definite instances and say that they have received infection from such vehicles. Chapter IV. is concerned with the defects of the present law in reference to the cleansing and disinfecting of public vehicles, and Chapters V. and VI. contain respectively the conclusions which have been drawn, and the preventive

measures which have been recommended, from a consideration of the foregoing.

As the question has an interest for everyone, I have avoided scientific terms, and have used simple language as far as possible.

I wish to express my indebtedness, for much useful information, to the various writers whose papers I have referred to in the text.

ALFRED GREENWOOD.

CREWE.

# THE PREVENTION OF INFECTION IN PUBLIC VEHICLES.

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## CHAPTER I.

### GENERAL REMARKS.

As is now generally recognised, tuberculosis is an infectious wasting disease which is responsible for about one-ninth of all deaths which occur, and for nearly one-half of all deaths between the ages of 25 and 35. The illness and mortality which it causes therefore entail serious consequences to the social condition of the people. In this country 60,000 persons die from tuberculosis each year, and the commonest and most fatal form of human tuberculosis is consumption, or tuberculosis of the lungs (also called pulmonary tuberculosis).

It will be proved in the following pages that the dust of public vehicles, *e.g.*, railway carriages, often contains micro-organisms, some of which are highly infectious and dangerous to health—notably the tubercle bacilli, or bacilli of consumption. The presence of these bacilli in dust is due chiefly to infectious sputum which has been coughed up by persons suffering from consumption, and which has then been allowed to dry into dust, which may be disseminated through the

atmosphere, and breathed by other people who are healthy. These bacilli retain their vitality for much longer periods when enclosed in places such as public vehicles than when they are present in open spaces. Two German observers named Schiff and Fisher have proved conclusively that dried tuberculous spittle remains infected for many months, provided it is not exposed to an excess of direct sunlight. Also Delépine has proved that the tubercle bacilli will grow at an ordinary temperature the whole year round. Therefore the danger of allowing dust to accumulate in public vehicles for long periods is very great. Sunlight cannot exert its germicidal action upon germs which are contained in dust beneath the seats and in the upholstering of the vehicles. Also low temperatures merely inhibit the development of the tubercle bacillus, but its vitality remains unimpaired after exposure to intense cold or prolonged freezing and thawing.

The bacilli may be present in the dust in enormous numbers, and Heller has calculated that the number of tubercle bacilli expectorated daily by a consumptive patient amounted on an average to 7,200,000,000. Some idea of the size of the bacilli may be gained from the following facts:—If a row is formed of them, placed in a line so as to make a length of 1in., there will be some 3500 in the inch, or if placed side by side so as to make a row 1in. long, there will be some 85,000 of them.

The following are prominent among the characteristics of tuberculosis, which have been proved by years of observation, by experiment and careful study.

I.—*Within the Body.*

- (a) A slow and indefinite period of incubation.
- (b) In the majority of cases it appears as a disease of the lungs.
- (c) Selection of the youthful or early adult period of life.
- (d) It exists as a disease of certain other mammals as well as of man.
- (e) Mode of entrance into the body (1) by the lungs; (2) by the alimentary canal; (3) by inoculation through the skin, in the foregoing order of frequency.

II.—*Outside the Body.*

- (a) The infection leaves the body mainly in sputum coughed up from the lungs, but may occur in secretions or excretions from other diseased organs. We are concerned here with the spread of tuberculosis through the *expectoration* of consumptives only.
- (b) The infectious sputum is mainly that of the lungs, and not that which is simply discharged from the mouth as saliva. It has been proved experimentally that the breath of consumptives does not contain the tubercle bacilli, but numerous drops of saliva are

ejected in the act of coughing which may contain tubercle bacilli. It has also been shown that tubercle bacilli cannot be spread through the air from a fluid which contains them, or from a moist surface, by evaporation, or by air going over it.

- (c) The tuberculous sputum especially dangerous is dry. So long as the material which has been expectorated remains wet it is harmless. The dangerous period begins when the sputum becomes dried into dust, the particles of which become spread mechanically.
- (d) The tuberculous sputum of enclosed air spaces constitutes a far greater danger than that which remains out of doors. Tubercle bacilli follow the law of gravity, and fall towards the ground unless they are retained by any object which can support them.

Hence consumption has the characteristics of an indoor infection.

Abbott\* says that a given number of healthy persons—say, 1000—having identical conditions as to age, sex, and race, and let them be divided equally, 500 to lead an indoor life, and the other half an outdoor life (for example, like fishermen); let an equal quantity of infectious material—for example, that of

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\* Paper read by Dr. Samuel W. Abbott, of Boston, at a meeting of the American Public Health Association, Philadelphia, Pa., October 27th, 1897.

diphtheria, scarlet fever, or the dried sputum of consumptives—be equally distributed among the two groups, and it may be laid down almost as an axiom that the indoor group will become infected in far greater numbers than the outdoor group. The reasons are clear:—The persons composing the indoor group are aggregated more closely together, and the air supply is limited in proportion to the efficiency of the ventilation; and these two conditions, the density of aggregation, and the limitation of the air supply—or, in other words, the ventilation—favour the spread of infection. The preservation of the vitality of infectious material is also secured by the protection afforded by enclosed areas, either in rooms, workshops, railway carriages, or other enclosed spaces. Hence the object of the measures adopted by certain sanitary authorities in fixing notices requesting occupants not to spit upon the floors of such places.

On the other hand, the out-door group is subjected to similar influences, but in a less degree. Ventilation is not needed, since the outdoor air affords the necessary protection by its enormous diluting power. The density of aggregation is greatly diminished, and disease germs lose their vitality under the destructive influences of sun, wind, and rain. The chief danger here arises from the conveyance of such material as dried sputum indoors upon the boots, shoes, and dress skirts. It is probably with the idea of diminishing this source of infection, *i.e.*, the transference of in-

fectious sputum from the outside to closed spaces, that the Liverpool Corporation are applying for power to Parliament, that the prohibition regarding spitting should also apply to spitting in the road, as well as on the footwalk; to spitting in any "place" within the meaning of the Act, and to spitting "on" tramcars and other conveyances as well as "in" them.

Cornet has stated that open-air infection from tuberculosis may be disregarded practically, since no positive evidence has ever been presented to the effect that human beings ever contract tuberculosis in the open air. Although the results of observation and experiment tend to show that a far greater danger lies in the direction of indoor infection, it would be wiser to take such steps as shall prevent the possibility of the transference of infection from outside to the interiors of closed spaces. In any case, the practice of spitting on the tops of tramcars and omnibuses is to be deprecated most strongly. A large mass of the public even yet do not look upon consumption as an infectious disease, and omit to take any precautions themselves to prevent its spread. Dr. Russell, in a pamphlet on the "Prevention of Tuberculosis," quotes the following statement of the French League for the Prevention of Pulmonary Phthisis:—"We know further that the consumptive is not in the least dangerous by contact or proximity, that it is neither his body nor his breath which is hurtful, and that we can chat with him for hours, live with him for years, and give him the most

constant care without running any serious risk, *provided we take certain precautions*, the chief of which is to collect his expectoration and not to delay the destruction of his spittle until it becomes dry, and is disseminated as dust into the atmosphere. This position is logical and unassailable. If you accept the doctrine as sound, the practice must be conceded as sufficient. Let there be spittoons handy for everybody; don't put your spit in the way of drying and becoming dust, don't anywhere stir up the dust in enclosed places. The remedy is so commonplace that, after reading all that has been written and spoken, and proclaimed and enjoined, when we look at our notes and find nothing but sputum, spittoons, and dust, we are apt to show a little temper, like Naaman when he expected the prophet to hold a solemn function over his leprosy, and he merely told him to go and wash himself. No doubt the very simplicity of the prescription will constitute the greatest difficulty in the way of its acceptance and observance. Only a clear apprehension of, and firm belief in, the doctrine that, practically, consumption is communicable through dried expectoration, and nothing else, will save the practice from ridicule."

The following are the reasons why promiscuous expectoration should be prevented:—

- (1) The habit is disgusting.
- (2) It may be injurious to the spitter.
- (3) It may be very dangerous to others.

(1) *The habit is disgusting.*

Every traveller by the railway, tramcar, or omnibus must have had most unpleasant experiences of the nauseating effects caused by the numerous evidences of expectoration. This practice is common in all parts of England, and many proofs of this appear constantly in the daily press. In the *Western Mail* of October 7th, 1901, one reads that "this practice is very prevalent in South Wales," and that no less than one hundred and forty evidences of this filthy habit were counted when walking a distance of not more than one hundred yards, viz., from the offices of that Journal at Cardiff to the Royal Hotel. In the *Sheffield Independent* of October 19th, 1901, the editor says:—"I believe that Sheffield is the most expectorating town in the United Kingdom; spitting seems as essential as breathing to many Sheffields—and is almost as frequent—and the habit is practised with an abominable recklessness." No town in England is free from evidences of this habit.

The author has noticed that there is a great amount of spitting in workmen's trains in various parts of the country which run between the hours of 5 and 6 p.m. and 5 and 6 a.m. In many cases these same carriages are used for traffic throughout the day in the dirty condition into which they have got, without any intermediary cleansing. Therefore the habit is not only disgusting, but it is widespread.

(2) *The habit may be injurious to the spitter.*

During expectoration saliva is ejected from the salivary glands, as well as sputum from the lungs. The uses of saliva are numerous, but its most important action in digestion is its diastatic or amylolytic action, *i.e.*, the transformation of starch into dextrin and some form of sugar due to a ferment called ptyalin. Saliva dissolves those substances which are soluble in water; its alkaline reaction enables it to dissolve some substances which are not soluble in water alone, but which require the presence of an alkali.

Saliva moistens dry food and aids mastication, and the formation of the "bolus," while by its mucin it helps the act of swallowing.

Saliva also aids articulation, and, according to Liebig, it carries down into the stomach small quantities of oxygen.

Lastly, saliva is necessary to the sense of taste to dissolve sapid substances, and bring them into relation with the end-organs of the nerves of taste.

As the salivary glands will only secrete a certain amount of saliva needed for the various functions mentioned above, it follows that a continual waste of saliva will result in placing an undue strain on these glands, or a less amount of saliva will be present at the time required to exert its mechanical and physiological actions. This condition may be a factor in the production of dyspepsia, as the food is not moistened

and thoroughly masticated, and it passes into the stomach, increasing the work of that organ. Moreover, the consumptive person who expectorates diminishes his own chance of recovery. It has now been proved abundantly that many cases of pulmonary tuberculosis do recover, and it behoves all these to take precautions against re-infection.

Therefore the habit of spitting is not only altogether unnecessary, but may be harmful to the offender.

(3) *The habit is very dangerous to others.*

This will be proved in Chapters II. and III. Spitting should be prevented amongst apparently healthy and unhealthy persons alike, since a man may have consumption and an infectious sputum without his knowledge.

## CHAPTER II.

## INFECTION FROM DWELLINGS.

It is well known that in former times there was a great mortality from consumption amongst persons living under conditions where the ventilation was bad, and the air polluted from overcrowding. This increased death-rate was seen amongst the inhabitants of barracks, convents, and common lodging-houses. Dr. Marfan, in "Revue d'Hygiene," 1890, vol. xii., page 66, has shown that the careless distribution of sputum upon the floors of workshops has had much influence in increasing the phthisis mortality of such workmen. A few instances of infected houses causing tuberculosis will be given now, with the view of proving that individuals may contract this disease by inhaling infected dust in closed spaces.

Niven, in his annual report on the health of Oldham for the year 1890, records a case in which three members of a family perished in consequence of the occupation of a room which had been inhabited previously by a consumptive patient. Mr. and Mrs. A. went to Southport in September, 1887, with one of their children. In the house where they lived was a consumptive woman, who requested them to change bedrooms with her, which they did. In January,

1888, the son died of meningitis, after an illness of two months. In June, 1889, a baby died of tabes mesenterica.

In September, 1889, Mrs. A. died of phthisis. The consumptive person who exchanged bedrooms with her is dead, and she was said to have contracted the disease from her husband, who died of it. There was no family history of consumption.

Coates investigated cases in Manchester, in which it appeared that phthisis had been acquired by living in houses which had been infected by a former phthisical occupant.

In one house there were two patients—man and wife. Before going to live in it both were quite healthy. The house was very dirty when these people went into it, and judging by the description given by them of the condition of the house at that time, the former tenant, who was a consumptive, must have been of very careless and dirty habits, as the walls and floor of his bedroom were soiled in many places with sputum. The man and wife occupied the bedroom used by the late consumptive tenant. No cleansing, disinfecting, or beautifying were done before they took possession. Three months after coming to live here the patient began with a slight cough, and shortly afterwards the wife began, and at the time of Coates' examination, twelve months after coming to the house, both were suffering from rapidly-advancing phthisis. The period between

exposure to infection and the appearance of symptoms was rather short—three months—but this was a case in which the conditions were very favourable to the infective agent.

In Albutt's "System of Medicine," vol. v., page 169, a case of house infection, published by Englemann, is described:—A newly-built flat in a fairly sanitary condition, but badly lighted and ventilated, had been occupied for eight years by three families in succession; all of them had presented a clean bill of health until the family (X) took up their residence in the same quarters. In this family the mother was consumptive when she came, and died in the flat. Shortly afterwards the family left, having lived there for one year only. The flat was next occupied by a family (Y) of seven persons, all healthy. After a year's stay they left, and some years later the father, mother, and one son died of phthisis, and a boy of chronic peritonitis. A third family (Z), all healthy to begin with, next took the rooms. One child died of meningitis, the mother acquired phthisis, and a child became scrofulous. A fourth healthy family (W) next came into residence. After a time the mother became phthisical, and two children died of meningitis.

In reference to these facts Dr. Payne remarks:—  
"Summing up the history, it appears that for eight years the dwelling was free from tuberculous diseases. Then came one year's tenancy by a person already tuberculous. After this, in a period of twelve years

at least twelve cases of tuberculous disease were traced to this source. It is to be noted that the dwelling was never vacant, the new tenants entering while it was, so to speak, still warm from the last; and during the whole period it was never painted or cleaned. In respect of the third and fourth families (Z and W), the facts point strongly to infection from this dwelling, but in respect to the second family (Y) some years elapsed between their tenancy of the infected house, and the deaths of some of them from tuberculosis, and therefore it is not quite clear that they were infected in this particular dwelling."

Dr. Ducor, of Paris, records the following case:—A family of eleven persons—father, mother, and nine children, hired a small apartment in October, 1890. This apartment had been occupied since 1888 by a man and his wife. The man died of phthisis in May, 1890, and the woman twenty days after, of the same disease. The mother and two of her children slept in the room where these two deaths had occurred. In 1893, these three persons—the mother, and little girl of nine years, and an infant sixteen months old—all showed symptoms of phthisis. Dr. Ducor, struck by the fact that the occupants of this room were the only members of the family who were affected in this way, made an investigation into the matter, which resulted in discovering the history of the former occupants. He then observed that the wall paper of the room in question was soiled with the remains of

dried sputum. Microscopical examination of this paper revealed the presence of tubercle bacilli, and two guinea-pigs inoculated with an emulsion made with fragments of the paper became tuberculous.

The above instances prove that tuberculosis may be contracted in rooms by inhalation of dust particles contaminated with the tubercle bacilli, as a result of previous occupancy by consumptives.

Coates has shown also that a considerable number of men employed as paperhangers and whitewashers in the houses of the poorer classes in Manchester suffered from phthisis. He pointed out that the methods which these men employed to cleanse dusty walls and remove dirty and dusty wall-papers show how easily such men might become infected if any of the dust on these walls happened to contain living tubercle bacilli. Coates stated that as a rule, when the men had occasion to strip the paper from the walls of a room, they simply tore it off as it was, without any previous wetting. Walls which were limewashed they brushed down with a dry brush before re-whitewashing. In a series of seven cases who developed consumption in this way, he could not gain any family history of tuberculosis; careful inquiry failed to reveal any other source of infection, and all the men had been quite healthy previously. These men would inhale large quantities of dust, and in stripping paper in this way from the walls of rooms previously occupied by consumptive people,

they would be placed in extremely favourable conditions for contracting tuberculosis of the lungs. It may be argued that it is unfair to compare the results of breathing infected dust by people who are constantly living in infected dwellings, with the results of breathing the dust from public vehicles, as in the latter case the duration of exposure to infection is much shorter than in the former case. But in the case of these paperhangers there is a source of infection by tubercle bacilli, which is more closely allied to infection by tubercle-infected dust inhaled from public vehicles.

In reference to the diseases contracted by the inmates of the above-mentioned infected dwellings, it should be stated that *Tubercular Disease* is classed by the Registrar-General under four headings :—

- (1) *Tabes Mesenterica*.
- (2) *Tubercular Meningitis*.
- (3) *Phthisis*.
- (4) Other forms of *Tuberculosis, Scrofula*.

## CHAPTER III.

## INFECTION FROM PUBLIC VEHICLES.

IN this chapter it will be proved that the dust of public vehicles, *e.g.*, railway carriages, often contains living tubercle bacilli. Also apart from the infective nature of the dust, no one will deny that the dirty conditions in which many public vehicles are allowed to remain are disgraceful in the extreme, and require vigorous remedies.

These vehicles are being used more and more every year by the public, and there are now few people who do not travel in railway carriages, tramcars, and omnibuses. Many people use all or some of these vehicles extremely often, and spend two or three hours daily in them. Also a large number of people are compelled to make long railway journeys frequently. It is therefore obvious that passengers who are subjected to a continued inhalation of dust which may be tubercle-infected will be in danger of contracting tuberculosis of the lungs. The way in which a public vehicle becomes infected with tubercle bacilli is as follows:—A consumptive person expectorates on the floor of the vehicle. This sputum then dries into fine dust and spreads as such into the atmosphere. The drying of the sputum is accelerated by passengers

entering and leaving the vehicle, and they help to grind it into fine dust. Also this drying is accomplished more rapidly in dry hot weather than in wet weather. Then currents of air which aid in spreading this infected dust into the atmosphere, may be caused by the movements of passengers, or by the movements of the vehicle itself. Some of these infected particles of dust are then inhaled by the passengers, other particles fall on the clothing of passengers, and others fall on and are retained by the cushions and upholstery of the public vehicles. The cushions which are usually employed in these vehicles are eminently adapted for the reception and retention of dust particles. The large amount of dust present in these cushions may be demonstrated easily by beating the cushions with a stick ; this results in the formation of the great cloud of dust which is such a well-known sight. Some dust also collects beneath the seats and in the corners of the vehicles.

The so-named "cleansing" of the interior of a railway compartment, as at present carried out, consists in stirring up the dust, sweeping out a portion of it, and shutting the doors and windows. This is done frequently just before the same train makes a new journey. If the carriage windows are more often shut than open whilst travelling, the danger is increased ; but however good the ventilation might be it could never remove the dust retained by the upholstery and present beneath the seats.

The outsides of public vehicles are frequently and vigorously washed, but the internal cleansing is practically neglected. The stirring up of dust which may be tubercle-infected, in public vehicles, and the subsequent entrance of passengers, remind one of the experiments of Tappeiner, who produced tuberculosis in dogs by causing them to inhale tuberculous sputum, which was delivered into the cage in the form of a fine spray. At first the spray was inhaled by the dogs twice for one hour each time, and they lived in the cage the remainder of the time. In the later experiments the spray was inhaled once daily, and the dogs spent the remainder of the day at liberty. The experiments lasted from four to seven weeks, after which the dogs were killed, and without exception were found to be suffering from marked tuberculosis.

Dogs were selected for these experiments because they rarely develop tuberculosis. Other animals, such as rats, mice, and guinea-pigs, have contracted tuberculosis produced experimentally, in a similar way. This experimental tuberculosis affected the lungs and other organs. That the danger of such tubercle-infected dust in conferring tuberculosis is real and not merely suppositious has been proved by experiments conducted by Professor Hamilton, of Aberdeen, who referred to this subject in a Presidential Address before the Congress of the Royal Institute of Public Health held at Aberdeen in 1900. He made a number of

experimental observations on the dust taken from the floors of railway carriages with the view of ascertaining in what proportion of these carriages the presence of the tubercle bacillus could be detected. Dr. Hamilton examined twelve samples of dust from first and third-class carriages, six of them first-class and the remainder third-class, six smoking and six non-smoking carriages. Some of them were engaged in through traffic between London and Aberdeen, and others ran between Aberdeen and Glasgow. The experiments were conducted with the utmost care, and were as follows:—The dust was gathered in each case with a separate sterile hog's hair brush, and was received into a sterile bottle. About an ounce of sterile water was then added to each bottle; the bottle was well shaken, and placed for two or three hours in the incubator at a body temperature, the mixture being shaken from time to time. The contents were afterwards strained through sterile muslin in order to separate the grosser particles, the filtrate shaken up and allowed to settle, the supernatant fluid centrifuged, and the sediment inoculated under the skin of the guinea-pig, either on the inner aspect of the thigh or over the abdomen. The guinea-pigs had been under observation for weeks previously, and were free from tuberculosis. From the twelve samples of dust collected, two, or 16·6 per cent., were proved to be contaminated by the bacillus of tubercle. The animals inoculated developed a tubercular lesion

at the point of inoculation; the glands leading off from this, and, indeed, the whole of the glands, more or less, throughout the body, were enlarged and caseous, while the lungs, liver, and spleen were beset with a tubercular eruption. In the two instances where a positive result was obtained, the carriages were used for smoking purposes; they were both first-classes, and one of them ran between Aberdeen and London, and the other between Aberdeen and Glasgow. Dr. Hamilton went on to say that such a high percentage of instances in which the small quantity of dust removed from the flooring of railway carriages was found to contain one of the most deadly of all disease parasites was certainly alarming, to say the least of it, and showed that the danger of infection from this source was extreme, and that persons predisposed to tuberculosis entering such carriages were liable to very great risk of acquiring the disease. If this be the case with tuberculosis, the risk of acquiring influenza, and even diphtheria—diseases in which the micro-parasite concerned in their production is voided in the expectoration—must also be very considerable.

In a very elaborate series of experiments carried out by the Imperial Health Authorities at Berlin, it was found that 700 bacilli per square inch might be present on the walls, seats, and floors of carriages *which appeared quite neat and clean*. Moreover, vigorous cleansing did not banish, but only diminished the

microbes, and retarded their multiplication. The experiments were made with no fewer than 428 compartments, and among the results established was the certainty that the dust emanating from the dried sputum of phthisical subjects, lodged on the floor and in the upholstery, contained active pathogenic germs sufficient to constitute a great public risk. The German and French Governments have issued new and more stringent regulations for the prevention of infection and contagion in railway carriages. It is obviously most difficult to point to definite cases of disease, and to say that they have originated in breathing infected dust from railway carriages or other public vehicles, because it is practically impossible to ignore, absolutely, all other sources of infection. Nevertheless, the fact that such a danger does exist in these situations and is preventible should result in the adoption of preventive measures.

In a paper read at Aberdeen in 1900, Cecil stated that he had addressed the following questions to sixteen of the Railway Companies of Great Britain :—

- (1) Have you a system of cleansing the inside of carriages ?
- (2) What means do you adopt with those in which the upholstery is fixed ?
- (3) Are there officials responsible for the proper cleansing and inspection of the sanitary conveniences, &c., on your premises ?

Only one company ignored this inquiry. The Great Western promptly acknowledged the receipt of his letter, but did not answer the questions for a considerable time. The Midland and Great Eastern replied courteously but very briefly, and took no notice of the questions separately. Ten companies answered the questions *seriatim* and fully; and Cecil pointed out that it was worth noting that it was not the wealthiest lines which ignored his communication, but quite the other way. The London and North-Western, London and South-Western, and North-Eastern, not only replied most courteously but gave detailed explanations of the methods adopted by them for the sanitation of their carriages and stations. The following seven also gave satisfactory answers:—Highland Railway, Great North of Scotland, Glasgow and South-Western, Great Central, Great Northern, Lancashire and Yorkshire, and South-Eastern and Chatham. Cecil gave the substance of the ten detailed replies briefly as follows:—(1) While the carriages are running they are regularly beaten, swept, dusted, and washed; and once a year every carriage goes into the works to be overhauled. (2) Movable cushions are beaten in the open air, and when the carriages go into the works all the upholstery is removed and beaten. At various intervals, longer than one year, the horse-hair and other padding are taken out and cleaned and carded. At the same time the woodwork is treated with disinfectants. (3) In large stations a special

cleansing staff attends to the conveniences, under a foreman, who is responsible; at small stations the cleansing is under the inspection of the station-master.

Cecil then proceeded to say that it would be readily admitted that all this was good, and the system as complete as the present construction of the carriages would allow; but that over against these admirable arrangements on paper stood the daily experiences of thousands of travellers on short-journey trains, and at small stations. My own opinion is that the above statements are too vague. Although we are told that the carriages are regularly beaten, swept, dusted, and washed, we do not hear how often these processes are carried out, and we do not hear that the interiors of carriages are ever washed. Too much stress cannot be laid upon the frequent wet disinfection of the interiors of public vehicles. Moreover, it is not sufficient merely to beat movable cushions in the open air, they should be disinfected with heat from time to time. The same remark applies to the upholstery, which is alleged to be removed and beaten once a year when the carriage goes into the works. I would submit that once a year under the existing conditions is not sufficiently often. The statement that "at various intervals, longer than one year," the horsehair and other padding are taken out and cleaned and carded is also vague, and may mean that this is only done at intervals of several years.

Many railway stations also require legislative

measures which shall ensure their frequent cleansing. One may read in the *Westminster Gazette* of September 5th, 1901, that some of the Metropolitan Underground Railway stations are often in such a filthy condition as to be a scandal. Spitting on the stairs and platforms is frequently indulged in, and the only "cleansing" operations which these undergo appear to be an occasional sweeping and stirring up of the dust.

Overcrowding is often allowed in public vehicles, especially railway carriages, and this leads to concentration of the atmospheric impurities.

## CHAPTER IV,

EXISTING LEGISLATION IN THE CLEANSING OF PUBLIC  
VEHICLES.

AT the present time there are no enactments in the British Isles which deal with the compulsory cleansing of railway carriages, tramcars, and omnibuses, but in this respect Scotland is ahead of England. The only legislation bearing upon the matter is a section contained in the Public Health Act (Scotland) of 1897, for which that isle is indebted to Professor Hay, Medical Officer of Health for Aberdeen. This section states :—

“65. The Local Authority may make bye-laws for securing the cleanliness and sanitary condition of public conveyances plying within its district, and for preventing overcrowding in such conveyances.”

There are several defects in the above section :—

- (1) It is permissive instead of being obligatory.
- (2) It would not apply to vehicles passing from one district to another, as they are constantly out of the jurisdiction of one Authority into that of another.
- (3) The term “public conveyance” does not

include a railway carriage, and Local Authorities are prevented from taking individual action in Parliamentary Bills affecting railway companies on this account.

In England the legislation on this subject is even behind that of Scotland, and our powers in enforcing good sanitary conditions in public vehicles are practically *nil*.

It is indeed significant that our law is so complete with reference to the use of public vehicles for scarlet fever patients, and that there is such a sad lack of any legal enactment with respect to other infectious diseases, such as phthisis.

It is also significant that the most detailed instructions are given with a view of preventing outbreaks of contagious diseases amongst animals whilst on railway transit, as seen in "The Diseases of Animals Act of 1894," and the Orders issued by the Board of Agriculture under that Act. A separate set of Orders is in force dealing with outbreaks of each of the contagious diseases to which horses, cattle, and dogs are subject. These consist of the most detailed instructions relating to the cleansing and disinfection of railway trucks, vans, cattle pens, byres, and even fields where contagious disease has broken out and is suspected to have prevailed. In cases where there has not been a contagious disease, the Animals (Transit and General) Order states that the horse-box, truck, or van employed in the transit of an animal

must "on every occasion after an animal is taken out of it, and before any other animal, or any horse, ass, or mule is placed in it, be cleansed and disinfected." All litter is to be removed, the floors and sides scraped and swept, and thereafter thoroughly washed, and, lastly, a coating of lime is to be applied.

The differences in the cleansing operations of vehicles used for animals and vehicles used for human beings are most striking. It would appear from this that the health of horses or cattle is of more importance than that of human beings.

When Sanitary Authorities wish to interfere as regards the conditions of the railway carriages used on workmen's trains, which are alleged to be in a filthy condition, they find that the Public Health Acts are inapplicable to railway carriages. The application of section 91 of the Act of 1875 relating to Nuisances must be restricted to "premises," and the term "premises" includes messuages, buildings, lands, easements, and hereditaments only, with the result that 'railway carriages' cannot be deemed to be "premises" to which the section applies.

In the legislation of this question the Americans are far in advance of the inhabitants of the British Isles, although even *they* have not attained a perfect state of the law. But such matters as these are partially accomplished by a general law *requiring* local Sanitary Authorities to make regulations and enforce them.

The following is a copy of the law:—

NUISANCES, SOURCES OF FILTH, CAUSES OF SICKNESS,  
&c.

*Board of Health to make Regulations respecting  
Nuisances, &c., 1797.*

The Board of Health of a town *shall* make such regulations as it judges necessary for the public health and safety respecting nuisances, sources of filth, and causes of sickness within its town, or on board vessels within the harbour of such town, and respecting articles which are capable of containing or conveying infection or contagion, or of creating sickness brought into or conveyed from its town, or into or from any vessel. Whoever violates any such regulation shall forfeit a sum not exceeding one hundred dollars.

A regulation that no person shall remove, cart, or carry through any of the streets, lanes, or alleys of a city any house dirt, refuse, offal, filth, or animal or vegetable substance from any of the dwelling-houses or other places occupied by the inhabitants in any cart, wagon, truck, hand-cart, or other vehicle, unless such person so moving, together with the cart, shall be duly licensed for that employment and purpose by the mayor and aldermen upon such terms and conditions as they shall deem the health, comfort, convenience, or interest of the city require, on pain of

forfeiting a sum not less than three dollars, nor more than twenty, is valid.

Hence it will be seen that the American law on this point is not merely permissive, but obligatory.

Also in America, in the case of railways, this can only apply to stationary structures, &c., but not to rolling stock, since the railway trains are constantly in motion from one city or town to another, and are consequently out of the jurisdiction of one authority into that of another.

I have heard from Dr. Samuel W. Abbott, secretary of the State Board of Health for the Commonwealth of Massachusetts, that an attempt has been made at this session of their Legislature to remedy this, but it failed.

If this point can be remedied at a future session, the powers of the sanitary authorities will be increased usefully.

Therefore, our law with reference to the cleansing and disinfecting of public vehicles should be amended in such a way as will enable authorities to deal with these matters effectively.

## CHAPTER V.

## CONCLUSIONS.

THE following are the conclusions which may be drawn from a consideration of the foregoing chapters:—

(1) That the dust of public vehicles frequently contains the germs of dangerous infectious diseases, to wit, the tubercle bacilli. This dust also may contain the germs of other infectious diseases, such as diphtheria, influenza, and scarlet fever.

(2) That this dust is infectious and produces tuberculosis when inoculated into previously healthy animals.

(3) That the origin of the tubercle bacilli in the dust of public vehicles is the tuberculous sputum expectorated by "consumptives," which has dried on the floors of the said vehicles, and spread as dust into the atmosphere.

(4) That the tubercle bacilli present in the dust of public vehicles may retain their vitality for very long periods.

(5) That absence of spitting in public vehicles would result in a less number of tubercle bacilli in the dust of such.

(6) That the linings of railway compartments are made of such material and fixed in such a way as to

render their efficient cleansing and disinfection most difficult. Also, this fixed upholstery receives and retains huge quantities of dust.

(7) That the present cleansing of interiors of public vehicles is inefficiently, and not sufficiently often, done. The present cleansing operations consist of dry methods, no liquids being used in the interiors. According to the Berlin experiments even scrubbing with soap and water is not sufficient alone. In addition to this, efficient disinfectants should be used.

(8) That the most dirty vehicles do not necessarily contain the greatest quantity of tubercle-infected dust. The degree of severity varies with the amount of tuberculous sputum which has dried therein. This emphasises the necessity of cleansing and disinfecting the interiors of all vehicles whether very dirty or apparently cleaner.

(9) That it is quite practicable to cleanse and disinfect the interiors of all public vehicles, and render them absolutely safe and free from all infection by adopting measures which do not entail any destruction of the upholstering.

(10) That improvements are needed in the construction of public vehicles, so as to render their interiors more easily cleansed and disinfected.

(11) That so long as the public are content to run these risks, so long will the danger continue.

(12) That although many people will spit, in spite of all efforts to the contrary, the number of those who

offend in this way will be diminished by adding to the knowledge of the public on the question.

(13) That at the present time there is an urgent need for improvement in our very defective legislation on this matter.

## CHAPTER VI.

## PREVENTIVE MEASURES RECOMMENDED.

IN order that the following preventive measures may be carried out successfully, the health of the travelling public must be considered of primary importance, and the scruples of the individual must give way in the cause of the public welfare. The aim of all sanitation should be to render conditions clean and less liable to act as breeding grounds for preventible diseases. As a previous writer has asked, "If preventible, why not prevented?" The constantly increasing traffic in our country renders it important and necessary, not only that public vehicles should be less liable to receive infection from travellers, but that the vehicles should be subjected to efficient and systematic cleansing and disinfecting operations by the owners. The need for these measures has been impressed upon the public frequently of late. Even during the last few years travellers have become more sensitive to the necessity for the cleanliness of the vehicles which they use than they were formerly. Great reform is needed in the habits of many travellers, and before any attempt at organised reform can be a success every traveller must realise his own responsibility. It is now admitted generally that

tuberculosis is not inherited, *i.e.*, directly transmitted from parent to child, but that a *tendency* to contract tuberculosis may be inherited. Those persons who have this tendency may be described as possessing a soil favourable for the growth of the tubercle bacillus. When tubercle bacilli develop on this favourable soil they must have been introduced from a source outside the body. If this introduction of bacilli could be prevented altogether there would be no fresh cases of tuberculosis. Moreover, if it can be proved that certain vehicles contain this infection, which is a source of great danger to the travelling public, preventive measures should be adopted. Such measures should consist in preventing sputum from being expectorated upon the floors of public vehicles, and also in killing the infection already present in many of them. Therefore my recommendations, which are quite practicable, resolve themselves into:—

(1) Obligations upon the public.

(2) Obligations upon railway, tramcar, and omnibus companies.

(1) *Obligations upon the public:—*

A matter of the highest importance in dealing with this problem is the education of the people. They must be taught to realise the great danger involved in the wholesale spitting which goes on constantly by “consumptives” and others, whose sputum is of an infectious nature. These dangers are often disregarded with a callousness which is well-nigh appalling, in

spite of many warnings. One cannot exaggerate the deadly peril to the community which is involved in the failure to destroy the sputum of a consumptive person. It is the duty of everyone to propagate this truth; to see, so far as he can, that no known consumptive with whom he is associated is permitted thus to infect the healthy, and to do everything possible towards swelling the volume of opinion that must put down the habit of spitting in public places and vehicles, by persuasion, and if that fails, by compulsion. It cannot be too well-known that every promiscuous spitter is an enemy to mankind; if he is healthy he is a disgusting nuisance, if he is a consumptive he is a disseminator of a disease which is second to none in its ravages. Notwithstanding the efforts already made to educate the public on this matter, hundreds of people, in utter ignorance, are contaminating the health of their fellows by this unnecessary practice daily, and only by eradicating the spitting habit altogether will it be possible to prevent the harm which these people do. Sanitarians should redouble their efforts to propagate knowledge respecting the undoubted dangers of spitting in public vehicles. Offenders who have unconsciously developed this habit should be told of the dangers which result either directly or indirectly from their bad example, and if they are at all reasonable they will determine to break themselves from this baneful habit. If they could only be made to understand how much pain, misery,

and loss of life result from promiscuous spitting, there would be a great diminution in the extent of this public nuisance. Public opinion is becoming stronger, however, in reference to this nuisance, and "Thou shalt not spit" is a commandment which has spread with rapidity of late. One reads in a daily paper that a man expectorated recently on a crowded boat coming from Hampton Court. A lot of people looked at him as they would look at a welsher or a pickpocket. Greatly perturbed at the accusing glances of twenty pairs of eyes, he muttered, "Sorry, — habit," and slunk away to the refreshment room. The effect of this public disapproval, silently expressed, was striking, and taught others besides the offender something of the power of an unanimous public sentiment.

The medical and lay Press have already done great service in bringing this matter prominently before the notice of the public, and it is to be hoped that this will continue. The following opinions taken from a very large number may be of interest:—*The Sanitary Record* of September 13th, 1901, states, "We gladly join Dr. Greenwood in pushing this matter forward," and the *Lancet* of October 5th, 1901, states, "We cordially endorse Dr. Greenwood's suggestions."

In educating the public, care should be taken only to adopt those measures which are likely to be followed by a reasonable amount of success. It appears that the most recent addition to the ever-growing num-

ber of leagues is the Anti-spitting League, which has been formed in Paris. The object of the league is by means of tracts, envelopes, post-cards, placards, and by all means, procedures, examples, persuasive, correct, and stamped with the most delicate urbanity, to attract the attention of the public to the dangers of spitting in places of public resort. The league has had a badge designed for itself, and is to publish a Bulletin. Every person who subscribes to the Bulletin, and makes a further contribution in aid of the objects of the league will receive the title of "Membre Bienfaiteur." The author is in full accordance with the editor of the *British Medical Journal*, who says, that while heartily sympathising with the objects of the league, he doubts very much whether tracts or post-cards decorated with warnings against expectoration will do much to abate the nuisance. As for measures inspired by the most delicate urbanity, he has no doubt at all about their utter uselessness. Until public opinion has been educated to such a point that spitting on the pavement or on the floor of an omnibus or railway carriage is looked upon as an act placing the offender outside the pale of decent society, this disgusting and dangerous habit will be indulged in by the ignorant and the unmannerly. We cannot expect that the change will come suddenly, it must be gradual; but we may hope reasonably that the change will come as the teachings of hygiene percolate the various

social strata, and that public spitting will in time become a thing of the insanitary past. In a similar way the force of public opinion has abolished duelling, and diminished drunkenness and swearing in good society. Constant and persistent agitation for reform in this direction is needed, and ultimately will lead to victory. Parents and teachers should aid in bringing about this much-needed reform, and it would be wise to include Elementary Hygiene amongst the subjects taught in all schools, thus giving the teachers opportunities of impressing upon youthful minds the results of this baneful practice. Sufficient prominence is not given to the subject of personal hygiene in schools, and Sanitary Authorities would do well to co-operate with school managers in making arrangements for this subject to be included in the syllabus of every school, and in offering prizes for competition by periodical examinations in this subject. Also efforts should be made on the part of the pulpit and the stage to enforce upon the public mind the importance of these questions. Those persons who are obliged to expectorate may avoid soiling public vehicles by carrying small square pieces of soft tissue paper which have been oiled. The spitter should then spit into the centre of one of these each time he expectorates. Then he should fold this up in such a way that his clothing will not become soiled, and place it in a pocket which he should keep for this purpose and no other. These soiled papers should be burned as soon as possible.

The papers which have not been used, and which are ready for use, should be kept in another pocket. Instead of using tissue paper in this way, the spitter may use a pocket spittoon containing a small quantity of a fluid disinfectant. These spittoons are now manufactured, and the demand for them is increasing. Care should be taken that the cap to the spittoon fits tightly, that it is screwed up well after using it each time, and that it is frequently and thoroughly cleansed with an efficient disinfectant. The habit of expectorating into the pocket-handkerchief should be discouraged as much as possible. If a consumptive person does this, he folds the sputum in his handkerchief and places it in his pocket, where it dries. This drying is, of course, assisted by the heat of the body. Each time the handkerchief is used the patient distributes tubercle bacilli into the air broadcast.

Cautionary notices against the dangers of spitting should be fixed in all public places as well as in all railway carriages, tramcars, and omnibuses. The number of towns in England is increasing where these spitting notices have been posted in prominent positions. The author has noticed that those public vehicles, especially railway carriages in the Metropolis which contain spitting notices are undoubtedly more free from the dangerous habit than those in which such notices are absent. This has also been his experience regarding the fixing of these cautionary notices in the omnibuses of Crewe.

These facts would lead one to believe that if such notices were fixed in all public vehicles the diminution in expectoration would continue, and this would necessarily mean a diminution in the infectivity of the dust contained therein. Good effects have also been seen from fixing spitting notices in Paris. Some of these notices border on the humorous. For example, a placard in an American hotel said: "Nobody who expectorates can expect to rate as a gentleman." Also the following notice appears in an American street car:—"Gentlemen will not spit—others must not." Outdoor spitting should be prevented as far as possible, because all infectious material constitutes a greater or less danger wherever it lies. The facts that tuberculous sputum may be swept up by long sweeping dresses and heavily-flounced under-skirts worn by ladies in accordance with custom, and by the boots of anyone, and that it may then, secondarily, infect either a dwelling or a public vehicle, are arguments in favour of the abolition of expectoration out-of-doors. Moreover, unless this outdoor spitting is abolished a greater number of people, when they are forbidden to expectorate on the tops of tramcars and omnibuses, will spit over the edge of the car. This is indulged in extensively already with an absolute indifference to the feelings of those who happen to be below.

Although the number of English towns is increasing where tuberculosis is a notifiable disease, we are still behind the Germans and Americans in this matter.

At the Congress on Tuberculosis held in London this year, a French delegate, M. Brouardel, Dean of the Faculty of Medicine of Paris, pleaded for international action in the disinfection of railway carriages, steam-boats, and hotels, and mentioned that in the United States hotel-keepers who receive a consumptive client have to notify it, and compulsory disinfection of the room has to be done. In Germany every doctor who attends a case of pulmonary or laryngeal tuberculosis is bound to report it in writing to the police. After death the room in which the patient has died must be disinfected as well as his belongings. Hotel proprietors, keepers of "furnished houses," and asylums, and other public institutions, are compelled to notify at once every case of tuberculous disease which arises in their establishments.

There will always be a certain number of people who will expectorate in spite of all efforts to the contrary, and the way in which these shall be dealt with involves a somewhat difficult problem. One cannot but admire the very good example which the United States are setting us in the vigour and determination with which they have recently set about the abatement of the spitting nuisance. In the *British Medical Journal* for June 8th, 1901, one may read the following:—

“Offenders are frequently arrested in New York, and magistrates are beginning to deal seriously with the offender. Mr. Sexton, President of the Board of Health, not long

ago assigned 70 of the 100 policemen, detailed for tenement, house, and other sanitary work, to the special duty of riding about the town on surface and elevated railways, and arresting those whom they saw break the ordinance against expectoration on the floors of the street and railroad cars, and other public vehicles, ferry boats, and public buildings. The persons arrested were dealt with in the regular way in the police-courts, and the officers will also report from time to time the general results of their work, and observations to Dr. Roberts, the sanitary superintendent. The street railroad companies, wherever they have not already done so, are required to place the following placard conspicuously in all street cars:—'Spitting on the floor is a misdemeanour; 500 dollars (£100) fine, or imprisonment for one year, or both, may be the punishment therefor. By order of the Board of Health. Section 194, Sanitary Code. Section 15, Penal Code.' Some persons have already been fined for breach of this law. In Newark and San Francisco the courts have enforced their anti-spitting laws, offenders having been convicted and penalties imposed. A millionaire was convicted by the Superior Court, and the judgment upheld by the Supreme Court,

of California. He paid his fine of 25 dollars (£5), and spent one day in gaol. In New Orleans a stringent ordinance was recently passed by the city councils."

Many other large towns in America have inspectors for railway carriages and tramcars, whose duties consist in arresting passengers who indulge in the spitting habit. Whether such legislation in our own country would be successful is a debatable question. My own opinion is, that if spitting were made an offence punishable by law before a bench of magistrates, it would help considerably, but the difficulty would be to get the law enforced universally. It has been stated that as there is a law against the public use of profane or foul language in the Statute Book, which is practically a dead letter, so a law against spitting would be equally inoperative. I do not agree with this. The two offences of using profane language and spitting are not comparable in their effects. The former is in no way attended by risk of injury to health, whereas in the latter case distinct injury to health and ultimate death may result. There appears to be some difficulty in enforcing the laws which exist in certain of the United States against this nuisance. The *Boston Medical and Surgical Journal* states that fifty-six men were recently summoned to appear at the Charleston District Court, charged with expectorating on the floors of elevated cars and stations. Only one man answered to the summons, and he was

fined 20 dols. The judge, in imposing the sentence, said he intended to stop the nuisance, and would hereafter impose the full penalty of 100 dols. What happened in the case of the other fifty-five men does not appear. Great determination and unanimity of purpose would be required on the part of judicial authorities in this country in enforcing any powers which they may obtain regarding the prevention of spitting.

It would be a matter for great surprise if there had been no difficulties in enforcing the spitting laws. Whether we are able to get similar laws or not in England, I believe that the most potent factor in remedying this unsatisfactory state of affairs will lie in the exercise of public opinion, which can only be strengthened by increased educational measures.

(2) *Obligations upon railway, tramcar, and omnibus companies:—*

Although much credit is due to those who are responsible for the great strides which have been made during the last few years in practical sanitation, it is a matter for considerable regret that until recently it has not been thought necessary to cleanse and disinfect public vehicles, which are so constantly used, and which are often in such a condition as to be extremely favourable to the spread of infection from the dust impurities which have been allowed to accumulate in them.

It is a matter of great wonder that the travelling public have borne with existing conditions as long as they have done, and it is very surprising that so many escape as they do. As mentioned before, the cleansing of the interiors of public vehicles is carried out in the most primitive and inefficient manner, and they are rarely, if ever, disinfected.

Of course railway companies, and owners of public vehicles generally, cannot be held responsible for the dangerous habit of spitting indulged in by those members of the public over whom they have no control, and whatever educational measures are adopted some people will continue to expectorate in public vehicles, in spite of all efforts to the contrary, and regardless of their own well-being, or that of their fellow-travellers. Hence, a certain amount of infection of public vehicles by tuberculous sputum will still continue, and to meet this condition other measures should be adopted. These measures involve systematic and thorough cleansing and disinfecting of the interiors of all public vehicles.

It is certainly doubtful whether a successful issue in dealing with this question would be obtained if reliance were placed on the voluntary action of the railway, tramcar, and omnibus companies. My own view is that the cleansing and disinfecting of these public vehicles should be compulsory measures enforced by legislation, and neglect or default to be punishable by heavy penalties. Also thorough super-

vision of the work should be made by officials appointed by the Board of Trade; some powers in this connection might be delegated to County Councils. The directors of companies owning public vehicles will probably regard my recommendations with great disfavour, especially during times of increased working expenses, but I think that many of them will admit the necessity of greater precautions.

As an instance of the strong feeling raised in the minds of some people against any interference with respect to the cleansing of railway carriages, I will quote the following extract from *Herepath's Railway Journal* of August 2nd, 1901, which appeared after the reading of my paper at the Eastbourne Congress:—

“The outcry about dirty railway carriages has as much truth in it as suffices to carry the lie. We should like to believe that the upholstery in most private houses is as free from dust and micro-organisms as that in an ordinary first-class carriage. The statement that carriages are dusted and cleaned with the windows shut is a gross fabrication. In their own interests the cleaners would act otherwise. What about the dirt and expectoration on the pavement, in saloon bars, theatres, and everywhere almost where men congre-

gate? To single out railway carriages is unjust. Railway carriages are cleaned every night, whereas most of those who complain of dirty carriages have but limited experience of perfect cleanliness elsewhere."

Sufficient has been said in this little work to prove that the dust of railway carriages often does contain dangerous infectious micro-organisms—to wit, the tubercle bacilli. The upholstery in private houses has nothing whatever to do with the question. The statement that carriages are dusted and cleaned with the windows shut has never been made. Some of the dust is swept out of the carriage, and all the dust is stirred up. This is done in a very short space of time; no wet cleansing is done in the interiors of the compartments, and no disinfecting is done; the windows are *then* shut, and the carriages are ready to receive fresh batches of passengers. The statement that "those who complain of dirty carriages have but limited experience of perfect cleanliness elsewhere" is as hysterical as it is false, and needs no further comment.

The recommendations which are made here refer to:—

- A. The construction of the interiors of public vehicles.
- B. The cleansing and the disinfecting of the same.

A. *The Construction of the Interiors of Public Vehicles*:—

The cushions of all public vehicles should be detachable. I have heard from managers of railway companies that they are unable to have movable cushions, &c., in railway carriages, because they were either stolen or thrown out of the windows. This difficulty could be met, in the future, by arranging the upholstery in such a way that it could be fixed to a movable frame screwed to the partition, so that the whole could be taken out bodily in order to facilitate cleansing and disinfecting processes. I believe that the new carriages on the London and South-Western and the Great Central Railways are being fitted up in a manner similar to this.

Also the floors of public vehicles should be covered with a detachable material such as linoleum. The cushions should be made of a less pervious material than that used at present. As mentioned previously, the cushions which are in use now are eminently suited to the reception and retention of dust. The cushions should be covered by an impervious leathery substance. The compartments in the Central London Railway (or Twopenny Tube) more nearly approach the ideal than any others which I have seen. The floors are covered with linoleum, and the seats with leather. Spitting notices are exhibited prominently in lifts and compartments. The above improvements in construction could be carried out in all public

vehicles at the time of re-upholstering, as well as in all new vehicles made in the future. Many vehicles, as omnibuses and tramcars, would be much more cleanly if the stuffed seats were discarded and replaced by varnished wood. These could be made very comfortable if they were shaped properly. Hansom and four-wheel cabs should also receive the same attention in their construction and cleansing, as other public vehicles.

*B. The Cleansing and Disinfecting of the Interiors of Public Vehicles.*

(1) *Cleansing.*—The interiors of public vehicles should be cleansed at frequent and regular intervals. An early step in preventing the spread of dust during the cleansing of public vehicles—especially railway carriages—should be the abolition of the dry duster and sweeping brush. To flick about dust from one place to another, or to scatter it through the air, are, to say the least, futile measures, and may even be attended with great danger. The development of the domestic fashion of using a damp cloth, together with the use of disinfecting solutions for cleansing purposes, would do much to cleanse public vehicles from “stuffiness,” as well as from infective microbes.

The interiors of all public vehicles should be thoroughly scrubbed with soap and water, to which a liquid disinfectant has been added. This should be done every week. There are now some disinfectants

on the market, *e.g.*, Carbolacene, which are liquid disinfectant soaps, and which, when added to water, form this combination of a soap and a disinfectant, ready for use.

In cleansing the wooden portions of the interiors of public vehicles, especially the floors, the scrubbing should be vigorous, because sputum clings with great tenacity to wood, owing to the mucus which it contains. Care should be taken that the dust is scattered about as little as possible. If the cushions were covered with leather they could be wiped down with a damp cloth. The fact that tubercle bacilli cannot be spread through the air from a moist surface is a plea for the necessity of employing a *wet* process in cleansing public vehicles. And the fact that a vehicle previously cleansed in this way may again become infected is another plea for the necessity of *frequent* wet cleansing.

(2) *The Disinfecting* of the interiors of all public vehicles should also be done at stated intervals. In my opinion this should be done at least two or three times a year. This process would be facilitated greatly if the upholstery could be fixed to a movable frame as mentioned previously. These frames could then be detached and removed to a disinfector, and treated in the same way as infected bedding. If each of these frames were marked with a number corresponding with the number of the carriage to which it belonged, several could be disinfected at the

same time without danger of confusion. Whilst the vehicles were deprived of their upholstery, the whole of their interiors could be well scrubbed with soap, water, and liquid disinfectants. No doubt, in olden times, when our means of disinfection were limited to destructive and strong-smelling products, one could understand the difficulty of efficient disinfection, but now there ought to be no excuse, since we have disinfectants such as formaldehyde (which can be used as a spray), which can deal with these problems with ease. As carbolic acid and sulphur seriously damage the drapings and fittings of public vehicles, the use of Formalin as a disinfectant is recommended. Formalin is thoroughly efficient in action, and does not damage textures or polish. Railway companies as a rule object to use a lamp or light of any kind, being restrained by their insurance policies, hence the use of Formalin lamps is inadmissible. For the purpose of disinfecting vehicles without any risk of fire, a Formalin solution of the required strength should be used. The best method for the distribution of the solution is that recommended by Dr. Poyntz Wright in the April number of the *Therapist*, 1901. This apparatus, the "Shpreutz," consists of a reservoir, with nozzles for the spray, to which a force pump, with valve and piston, is attached, and which produces a very finely-divided cloud-like spray. After spraying, the carriage should be shut up over night to enable the gas to thoroughly sterilise the drapings; the dust

on the floor will by this means also receive a portion of the fluid, and will be effectually dealt with. The importance of this is evident when we read that it has been shown bacteriologically that if Formalin gas is diffused, and all the suspended specimens of micro-organisms have been inhibited, the dust on the floor or the room may nevertheless be unaffected. The "Shpreotz" is a well-made apparatus, light in weight, and can be worked easily by a labourer with ordinary care. I believe that the working of this instrument has been submitted to the Board of Trade, and that they have given their approval for its use in ships, instead of sulphur, &c.

The above method of disinfection might very well be adopted in all vehicles the upholstery of which is at present fixed. In order to obtain effective disinfection, the air of the vehicle should be saturated with moisture, and this is secured by using Formalin as a spray in the above manner. Also, the air of the vehicle can be quickly saturated with Formalin, of any strength desirable, by this means.

I would recommend that overcrowding should be prevented in all public vehicles, so as to avoid concentration of the air breathed by the passengers. Some tramway and omnibus companies adhere very strictly to this rule, and there is no reason why it should not be carried out with equal rigour in the case of railway carriages. Indeed, it has been decided at law more than once that no person has a right to

enter the compartment of a railway carriage already full. Efficient ventilation should be provided for in all public vehicles.

Also I would recommend that Government should take action by instituting a Parliamentary inquiry into the whole question, or that it may be investigated by the Royal Commission on Tuberculosis which was appointed in September last. This Committee of inquiry would then be able to prove the conclusions named, and to consider the practicability of the suggestions which have been made in this work. Extended bacteriological investigations into the infectivity of dust of public vehicles would be required.

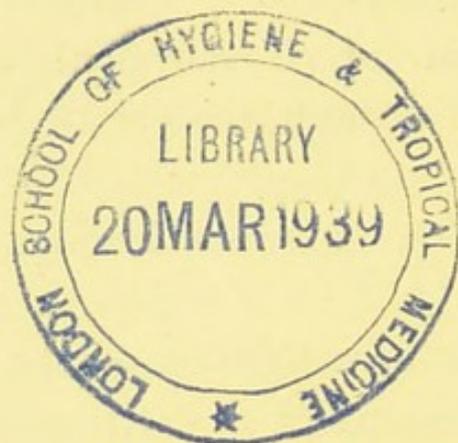
Finally, great benefit would result from the appointment of an Imperial Board of Public Health, with a Minister of Cabinet rank, to deal with these and kindred subjects.

Many persons may say that it would be extremely difficult to carry out these recommendations, but they may be answered by saying that greater difficulties than these have been surmounted in practical sanitation during recent years.

#### SUMMARY OF RECOMMENDATIONS.

- (1) Increased educational measures.
- (2) The fixing of cautionary notices against the dangers of spitting in every public vehicle.
- (3) The imposition of penalties for infringing this rule.

- (4) Improvements in the construction of the interiors of all public vehicles made in the future, respecting the cushions and flooring.
- (5) The disinfecting of the interiors of public vehicles frequently and regularly, and the thorough washing of each interior still more frequently.
- (6) Removal and disinfecting of the upholstery periodically.
- (7) The above processes to be carried out under the supervision of Government officials, and neglect or default thereof to be punishable by law.
- (8) The prevention of overcrowding in all public vehicles.
- (9) The thorough investigation of the whole question by means of a Parliamentary Inquiry Committee.
- (10) The appointment of an Imperial Board of Public Health.







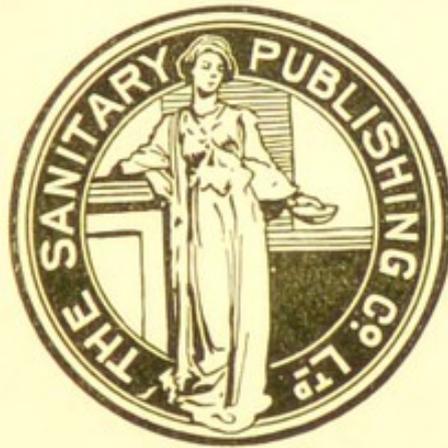
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