SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS,

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"The Living Earth."

Gentlemen,

I am very conscious of the great honour done to me by the Council of The Sanitary Institute, in asking me to preside over the important Section of Preventive Medicine at this Congress held in the chief health-resort of the United Kingdom.

When the Council asked me to preside, they were doubtless well aware that I held no official position as a guardian of the public health, and have never held such position; and that consequently I cannot lay before this Section any experiences in connection with sanitary administration, unless it be the experiences which we all have as citizens and ratepayers.

My only chance of interesting you seemed to lie in the choice of some subject capable of very wide application, the discussion of some scientific principle, which all sanitarians must study.

Sanitation in large cities is, at the best, a makeshift, and no high level of health is attainable, in a place where the chief object of hygienists seems to be to enable persons to live as densely packed as possible.

This prelude is necessary, because the remarks which I am about to make are addressed mainly to persons who live in the country, and who enjoy the luxury of elbow-room, and I trust that what I am about to say, will make them hesitate before they hastily copy the sanitary methods of the Town, and heed-

lessly begin to foster overcrowding, the bane of all sanitary and social virtue.

I say that my remarks are addressed to dwellers in the country, because I have taken for my subject the "Living Earth," a subject which those who live on paving stones, tarred blocks, asphalte, or macadam, have to take upon trust.

The "Living Earth"! Some of you may ask what I mean by this, and whether I intend to apply the epithet 'living' to the dark colored inert mould which the countryman sees in the fields and gardens, and the Town dweller finds in the flowerpot which holds his struggling geranium?

My reply is, "certainly." We have arrived of late years at a certain knowledge of the fact, that the mould which forms the upper stratum of the ground on which we live, is teeming with life, and as this fact seems to me to be one of prime importance to sanitarians, I propose to bring some points in connection therewith before you this morning.

It has long been recognised by agriculturists, that the upper stratum of the soil differs from that immediately below it in fertility; and in treatises on gardening (notably in that admirable work written by William Cobbett, nearly 70 years since) the warning is invariably given to be careful in trenching, not to bury the top spit of soil beneath the lower spit, because the top spit is by far the most fertile. The fertility in this case was supposed to be due to prolonged exposure to air, and the lower stratum of soil if brought to the surface, would only become fertile after a considerable interval. It is interesting to observe, that although these early writers were unacquainted with the whole truth, they had grasped the most important fact, and their practice was sound. This is often the case, and I feel sure that we act rashly when we hastily abandon the custom of centuries, because some new fact dazzles us, and distorts our vision.

In connection with William Cobbett, I will draw attention to a term which he uses, more than once in the work referred to, viz., the *Fermentation* of the soil. I have not found this expression employed by any other writer, but I have made no special search, and my knowledge of Agricultural Authors is limited. Cobbett tells us that the earth begins to ferment in the spring, and that before sowing, a thorough tilling and mixing of the upper strata of the soil is very necessary, with a view not only to the disintegration of the soil, but to a thorough leavening of the whole mass with fermentible matter. There is no doubt that this term "Fermentation" as applied to the soil is perfectly apt, as we shall find further on.

The black vegetable mould which lies upon the surface of the

earth, is largely composed of organic matter, which is not to be wondered at, seeing that every organised thing whether animal or vegetable which inhabits this globe, falls, when dead, upon the earth, and becomes incorporated with it.

This black vegetable mould is largely composed of excrement, for not only is the excrement of the larger animals being constantly added to it, but this and the varied organic debris which compose it, pass repeatedly, probably, through the bodies of animals which inhabit the earth, and especially of earthworms. Darwin in his book on Vegetable Mould and Earthworms, has forcibly drawn attention to the enormous amount of work which worms perform in the aggregate. How they disintegrate the soil. How they riddle it with burrows, which admit air to the deeper recesses of the soil. How their castings which are incessantly being thrown off, tend to level inequalities, and gradually to bury stones or whatever dead inorganic matter is incapable of solution, digestion, or disintegration. Earthworms are found almost everywhere, and they are probably the most important of the animals which live in the soil, but I need scarcely say that there are many others, and everyone who has a garden must recognise the fact, that gardening is only carried out at an enormous sacrifice of animal life, for with every thrust of the spade into rich garden mould, a death blow is dealt to many of its inhabitants.

The disintegration and aeration of the soil, which is effected by the quiet tillage of the earth-dwellers, is of the greatest importance to the agriculturist, for it is hardly conceivable that the delicate rootlets of plants could grow and extend, unless the soil had been softened and pounded by the digestive fluids and the gizzards of the earthworms and their neighbours.

Seeing, therefore, that agricultural mould has all passed through the bodies of worms, and much of it through the bodies of other animals antecedently, we shall not be wrong in insisting that this so-called vegetable mould is mainly an animal excrement. The peculiar, sticky, glutinous quality of rich mould when moistened, is probably in part due to this fact.

Although the amount of *Animal* life in the earth is considerable, it is as nothing compared with the richness of the soil in the lower forms of *Vegetable* life. The dead and excremental matter becomes the food of Saprophytic fungi, which abound in the soil to a very great extent. This must be the case, for we know that Saprophytes and their allies abound everywhere, and as the surface of the earth is the common reservoir of all forms of life, it follows that these low vegetable microbes must be more abundant in the earth than elsewhere, and more abundant at the surface than deeper down. In Watson Cheyne's editions

of Flügge's work on micro-organisms (New Sydenham Society, 1890), this is very clearly stated: "Enormous numbers of bacteria have always been found in the soil, by the most various observers. Infusions made from manured field and garden earth, even though diluted 100 times, still contain thousands of bacteria in every drop, and the ordinary soil of streets and courts, also shows the presence of large numbers. Bacilli are present in much the largest numbers; but in the most superficial layers, and in moist ground there are also numerous forms of micro-cocci."

These micro-organisms of the soil are very active in producing changes in organic matter added to the soil. These changes are usually in the direction of oxidation, occasionally the change is one of reduction. One thing is certain, that if the soil be sterilised by heat or other means, it is no longer capable of producing any chemical change in organic matter. This seems to me to be a fact of prime importance to the sanitarian. The oxidation and nitrification of organic matter in the soil is a biological question, pure and simple. It is an effect produced by the *living earth;* a process analogous to fermentation, which Cobbett seems to have appreciated.

Whether the nitrifying process which takes place in the soil, is due to one or to many varieties of microbe, is doubtful, but the latter supposition is probably correct, and experiments seem rather to point to the conclusion, that, given favorable conditions—the free admission of air to a soil which is not unduly moistened—nitrification will go on. Many attempts have been made to isolate a nitrifying organism, and one of the latest, by Professor Percy Frankland and Grace Frankland, the results of which were communicated to the Royal Society, in February 1890, appears to have been successful, for these observers isolated a "Bacillo-Coccus," the power of which in producing nitrification appears to be most remarkable. Whether this bacillo-coccus is one of many having similar power, or whether it stands alone is not known, but in any case we must regard it for the present as the "Nitrate King" among microbes.

It has been asserted that fungi of a higher class, mould fungi, are also active in producing the disintegration and oxidation of organic matter in the soil. It is possible, however, that the *Bacillus mycoïdes*, which forms threads closely resembling mycelium, has been mistaken for mould fungus. This bacillus mycoides is one of those which is constantly present, we are told, in garden soil.

It has been conclusively shown by Flügge, Koch, and others, that the microbes are most abundant in the superficial layers of the soil, and that they tend to disappear in the deeper layers.

They are practically absent in the deeper layers, unless the earth has been deeply stirred or trenched, or unless sewer or cesspool has conducted filth to the deeper layers without touching the superficial ones.

"Numerous filtration experiments on a large and small scale, have shown most distinctly that a layer of earth ½ to 1 metre in thickness, is an excellent filter for bacteria, and hence the purification of fluids from bacteria must be still more complete in cultivated, and especially in clay soil, and where the fluid moves with extreme slowness. Further, it has been repeatedly shown, that wells which are well protected against contamination with bacteria, from the surface and from the sides of the well, furnish a water almost entirely free from bacteria; that, further, wells of water containing bacteria become the purer the more water is pumped out, and the more ground water comes in from the deeper layers of the soil."

The vegetable living mould on the surface of the earth is in short a filter of the most perfect kind. It is very rich in saprophytic bacteria, whereas the subsoil at a depth varying from 3 to 6 feet is barren of bacteria, as well as of other kinds of life. The subsoil is mineral, inorganic, and dead; the mould upon the surface is organic, and teems with life.

Anything which is thrown upon the surface of the ground soon disappears.

This is especially the case with water. The absorbing power of soil for water, varies according to its mineral constitution. Loose sand and chalk absorb water very readily, and clay less readily, but the absorbing power of vegetable mould, or humus as it has been called, is infinitely greater. Humus is said to be able to absorb from 40 to 60 per cent. of water, and to hold it very tenaciously. This is from two to three times as much as the most porous dead mineral soil is capable of absorbing. We all know that in times of heavy rain, it is infinitely rarely that we see water lying in pools on the surface of cultivated soil, whereas it soon collects on roadways and paths, which are made of dead mineral matter. The tenacity with which mould retains water, is due to the fact that the water is absorbed into the interior of millions of vegetable cells, and is not merely held by capillary attraction in the interstices between small mineral particles. It is the swelling of individual cells which forms so effectual a barrier to the passage of bacteria.

Not only water, but everything else when thrown upon the soil, disappears sooner or later. Such things as pieces of wood, or leather, about the toughest of organic materials, become softened and permeated by fungoid growth, and finally crumble away. In some parts of the country, rags of all kinds are

largely used for manure. Through the autumn and winter these may be seen lying on the surface, but when in spring the tilling of the land goes forward, and the fermentation of the soil commences, the coarsest of these rags disappear. If wood, leather, and rags disappear, leaves and animal excrement disappear as we all know far more readily. The disintegration is forwarded by birds, insects, worms, and their allies, and what was the excrement of a large animal, becomes as it were, the excrement of many small ones, until finally by the action of saprophytic fungi, these organic matters become fertile "humus," which is the only *permanent* source of wealth in any country, the source whence we derive all the materials for our food and clothing.

The question whether among the bacteria which are found in the soil, some may not be hurtful to mankind, is a question of great interest and importance. If disease-causing organisms, find their way into the soil, may they not multiply or at least continue to live, and then prove a danger to health? There can be no doubt that pathogenic organisms do exist in the soil, but their power for harm would seem to be practically very small indeed; and to regard the soil as dangerous because some pathogenic organisms may lurk in it, would be about as rational as it would be to condemn vegetable food because of the occasional dangers of hemlock, aconite, or the deadly nightshade. It is well known that if soil be inoculated into some of the lower animals, such as guinea pigs, fatal results will follow from malignant œdema and tetanus; and it is also well known that earth, and especially street-mud, if ground into wounds in the human subject, may cause malignant œdema, and the death of the victim. It is equally well known that the workers of the soil, agricultural labourers and gardeners, are amongst the healthiest classes of the community, and that they are not credited with any diseases which are special to their calling. It seems to be a fact that the great doctrine of "*the survival of the fittest*" holds good for microbes in the soil, as for all other organised things everywhere; and that organisms which flourish in the human body, languish and cease to multiply in the soil, where the conditions are unsuited for their multiplication or even for their survival. They get overgrown by saprophytic microbes, and even if they do not die the risk of their finding their way into the ground water is practically nil, for we have seen that humus is the best of filters.

The life-history of at least one microbe, which undoubtedly flourishes in the human intestine, has been very carefully studied by many observers, and it may profitably occupy our attention for a time. This is the so-called spirillum of Asiatic cholera, the comma bacillus of Koch, of which we heard so much during the last epidemic of cholera in Europe. Whether or no this microbe be the cause of cholera, must yet be considered an open question. I bring the subject before you merely as the life-history of a microbe which undoubtedly flourishes in the human intestine, and has not been found except in association with a deadly disease. This microbe, which has been met with exclusively in the dejecta of cholera patients, is easily cultivated on gelatine or potatoes, in neutralised meat infusion, on blood serum, and in milk, its growth being unaccompanied by any disagreeable odour. Growth ceases when the infusions become very dilute, and in water growth only takes place at the margin where there is an accumulation of nutrient material. Growth is able to take place with a very limited supply of oxygen, and it is most active when the temperature is high—30° to 40° C. Koch has made the very interesting observation that comma bacilli die very rapidly when dried, a cultivation if spread out upon glass and exposed to the ordinary temperature is dead and incapable of further multiplication in a very few hours. Hence it is inferred that no living comma bacillus can exist in dust, and that the transport of *living* comma bacilli through the air is impossible.

Another factor very unfavourable to the growth of comma bacilli is the presence of saprophytes in large quantities; under these circumstances they are overpowered, and die out. "If the saprophytes are in excess in the first instance, or if the sum total of the conditions of life are not very favourable to the comma bacilli, the latter do not multiply at all, but the saprophytic bacteria lead rapidly to the death of the comma bacilli present either by using up the nutrient material or by producing poisonous products" (Flügge). If, however, the bacilli be kept moist in the absence of saprophytes, they may be kept alive for months. Low temperature (freezing) does not kill them but merely suspends their vitality; temperature over 60° C soon kills them.

If the bacilli find their way into pure running water, or wells of "pure" water, it is probable that multiplication never occurs. In the case of stagnant water, however, in the bilge water of ships, in the water in harbours, which is often extremely dirty, it is probable that the comma bacilli may retain their vitality for a much longer time; and in the case of a tank in India, "where the small amount of water was not only employed for bathing, drinking, and cooking, but also for washing the linen and for the reception of the contents of the water-closets, Koch was able to demonstrate such a large number of comma bacilli that it seemed likely they had multiplied to a great extent in the tank, and that their presence was in all probability the

source of infection of a number of cases of cholera which occurred at a later period among those persons who lived in the neighbourhood" (Flügge).

Supposing comma bacilli to exist in dejecta, what is the best way to stop their multiplication and accidental passage into drinking water? Clearly to dry them and place them with other saprophytes. If they be buried in the upper layer of vegetable mould the sun will dry them; or even if it be raining the living filter will stop their passage downwards. The growth of saprophytes will kill them; and if the ground be cultivated, the comma bacilli will be destroyed and nitrified, and pass upwards into the crop and not downwards into the wells. If, on the other hand, the dejecta be mixed with water and be taken in an impermeable pipe through the living humus of the surface, to the dead mineral subsoil where the sun does not reach to dry them, and where saprophytes to eat them up exist not, the danger of their finding their way through interstices and crevices into drinking water, appears to me to be very great indeed.

That the under strata of the soil are a very inefficient barrier against filth contamination has been demonstrated in all our large towns, and especially in London. In that city the lower rooms of the houses are almost universally below the level of the street, and the house drains leave the house at the lowest point to reach the sewer at a lower level still. As underground drains, however well laid, are sure to leak in time; their contents escape, and water continually escaping at one point is sure to work a channel for itself, and take its natural course to the nearest stream or well. Still more is this sure to happen if the house drain leads to a cesspool, a contrivance which necessity invented as soon as we had water under pressure, and began to use it as our only scavenger.

In London, a city renowned for its innumerable wells, we have had to close every one of them, and as the excessive dirtiness of the air makes rain-water not available for domestic purposes, we have become absolutely dependant upon the water companies, and it is only quite recently that the public has become alive to the fact that the causes which poisoned the surface wells, are equally poisoning the Thames and the Lea, and the other sources of London water. No thinking being can feel easy about the London water supply, and it is to be hoped that some day the public mind will be roused to an appreciation of the fact that if we want pure water we must make some serious attempt not to foul our wells and streams.

I am convinced that in our sanitary arrangements we have not sufficiently distinguished between the living mould of the

surface, and the dead earth of the subsoil. The living mould is our only efficient scavenger, which thrives and grows fat upon every kind of organic refuse; our only efficient filter, a filter which swells and offers an impassable barrier to infective particles, a filter which affords a sure protection to our surface wells. When we perforate the living humus with a pipe and take our dirty water to the subsoil, we, as it were, prick a hole in our filter, and every chemist knows what that means.

In order to keep the soil healthy, to keep up its appetite for dirt and its power of digestion the only thing necessary is tillage. Well-cultivated soil, which is compelled to produce good crops, has never yet been convicted of causing any danger to health.*

Sanitation is purely an agricultural question, and in the country, where every cottage has, or should have, its patch of garden, there ought to be no difficulty in the daily removal of refuse from the house, and in applying it to agricultural purposes, without any risk of contaminating the water supply. Given the patch of garden, the only thing necessary to bring about this, the only complete form of sanitation, is the will to do it—the will, that is, to do a profit to one's self, without the possibility of damaging one's neighbour. This, unfortunately, is rarely forthcoming, in spite of the Christian Religion and the

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* As to the power of earth upon organic fluids I have recently been making, with the able assistance of Mr. Wells, a few simple experiments, which seem to me to be very striking, and worth recording, as showing the effect produced upon urine by slow filtration through earth. Small quantities of urine (averaging half a pint) were added day by day to earth contained in a conical metal vessel, resembling in size and shape the ordinary "jelly bag" which is used in domestic kitchens, and having a perforation at the apex. The experiment was commenced on June 26th, and on July 10th, when 119 ozs. of urine had been added and the earth had become saturated, our filter began to yield us a filtrate, which differed in a very marked degree from the urine put into the filter. The results obtained may be summarized as follows:—A total of 200 ozs. of urine was added to the filter, and the total filtrate amounted to 73 ozs. Thus, 127 ozs. either remained in the filter, or was lost by evaporation; and as the experiment was conducted indoors in July, and lasted from June 26th to July 22nd, or exactly 26 days, the loss by evaporation must have been considerable. The average specific gravity of the urine used was 1021·4, whereas the specific gravity of the filtrate was always 1011, except upon one occasion, when it was 1012.

The total solids of the urine averaged 4·44 %, of which 3·45 was organic and ·99 inorganic; while the total solids of the filtrate averaged 1·78 %, of which 1·069 was organic and ·710 inorganic.

The urea in the urine averaged 2·32 %, and in the filtrate ·35 %. The chlorides in the urine averaged ·666 %, and in the filtrate ·409 %, The surface of the filter smelt from the first strongly ammoniacal, but the filtrate, although of a deep colour, was free from odour, and could be evaporated to dryness without offensive smell. The filtrate had no tendency to putrefy, nor did a drop of it, when added to sterilized urine in a tube, set up putrefaction.

Education Act, and we go on, even in country places, polluting our streams and wells, with our minds agitated, as well they may be, as to when our water will become too poisonous to drink, and where we shall turn for a pure supply in the future.

Sanitation is a purely agricultural and biological question. It is not an engineering question, and it is not a chemical question, and the more of engineering and chemistry we apply to sanitation, the more difficult is the purifying agriculture. This, at least, has been the practical result in this country.

The only engineering implements which the cottager with a bit of garden requires for his sanitation, are a watering pot and a spade, and if his garden be an allotment away from the cottage, a wheelbarrow may become necessary. The cottager, to whom the produce of his bit of land is a matter of consequence, will endeavour to fertilize as much land as possible with the organic refuse at his disposal, and as long as this endeavour is made, there need be no fear of failure, either from the agricultural or sanitary point of view. When however an engineer by means of water under pressure, has collected the organic refuse of a province at one spot, has diluted it a thousand-fold, and endeavours to submit it to a mock purification, by means of the least amount of land possible, failure is inevitable, both in the agricultural and sanitary sense. It was in 1848 that the advice to "drain" was tendered with a light heart, by the pioneers of modern sanitation, who thought it would be an easy thing to purify the sewage, and make a profit from it. The Thames, the Liffey, the Clyde, the Mersey, and the Irwell, are a standing testimony to the failure of these great engineering schemes, and I would remind you, that the last engineering scheme put forward with regard to the sewage of London, viz., to convey it all to the Essex coast and cast it into the sea, is not only a most lame and impotent conclusion, quite unanticipated by the pioneers of '48, but it is an experiment which, like our previous experiments, may be productive of unforeseen results.

The engineer of the present day when dealing with sewage, appears to think that one may "as well be hung for a sheep as a lamb," and he is ever ready to tender the advice that "if you are going to make a mess, it is well to make a big one." It is quite characteristic that this last scheme for dealing with the London sewage, contemplates dealing not only with the material which is collected by our present system of sewers, but proposes to take that of other and adjacent systems as well.

The people of Berlin have in this respect, shown themselves wiser I think than the people of London, because they have taken their sewage to several points, instead of collecting it all at one spot.

So far it is probable that the bulk of those I am addressing will agree with me, but I am not so certain that I shall command your assent to all that is to follow.

The panacea for all sanitary ills has been and still is "drainage," and the only scavenger that is in favour is water, notwithstanding the fact that sanitation by water has for its main characteristic "incompleteness." The work is begun and never finished. Our houses are flushed, but we pay for it by fouling every natural source of pure water, whether river or surface well. If there come an outbreak of typhoid, we, as often as not, find the "drains" are to blame, but as a matter of fact we prescribe "more drains" as the remedy.

I have asked my friend, and former pupil, Mr. F. W. Wells, M.B., to go through the official reports which have emanated from Whitehall since 1856, and make an abstract of the chief outbreaks of typhoid fever in this country, which have been reported by the medical officers of the Privy Council, and the Local Government Board. This Mr. Wells has done in a most painstaking and methodical manner, and the tables which he has constructed form an Appendix to this paper which is well worthy of perusal. If you will scan this appendix, you will find that there is one factor common to all these outbreaks, viz., the mixing of excremental matters with water. This mixture generally leaks to the well or rivulet, or water-pipe which supplies the drinking water, which water has not unfrequently been sold under the name of milk, and the result is an outbreak of typhoid. Or the mixture putrefies in a cesspool or sewer, and the gases finding an entrance to our houses cause an outbreak of typhoid. There is no doubt whatever that whenever excrement is mixed with water, we are in danger of typhoid. Typhoid was not recognised in this country until the water-closet became common. We, doubtless, manufactured typhoid in a retail fashion in old days, but with the invention of the water-closet we unconsciously embarked in a wholesale business.

We had not been at this work many years before we recognised that the water-closet poisoned all sources of water. We have had to go far a-field for drinking water, and the result has been that, as we left off consuming the springs which we have wilfully poisoned, the amount of typhoid has somewhat abated. When the more remote sources of water get poisoned in their turn—as with our increasing population, and our methods of sanitation, they inevitably must—the present comparative abatement must, one would fear, cease.

The foregoing observations apply, be it observed, to cholera equally with typhoid.

It is comparatively recently that we have learnt to recognise

the dangers which result from the putrefaction of a mixture of excrement and water in a sewer or cesspool. The ingenuity of sanitary engineers has been exercised to save us from these dangers, and they have given us what they are pleased to call self-cleansing sewers, innumerable forms of trap, endless methods of ventilation, and disconnection on scientific lines, until the medical officer of health is expected to have at his fingers' ends all the knowledge of a patent agent and a plumber's foreman. If apparatus never wore out, if ventilators never got stopped up, if traps never got unsealed by leakage, evaporation, or other cause, one might feel secure against the enemy which is ever at our gates, provided the study of Bacteriology did not lead us to recognise that a few feet of filthy pipe may be as dangerous as a mile, and that a trap may possibly serve, especially in hot weather and when the family is away, as a most efficient cultivating chamber.

It is commonly urged by those who defend our present methods of sanitation that, as we must of necessity provide some channel for the escape of slops from our houses, it is false economy not to make these channels carry everything, or, in other words, that, as sewers are a necessity, there is no harm in making them a bigger nuisance than they necessarily must be. I confess I am unable to follow this argument, and I would submit some reasons why every effort should be made to keep excremental matters out of the sewers.

1. Excrement is the only ingredient of sewage against which dangerous infective properties have been proved again and again. It is the ingredient which, when mixed with water, finds its way to our drinking water and causes typhoid and cholera. Sewage without excremental matters is, doubtless, offensive and is probably unwholesome in many ways, but it stands in the position of a "suspect," rather than that of an habitual criminal against whom no end of previous convictions have been proved.

2. If excremental matters were stopped out of our house drains, we could in country places, often have recourse to the old practice of allowing our household slops to run in open gutters, concerning the ventilation of which there could be no doubt, and the gutters might be subjected to the wholesome discipline of a broom, and the purifying influences of sunlight and drying winds.

3. If excremental matters be stopped out of the house drains, the total volume of sewage to be dealt with would be diminished by at least one-fifth, and this surely is a great gain. We should deprive the sewage of just those ingredients which are most troublesome to the sewage farmer by clogging the pores of the ground, and we should leave the sewage very "thin" and

admirably suited for downward filtration. It seems to be an acknowledged fact that for the application of sewage to the land, the more watery it is and the more completely solid matters are strained out of it, the simpler and more satisfactory the processes become.

4. Another class of objections which has been made to the exclusion of solid excrement from house drains, has reference to the so-called "manurial value" of sewage and its constituents—that excreta without the total urine are of low manurial value, and that the stopping of excreta out of the sewers lowers the manurial value of the sewage. "Manurial value," is a term used by chemists to express the amount of nitrogen that may be present. Now I do not doubt the ability of chemists to make a quantitative estimation of nitrogen, nor their power of informing farmers of the extent to which they may or may not have been cheated when they purchase artificial manures. I would humbly suggest, however, that the real practical manurial value depends, not only upon the amount of plant-food present, but also upon whether the plant-food is present in a form in which it can be digested and exhaustively utilized by the plant. For the latter information, which is of the highest importance, I would sooner apply to a practical farmer or gardener than to a chemist.

A chemist, for instance, who had regard to his analyses and nothing else, might tell us that nut-shells had a certain dietetic value; but ordinary men and monkeys know better than that.

He might tell us that gin was richer in certain dietetic ingredients than ginger beer, but we know that ginger beer is the better article of diet.

Again guano has a far higher manurial value than "rich garden mould"—such as is got by mixing earth with organic refuse—; but if we do not dilute our guano to the same level, so to say, as our rich garden mould, we may kill our plants. To declare that rich garden mould is of low manurial value is absurd, because we know that in it plants of all kinds reach the highest development which is attainable. Farmers and market gardeners will tell you that artificial manures have "got no bottom in them," that their use is, so to say, a speculation; and if climatic conditions are unfavourable when the artificials are applied, the money spent on them is lost for ever. With organic refuse, however, the case is entirely different, and the effect of the application of organic matter, especially of human origin, to the soil, is plainly discernible for three or four years. Solid organic matter cannot be washed away, it nitrifies slowly and doles out the nitrates to the roots of the plants in proportion as they are needed.

I wish to say, emphatically, that the manurial value of human excrement is enormous, and that it produces all kinds of fruits, flowers, and vegetables in the highest perfection. I speak from a practical experience of nine years, and my belief is that soil cannot be made more fertile than by mixing it with solid excremental matter.

It is quite true, no doubt, that the manurial value of urine is very great, but being fluid it is not so easily retained at the spot where the agriculturist wants it; and we know that when fresh and undiluted it is very dangerous to herbage. The fact is that plants absorb their nutriment from very dilute solutions; and it has been found that a fluid containing about ·2 per cent. of solids, is the *optimum* for plant culture. Ordinary urine, therefore, which contains 4 per cent. is twenty times too strong; but if it be applied to the soil in its state of optimum dilution, much of the liquid will necessarily soak out of the reach of the roots.

Manurial value is a practical matter rather than a chemical problem, and I have no doubt whatever that those who assert the manurial value of earth-closet manure to be low, are making a very serious practical mistake; and I have no doubt that arguments based on the theoretical manurial value of sewage as a whole or of its several ingredients, are worthless in helping us to decide whether it is advisable or otherwise to keep solid matters out of the drains.

What use is there in discussing the "manurial value" of sewage in the face of the deliberate declaration of that eminent agriculturist, Mr. Clare Sewell Read, made a few months since in the "Journal of the Royal Agricultural Society?" "Sewage," says Mr. Read, "has come to be regarded by all sensible people simply as a nuisance to be got rid of." And he goes on to state that, owing to the unmanageable quantities of water which have to be dealt with, sewage is ruinous to all grain crops and all other farm crops except rye grass.

The composition of sewage as it flows from towns is so doubtful, and must be so variable that no sensible man would let it run over his farm. Chemicals and antiseptics are very abundant at the present day, and they are very largely used to lessen the dangers which are inherent in our present system of sanitation. Antiseptics, however, which stop the growth of putrefactive microbes, also check the growth of nitrifying organisms, and are deadly poison to plants. All town sewage is liable to contain dangerous chemicals which must render the "manurial value" a very minus quantity, the presence of nitrogen notwithstanding.

As it is idle to discuss the theoretical manurial value of a

practical nuisance, which no sane farmer would take as a gift, it is imperative for us to discover means, if possible, by which those ingredients of sewage which have great enriching power for the soil may be saved for the benefit of the cultivator and consumer.

From every point of view — scientific, sanitary, moral, economic—I feel strongly that dwellers in the country should take warning by the towns. They should revert to the cleanly and decent habits of our forefathers, and keep the sanitary offices away from the main structure of the house, and not, as is the filthy custom of the present day, bring them almost into the bedrooms. They should keep solid matters out of the house drains, and see that they are decently buried in the living earth every day, and they should replace the drains by gutters and filter all the household slops by applying them to the *top* of a different piece of cultivated ground every day. Whether an ordinary watering pot, or a tank upon wheels drawn by a horse be necessary for accomplishing this latter object, will depend upon the size of the establishment; but only those who have systematically pursued this plan, as I have done, can know the vigour which is imparted to hedge-rows, shrubberies, fruit trees, or forest trees, by a tolerably frequent dose of household slops. There is no difficulty in doing this, provided the will be present —the will that is to combine your duty towards your neighbour with an act which is profitable to yourself.

Finally, you dwellers in the country, whether Squires who are the owners of broad acres, or Occupants of modest villas with a garden, or still more, if you be Cottagers with an allotment, where it ought to be, round your cottage, what I have to say to you is this:—

1. That sewage, being a nuisance although a necessity, it is to your interest not unnecessarily to increase its quantity or its offensiveness.

2. Keep solid matters out of the drains, for by doing this you will prevent the putrefaction of the solid, and you will find the purification of a liquid by filtration through the earth is effected with ease, which is proportionate to the thinness of the fluid.

3. Remove all solid matter every day from the immediate neighbourhood of the house, and bury it in the top layer of cultivated ground. Pour the household slops on to the surface of the garden, and do not make the mistake of attempting what is known as subsoil irrigation. If these directions be followed I feel sure that by no possibility can you be troubled by sewer gas, and I also believe that you may drink the water from your surface wells with safety.

I am, as some of you know, no mere theorist, I practice what

I preach, and have now some nine years' experience, experience which has served to strengthen my opinions and enables me, unreservedly to exhort others to pursue a similar course with myself.

In Hampshire I have a garden, and adjoining it are twenty cottages which I also own, inhabited by about a hundred persons. These cottages are scavenged *every day*, and the scavengings are buried in the garden. The scavenger's first duty is to the cottages, to remove filth and bury it, to whitewash, paint, and to keep decent. His second duty is to the garden, where he acts as under gardener. In the garden, which has an extent of about 1¼ acres, I am obliged in self defence (what a hardship!) to raise the biggest crops possible. This garden not only supplies my London house with a variety of fruit, flowers, and vegetables (cabbage, potatoes, carrots, turnips, parsnips, beet, salsify, lettuces, artichokes of both kinds, peas, beans, asparagus, seakale, peaches, plums, apples, pears, figs, strawberries, currants, raspberries, &c.), which I doubt if I could purchase for £50 a year of the neighbouring greengrocer, but the overplus, which is marketable, just about pays the wages of the scavenger and under gardener. I cannot help thinking that the combination of market gardening with cottage owning in country places, opens up the possibility of an industry which is at once profitable and advantageous to all concerned, and affords a good chance of solving a sanitary difficulty.

I am addressing myself to dwellers in the country, but I should like to say to town dwellers that complete sanitation is impossible, unless cultivated land be brought into tolerably close relationship with the dwelling. At present our sanitary arrangements are magnificently begun, and seldom completed, and while we almost uniformly leave a most dangerous loose end to our sanitary measures, we shut our eyes to it, and blow the trumpet of self-satisfaction as if the sanitary millenium had begun. The Allotment Act as affording an outlet for organic refuse, ought not to be without its effect upon sanitation, and it is to be hoped that the masses will some day wake up to the great importance, from the moral and sanitary standpoint of providing every dwelling with an adequate outlet. As things go at present, I have very little doubt that the agricultural labourer with his cottage and garden and 12 shillings a week, is infinitely better off than the town artizan on 25/-, who pays dearly for pigging it in overcrowded rooms, in which a cleanly and decent existence is impossible.

I have been reading the last volume of our transactions, and in it I find a very interesting paper by Dr. Sykes, who quotes Dr. Corfield, who, in his turn, is quoting Sir Henry Acland to

the effect, that the disappearance of the great cities of antiquity was due to pestilence, rather than war. We must all admit the possibility of such an assumption, and certainly no one can ponder upon the disappearance of Egyptian, Babylonian, Assyrian, Greek, and Roman civilization, without speculating upon the cause, and without applying the lesson to ourselves, and asking ourselves how much longer is our British civilization to continue?

Nationalities seem as mortal as the individuals which compose them.

If great nations are destroyed by neglect of sanitary laws, and if prolonged national life is indicative of sound sanitary measures there is at least one race upon the globe which is worthy of profound study by all who concern themselves with public health. This race is the Chinese, who have seen all the great nations of antiquity in and out, who were probably a great people in the days of Moses and before, and whose thrifty myriads are even now successfully contending with the Anglo-Saxon race, in America and Australasia. The Chinese, as is well known, have had to contend with national calamities of a most stupendous kind. In our own days we hear of floods and famines which claim their millions of victims, and yet the race continues to increase in such a way, and to overflow its natural boundaries to such an extent that it is certain, even without the exact returns of a Registrar-General, that the birth-rate must very considerably exceed the death-rate, and must have done so in an average way during the three or four thousand years that the Chinese nation has existed.

I think there is no doubt that unless we mend our ways, the Chinese will see us out, as they have seen the other great nations of the world out, and the reason, I believe, is obvious. The Chinese are the most thrifty nation in the world. In China nothing is wasted, and all organic refuse is ultimately returned to the soil. Agriculture is in China a sacred duty, and the Chinese have got a firm grasp of the elementary principle that if the fertility of the earth is to be maintained, we must constantly replenish it. The nineteenth volume of the Health Exhibition literature contains a most interesting series of papers on China, by Surgeon-General Gordon, Mr. Hippisley, and Dr. Dudgeon, of Pekin. The papers by Dr. Dudgeon are especially worthy of study, for many years of residence among the Chinese have impressed him with the fact that we have much to learn from them. I have not the pleasure of Dr. Dudgeon's acquaintance, but, were he here, I am sure he would give a general support to the propositions I have laid before you.

The question of our duty to the soil is fundamental in sanitary matters. If we starve the soil and turn our fertilizing materials into the sea, we may rid ourselves (though this is doubtful) of filth diseases for a time; but it is by no means doubtful that we shall ultimately replace filth diseases by those diseases that are bred of starvation. How soon this will happen no one can say, but that it will happen eventually seems to me as certain as is the axiom, "ex nihilo nihil fit." Do not let us commit the great blunder when dealing with this national question, of forgetting that the life of a nation ought to be measured by centuries; do not let us make a suicidal use of a paltry 50 years statistics, and because the figures of the last decennium happen to be favourable, conclude therefrom that all our sanitary principles are right.

Perhaps someone will say, "How ridiculous to hold up the Chinese as an example! The Chinese masses are acknowledged to be exceptionally filthy in their customs and habits." This, perhaps, is true, but I am sure that this audience will not make the error of confounding principles with details. The Chinese principle of returning all organic refuse to the soil is, there can be no doubt, absolutely sound. The Chinese details may be filthy and susceptible of improvement. In this country the details of our domestic sanitation are refined, elegant, and ingenious. It is the principle subserved by these details which is absolutely rotten. The main problem of sanitation is to cleanse the dwelling *day by day*, without fostering starvation. This can only be done by returning all organic refuse to the soil, and the perfecting of the details by which this duty is to be done is the most important work of the modern sanitarian.

This question is a national one and concerns us all. Every country squire ought, in these matters, to set a good example to his tenants. If he does not set the example of increasing the fertility of the soil by the daily addition to it of all the organic refuse of his country mansion, he cannot command our sympathy when he goes without his full rent. If a landowner embarks on a great building scheme, he ought to keep the sanitation in his own hands. If a well-known landowner had done this—if he had preserved his autonomy on his own estate, and if he had, by a rational use of the railway, transferred the daily scavengings of his valuable City estate to his broad acres in Bedfordshire, perhaps his right-of-way on his London estate would not have been confiscated, and perhaps he would not have been obliged to remit 25 per cent. of his Bedfordshire rental. As it is, he allowed the vestry to do his sanitation for him, and by so doing lost his autonomy. Who can see how far the process of confiscation which has set in will ultimately reach?

This question has an immediate personal interest for all who derive their income from the soil. I feel sure that the clergy would do well to enforce by example as well as by precept the old injunction, to "replenish the earth and subdue it." If they do not they must expect to go without their tithes. Improvement in this direction is only to be attained by rousing the public conscience. So soon as the majority of individuals is impressed with the fact that it is wicked to foul our streams and starve the soil, and that our individual responsibility does not end, even though the fouling and starving be done by a "Board," so much the better will it be for the public health and national wealth. Parliament has compelled us to hand over our responsibilities to public authorities, with the consequence that the individual has lost his liberty and independence, and is drifting into a condition of sanitary imbecility. Let us not forget that the present state of our rivers is the direct result of Acts of Parliament. Let us not forget that Parliament, which wasted its time and our money in passing that most inoperative of all Acts, the "Rivers' Pollution Act," scavenges its own palace direct into the Thames; as though Imperial Parliament could hand over its responsibilities to a Local Board! It is hardly credible that such a condition of things could exist outside the libretto of a comic opera.

A respect for the purity of water should be enforced in our board schools and churches; and that powerful party in the State—I mean the temperance party—would do well to devote some of its energies towards ensuring that the beverage which it champions should be in all places a safe one to drink. As it is one has only to walk about the country to see that our streams and rivulets are universally regarded as receptacles for rubbish and impurities of every kind.

This question I must reiterate, in conclusion, is a national one of the first importance. A nation that fouls its streams and starves its soil is in danger of poisoning and inanition. A nation which imports a great part of its food and a great part of its manure, and systematically and by Act of Parliament throws all its organic refuse into the sea, is undoubtedly living on its capital. Our capital just now is undoubtedly considerable, but we are in a fair way to run through it; and when we have done so who can forcast the future.

EPIDEMICS OF TYPHOID.

* *Tabulated from the Reports of the Medical Officer of the Privy Council and Local Government Board.*

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1858	Windsor.	400	26.	Mr. Austin.	Slovenliness as to removal of filth; offensive pig-sties; unregulated slaughter-houses; unremoved refuse; obstructed surface drainage. Three-fifths of the houses supplied from surface wells, sometimes in proximity to undrained premises, or imperfect drains. Sewerage without adequate exterior ventilation, and so ventilating itself into houses. On account of the summer drought, the sewer atmosphere at maximum of poisonousness.
1859	Kirkby-Stephen.	½ of the 1,500 inhabitants.	11. (Typhoid or Typhus?)	Dr. Ord.	Bad drainage. Sewage draining into drinking-wells. Accumulation of excrement in proximity to houses.
1859-60	Bedford. (Autumnal epidemic for some years.)		30 per annum from fever & diarrhœal diseas's	Mr. Austin and Dr. Whitley.	Water contaminated with decaying animal matter. Cesspools universal—upwards of 3,000 of them. Water-supply from wells frequently in close proximity with cesspools. Water both in cesspools and wells rises and falls with river.
1860	Bath. (Bathwick.)	35 houses.		Dr. Whitley.	No sewerage. Cesspools general. Defective house drains leaking beneath houses. Fæcal putrefaction in air and drinking water.
1859-60	Kingston-Deverill. (Wilts.)	66 (out of population 400).	6.	Dr. Whitley.	First contagium imported. Badly-ventilated houses. Not attributed to sewage-tainted water or sewage-tainted breathing air; probably to want of precaution in dealing with evacuations.

* This Table has been kindly prepared for the Author by Mr. F. B. Wells, M.B.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1859-60	Dronfield.	556 (out of 2,500 inhabitants).	41.	Dr. Ord.	Sanitary neglect. Accumulation of animal filth in privies, cesspools, pig-sties, slaughter-houses, and drains. Drainings soaking through house walls. Refuse draining itself to dammed-up brook in valley; two much-frequented wells habitually in danger of pollution from this brook.
1861	Calstock. (Gunnislake.) (See also 1871, p. 57.)	213.	12.	Dr. Bristowe.	Accumulation of excrement, slops, and decaying animal and vegetable matter. Deficient privy accommodation. No efficient house drains or sinks. An unusual number of filthily-kept pigs and of putrid and overflowing refuse pits and heaps.
1861	Over-Darwen. (See also 1874, p. 62.)	1,000.	35 (some of these registered as "Typhus").	Dr. Greenhow.	No system of drainage, or of scavenging. Night soil, ashes, and general refuse allowed to accumulate for months and years. Overcrowding. Water and liquid refuse making for themselves channels in the unpaved streets.
1861	King's Langley.	16.	2.	Dr. Ord.	Drains opening near cesspools pass between or beneath houses; in hot weather offensive stinks proceed from these drains. Drinking-wells in danger of contamination from cesspools. Filth and excrement allowed to accumulate from deficient scavenging.
1861	Yeadon.	130.	11.	Dr. Ord.	Deficient privies and deficient scavenging. Drains communicating with dam whence water is pumped to mills, and there boiled for trade uses. Open gutters, into which slops are thrown. One drinking-well liable to sewage fouling.
1863	Whitehaven.	1,000.	110 (including 17 registered in St. Bees).	Dr. Bristowe.	Overcrowding. Bad ventilation of houses. Bad privy accommodation. Bad scavenage. Practically no drainage. Absolutely none for water-closets. Gutters running down courts carry off surface water, and whatever else may happen to escape from middens, piggeries, &c., or be thrown therein.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1863	Festiniog.	600-700.	67.	Dr. Buchanan.	Great majority of houses without privies or ash-pits. Fields and house utensils are used—the latter being emptied near the houses. Streams in valley polluted by rain water washing down excrement from houses. This water-supply only used for domestic and not drinking purposes. Drinking water from mountains free from pollution. Great overcrowding. Cold and wet attributed as causes. Such privies as exist are generally offensive.
1863-4	Grantham. (Including Spittlegate.)	Not ascertained.	22.	Dr. Bristowe.	Impure water. The drinking water (spring water) became mixed with the river water. This latter receives part of the drainage of a village. In most cases the effluvia from accumulated human excrement are blamed, from untrapped drains, imperfect sewers, and bad system of privies.
1865-6	Buglawton.	150.	14.	Dr. Buchanan.	Only superficial sewers, receiving rainfall, house slops, and in some cases midden excrement. Foul smells from untrapped sewers. Middens in common use, but scavenage very bad. The river dam receives the sewage of many houses, and from this river near where sewage enters, water for domestic use is obtained. Drinking water from well liable to contamination from privies adjacent. Water analysis proves the contamination. "Facts point to specific contamination of the well water by typhoid poison, derived from the first patient in the house adjacent to the well."
1864-5-6	Tottenham. (Page Green.)	100.	2 or 3.	Dr. Seaton.	Where fever occurred, the drinking water was wholly or in part from surface wells. Some of these wells liable to surface and sewage contamination. Water analysis showed organic impurity.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1865-6	Winterton.	100 (ex. 145 inhabitants).	17	Dr. Thorne.	Disgraceful state of privies, cesspools, ashpits, and wells. Contents of privies running into gardens, often penetrating into the wells. Refuse, slops, urine thrown into yards, or deposited in open cesspools. Urine and bowel discharges of typhoid patients thrown into open ash-pits. These sources of fæcal fermentation situated close to the houses, and in immediate vicinity of wells. Untrapped drains communicating with main sewer evolving stinking effluvia. Within a circuit of 14 feet round a drinking well are an open drain, an open ash-pit, two pigsties, three privies, and one open cesspool, all (except the drain) raised from 1½ to 3 feet above the well, and situated on a loose porous soil.
1867	.....	55	6		
		155	23		
1867	Guildford.	500.	21.	Dr. Buchanan.	Sewer receiving mainly surface water, receives also excreta from certain water-closets, and the overflow of certain cesspools; some privies also discharge their liquid excreta into this sewer. Sewer runs within 10 feet of well, and by percolation and by a fissure in the chalk, excrementitious matter leaked from the sewer to the well.
1867	Terling.	300 (ex. 900 inhabitants).	41.	Dr. Thorne.	Slops, ashes, manure-heaps, broken-down privies and cesspools surround the cottages; drinking water is obtained from wells at a lower level, and separated by loose porous soil from the above nuisances. The remaining drinking water is got from ponds into which drainage from the fields and roads run, or from river water contaminated by sewage. Overcrowding everywhere.
1869	Wicken-Bonant.	45.	4.	Dr. Buchanan.	Privy of first house affected with typhoid stands on edge of water channel; the undisinfected stools were thrown into the privy; thus the excrement got from privy to brook, and the brook communicated with the parish well. The method of infection in the first patient is uncertain, but was caused in some manner by typhoid fever previously imported from London.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1870	Annesley. (Notts.)			Dr. Buchanan.	Arrangements for excrement disposal and water supply such that people must drink their own excrement.
1870	Appledore and Northam. (Devon.)			Dr. Thorne.	Streets and courts ill-constructed and ill-drained, with excrement and refuse lying about everywhere. Water sources befouled. "Epidemics of enteric and scarlet fevers."
1870	Coventry. (Neighbourhood of.)			Dr. Thorne.	"Enteric fever seriously prevalent." Ascribed to use of polluted water, want of efficient sewerage, and various accumulations of filth.
1870	Croyde. (Devon.)			Dr. Home.	"Serious prevalence of enteric fever." No public sewerage or house drainage. Excrement and refuse accumulations. Pigsties and dung-heap nuisances, sometimes polluting the water.
1870	Penryn. (Cornwall.)			Dr. Thorne.	"Considerable outbreak of enteric fever." Streets lined with excrement and refuse. Want of sewers, privies and ash-pits. Water sources polluted.
1870	Rolvenden. (Kent.)			Dr. Thorne.	"Enteric fever epidemic." Water supply polluted. Want of drainage and proper means of excrement disposal. Abundant nuisances.
1870	Spinkhill. (Derbyshire.)			Dr. Thorne.	"Habitual prevalence and present outbreak of enteric fever." Water of public and other wells polluted. Drains defective. Want of privies and ashpits. Filth accumulations.
1870	Ystrad-y-fodwg (Glamorgan.)			Mr. Radcliffe.	"Great prevalence of enteric fever." Neglect of all sanitary precautions. No due provision for excrement or refuse disposal. Water supply insufficient and liable to pollution.
1871	Brackley. (Northampton.)			Dr. Buchanan.	"Epidemic of typhoid." Accumulation of excrement. Wells near cesspools.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1871	Bulwell. (Notts.)			Dr. Harries.	"Epidemic of typhoid." Pollution of water by excrement nuisances. Privies filthy and insufficient.
1871	Burbage. (Leicestersh.)			Dr. Harries.	Epidemic of typhoid fever, connected with use of water from a well communicating with a privy probably infected by an imported case of typhoid. Bad excrement management, and improper water supply generally.
1871	Calstock. (Cornwall.)			Dr. Blaxall.	Frequency of typhoid epidemics. Continuance of unwholesome conditions previously reported. (*Vide* 1861.)
1871	Carlton. (Notts).			Dr. Harries.	"Enteric fever epidemic." No proper water-supply. Privies few and bad. Nuisances abounding.
1871	Helions-Bumpstead. (Essex.)			Dr. Airy.	"Epidemic enteric fever." Great accumulations of excrement and filth. Foul ditches. Much of water-supply polluted.
1871	Higham-Ferrers. (Northampton.)			Dr. Home.	"Habitual prevalence of enteric fever." Ground sodden with leakage from privy pits and cesspools. Water polluted. Insufficient ventilation of sewers. Accumulations of excrement and house filth. Trade nuisances.
1871	Hugglescote. Donnington. Coalville. *Packington. (Leicestersh.)			Dr. Home.	"Enteric fever severely epidemic." Air and water polluted by excrement. No proper drainage. Nuisances from privies and pig-sties.
1871	Ilminster. (Somersetsh.)			Dr. Blaxall.	"Considerable epidemic of enteric fever." Foul open sewers. Excremental filth everywhere, saturating ground and contaminating most of drinking water.
1871	*Packington. (Leicestersh.) (& Derbyshire.)			Dr. Home.	"Severe epidemic of enteric fever." Water-supply polluted. Serious accumulations of excrement and other filth.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1871	Sunderland.			Mr. Radcliffe.	"Epidemics of typhus, typhoid, and small pox." Overcrowding. Defective drainage. Improperly regulated water-closets. Excremental nuisances. Defective water supply.
1872	Ashton-in-Makerfield. (Lancaster.)			Mr. Radcliffe.	"Epidemic of typhoid fever." Insufficient water supply, and partly from questionable sources. House drainage bad. Accumulations of excrement. Want of scavenging.
1872-3	Sherborne.	243.		Dr. Blaxall.	Water in surface mains exposed to contamination from water-closets by excrement and sewer air. In some cases the specific contagium of typhoid would thus enter the water-pipes. This entrance to the water-pipes was made possible on account of the water supply being itself shut off near the supplying reservoir. Water-closets defective: filthy privies in the town with large pits, producing soil saturation and air pollution. Inefficient sewerage and drainage. Overflow of bath pipes (in some instances) communicating with soil pipes or drains. Remains of old sewers and dead wells in the town evolving foul smells. Public water supply good, but in addition several wells exist in the town exposed to contamination from soil of privy pits or leakage from old sewers.
1872	Armley.	107.	11.	Dr. Ballard.	Defective drainage. Large privy cesspools the usual thing. The earth upon which the dwellings stand is polluted with soakage from drains and cesspools. Typhoid first attacked dairyman and then spread to a large number of his customers. His well was found to be extensively contaminated with sewage.
1872	Abingdon.			Dr. Thorne.	Water supply mostly from surface wells in porous soil soaked with excremental and other filth. Sewerage defective. Subsoil in part water-logged. Privy and water-closet nuisances. Accumulations of excrement. "Enteric fever and diarrhœa."

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1872	Burton-Latimer. (Northampton.)			Dr. Thorne.	"Typhoid epidemic." Water supply obtained from wells polluted by soakage from privies and cesspools. Sewerage and drainage defective. Accumulations of excrement and refuse. Nuisance from piggeries. Overcrowding.
1872	Huddersfield.			Dr. Buchanan.	"Typhoid epidemic." Sewers defective. Certain water supplies largely polluted with sewage.
1872	Leigh. (Lancashire.)			Mr. Power.	Privy accommodation insufficient. Polluted water used from wells close to drains, privies, and middens. Accumulations of excrement. Imperfect sewers. Badly constructed and arranged houses.
1872	Olney. (Bucks.)			Dr. Thorne.	"Constant prevalence of enteric fever." Imperfect drainage. Soil round wells sodden with soakage from privies. Cottages without privies or ash-pits. Accumulation of excrement.
1872	Swinton. (Yorks.)			Dr. Ballard.	"Enteric fever endemic." Soakage of excremental filth into wells. Accumulation of excrement and filth.
1872	Wellington. (Somerset.)			Dr. Blaxall.	Water liable to pollution. Imperfect sewerage and drainage. No system for removal of refuse. Nuisances from manure, pigsties, and slaughter-houses.
1872	Whitchurch. (Hants.)			Dr. Thorne.	"Enteric fever." Water obtained from wells sunk in porous soil saturated with sewage. No proper sewerage system. Nuisance from piggeries.
1872	Wincanton. (Somerset.)				"Continued prevalence of enteric fever." Foul privies and drains. Air and soil polluted by sewage. Cesspits. Water supply from reservoir polluted.
1873	Brecknock.			Dr. Harries.	"Enteric fever." Defective drainage. Cesspits leaky and rarely emptied: pollution of soil water. Badly-constructed privies. Nuisances from animals, and from accumulations of manure.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1873	Littleport.			Dr. Thorne.	"Typhoid fever endemic." Water supply insufficient and in part polluted. Nuisances from cesspools, privies, and imperfect drainage. Accumulations of excrement.
1873	Tottenham.			Mr. Radcliffe.	Ill-designed cesspools in parts not sewered. Water supply contaminated with decaying animal refuse. Water-courses and ditches used as sewers. Large deposit of sewage mud at sewage works. Effusion of sewage on lower parts of village due to a flood. Escape of sewer air into the houses on the higher levels.
1873	Moseley and Balsall Heath.	96.	10.	Dr. Ballard.	Porous soil extensively polluted by soakage from dumb wells, bad drains, and ash-pit privies. Wells supplying water for domestic use polluted with sewage or excremental matters. Typhoid fever broke out at a dairyman's; fever evacuations were here thrown into the privy; by soakage, excrement from this privy polluted two wells. Thence infection was borne *via* the milk to the customers. "Suds" in which infected clothing had been washed, afterwards polluted well-water, from the use of which fresh outbreaks were traced.
1873	Marylebone.	244.	26.	Mr. Radcliffe and Mr. Power.	Due to infected milk supply, obtained from a farm near Chilton. The owner of this farm died of typhoid fever, his evacuations being buried, without disinfection, where they found their way into well-water used for dairy purposes. Defects in sewerage and drainage were also discovered in the affected houses.
1873	Combrooke. (Warwickshire.)			Dr. Ballard.	Typhoid imported from Leamington, and spread to adjoining houses. The water much used in these houses was obtained from a well exposed to pollution. Privies in village imperfectly constructed.
1873	Caius College. (Cambridge.)	15 (12 being in Tree Court).		Dr. Buchanan.	Excremental contamination of a particular section of the college water service.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1873	Guisborough. (Yorks.)			Dr. Harries.	"Serious prevalence of typhoid." Water polluted from privy and refuse nuisances. Imperfect scavenging. Ill-built and overcrowded houses.
1874	Baldock. (Herts.)			Dr. Thorne.	"Outbreak of enteric fever." Polluted water. Air fouled by sewer emanations. Water-closets without means of flushing. Accumulations of house refuse. Overcrowding.
1874	Chippenham. (Wilts.)			Dr. Blaxall.	"Typhoid epidemic." Water supply inadequate and polluted. Numerous and very offensive cesspits. Sewers and drains leaky. Refuse heaps and pig-sties near to dwellings.
1874	Godalming.			Mr. Power.	"Constant prevalence of enteric fever." Wells close to cesspools. Imperfect sewerage. Excremental accumulations.
1874	Truro.			Dr. Blaxall.	"Outbreak of typhoid." Entrance of foul air from sewers into dwellings. Water supply exposed to pollution. Defective sewerage. Insufficient privy accommodation and scavenging. Trade and pig-stye nuisances.
1875	Chatteris. (Cambridge.)			Mr. Radcliffe.	"High rate of mortality from fever." Privy-pits in a porous soil and not water-tight. Wells often close to privy-pits, from which there is soakage into soil.
1874	Auckland. (Durham.)			Dr. Thorne.	"Extensive prevalence of enteric fever." Polluted water. Imperfect sewerage and drainage. Insufficient privy accommodation. Filth nuisances. Overcrowding.
1874	Bourton-on-the-Water. (Gloucester.)			Dr. Ballard.	Polluted water-supply. Defective drainage. Privy nuisances.
1874	Lewes. (Sussex.)			Dr. Thorne.	Large epidemic of typhoid; due in first instance to pollution of town water-supply by water drawn from the Ouse, which receives the town sewage, and spread by suction of polluting matter into the water-pipes of an intermittent water service.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1874	Over-Darwen. (Lancashire.)			Dr. Stevens.	Large typhoid epidemic. Public water-supply polluted by soakage from drain, into which excreta from enteric fever patient had passed, and in various other ways. River extensively polluted. Houses polluted by soakage from privies and cesspools. Gross neglect of scavenging. Accumulations of excrement. Sewerage system defective.
1874	Lower Gornal. (Staffordshire.)	700.	39.	Dr. Ballard.	"Severe outbreak of enteric fever." Absence of drainage. Accumulations of excrement. Foul privies and surface nuisances everywhere. Polluted wells, with sewage containing the specific contagium and excremental matter. Unwholesome cottages.
1875	Croydon (Parish of)	1,200.	90.	Dr. Buchanan.	Escape of infected air from sewers, and its inhalation by persons susceptible of the disease. The air of sewers was "laid on" to houses. No evidence of the well-water having been a vehicle of infection. Opportunities exist for the passage of infection from sewers into small confined cisterns and water pipes, but water pollution played a much less considerable part than sewer air infection in this epidemic.
1875	Northampton Lunatic Asylum			Dr. Buchanan.	"Extensive outbreak of typhoid." Its extension due apparently to the defective state of the drains of the asylum.
1875	Royton (Lancashire.)			Dr. Stevens.	System of sewerage defective. Privies dilapidated and overfull. Soil and air polluted by overflowing cesspools. No system of scavenging. Enormous masses of excrement deposited in the neighbourhood by the Carbon Fertilising Company. Overcrowding.
1876	Chalvey. (Bucks.)			Mr. Power.	Cesspools and wells intermingled in porous soil. Hand-flushed closets, sinks, and stop-drains in connexion with cesspools. Excremental fouling of air, earth, and water.

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1876	Eagley and Bolton.			Mr. Power.	Simultaneous outbursts of enteric fever in Eagley and Bolton, in connection with the milk service of a particular dairy. Dairy water obtained from a brook, the course and banks of which had recently been largely fouled by human excrement. Sewerage, drainage, and water-supply arrangements deficient.
1876	Great Coggeshall. (Essex.)			Dr. Thorne.	Epidemic of typhoid spread in first instance through the agency of an infected milk supply, and subsequently through the generally defective sanitary arrangements of the town.
1876	Llanelly. (Brecon.)			Dr. Blaxall.	"Continued prevalence of typhoid. Epidemic of typhoid at Darenvellin." Insufficient privy accommodation. Absence of sewerage and drainage. Accumulation of refuse near dwellings. Water supplies generally exposed to contamination. Unwholesome method of excrement removal.
1876	Royston Rural Sanitary Dist.			Dr. Thorne.	"Large mortality from enteric fever." Water supply in many villages very deficient and very foul. Ill-constructed and ill-managed closets. Sewerage and drainage, when present, sources of nuisance. Dwelling accommodation dilapidated and filthy.
1876	Tideswell. (Derbyshire.)			Dr. Thorne.	"Outbreak of typhoid." Spread of disease favoured by conditions in an intermitting water surface allowing suction of foul air into water-pipes. Sewerage defective. Closet accommodation insufficient and a nuisance.
1877 (1873-77)	Ascot.	69.	2.	Dr. Ballard.	Epidemic of enteric fever lasting, with occasional intermissions, for 4½ years. Found to have invaded, almost exclusively, families supplied with milk from one particular dairy-farm, and to have spread mainly by the use of that milk. Drainage arrangements at dairy bad. Water used for cleaning milk-cans, and for other dairy purposes, inevitably polluted by emanations from drains, which also polluted the atmosphere of the dairy. Well-water contaminated from cesspool privies, dung-heap, &c. Specific infection of milk was also possible.

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1877	Bedale. (Yorks.)			Mr. Power.	Outbreak of enteric fever following importation to the town of a case of that disease. Wells generally liable to pollution. Nuisances from midden privies, and from keeping of animals. Deficient drainage.
1877	Bradford. (Wilts.)			Dr. Thorne.	Epidemic due to use of water subject to constant risk of excremental pollution. Nuisance from common privies. Absence of means of drainage in one part of the town.
1877	Padstow. (Cornwall.)			Dr. Blaxall.	Specifically infected sewer air. Excremental accumulation and defective arrangements for its removal. Insufficient water-supply, and wells exposed to contamination. Dwellings dilapidated and unwholesome. Sewers insufficiently ventilated.
1878 (Date of inspection: see under col. vi. for dates of epidemics).	Dewsbury District.			Dr. Thorne.	"Epidemic of typhoid in first quarter of 1877." Midden privies a source of great nuisance. Urine stored about houses for trade purposes. Water-supply subject to pollution: supply intermittent and liable to be fouled by suction of filth into mains. Sewerage and drainage deficient. Water-supply in some cases from polluted wells.
	Gomersal. (In Dewsbury District.)				"Extensive epidemic of typhoid in 1873." Wells liable to pollution. Sewerage defective. Foul air passing from sewers into houses. Disposal of excrement and refuse very faulty.
	Thornhill. (In Dewsbury District.)				"Large mortality from typhoid." Defective and polluted water-supply. Sewerage and drainage facilitating escape of foul air into dwellings. Grave nuisance from excrement disposal.
	Soothill-Nether.				"Very large mortality from typhoid." Causes as described under "Thornhill."

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1879	Chichester.			Dr. Airy.	"Outbreak of enteric fever." Due to infected milk (no contamination traced unless it were in the use of water taken from polluted stream for washing the cows' udders). Drainage mostly into cesspools, often very near drinking-wells. Branch of stream receiving sewage foul and stagnant.
1879	Newquay. (Cornwall.)			Dr. Ballard.	"Serious outbreak of typhoid." Faults of drainage. Use of well-water polluted with sewage. Prevalence of nuisances.
1879	Redhill and Caterham. (Surrey.)	352.	21.	Dr. Thorne.	Epidemic limited to the consumers of the Caterham Waterworks Company's water. This water was contaminated by means of the evacuations of a man employed in the construction of an adit between two of the Company's deep wells, whilst suffering from an attack of unrecognised typhoid fever.
1879	Selborne. (Hants.)			Dr. Blaxall.	"Outbreak of enteric fever," spread by polluted water and infected privies from an imported case of typhoid. Water supply from wells liable to pollution. Filthy privies. Excremental accumulations.
1879	Wing. (Bedfordshire.)			Dr. Blaxall.	Epidemic of typhoid in a circumscribed area associated with the use of water from a well polluted by soakage from privies and drains. Excremental nuisances generally prevalent.
1880	Aveley. (Essex.)			Mr. Spear.	"Outbreak of typhoid." Spread of fever due to sewage nuisances and polluted well-water. Drainage entirely by cesspits, often in close proximity to houses. Well-water exposed to excremental pollution. Scavenging neglected.
1880	Blaby Sanitary District. (Leicestersh.)			Dr. Blaxall.	"Numerous outbreaks of typhoid." Due to drinking water from wells specifically polluted by soakings from infected privies. Also spread by infected atmosphere of privies and by milk. Accumulations of midden privy excrement. Wells exposed to pollution. Drainage either absent or defective.

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1880	Haverfordwest. (Pembrokesh.)			Dr. Parsons.	Origin of epidemic uncertain, but disease spread by sewer exhalations and polluted water. Sewers and drains faulty. Drain atmosphere escaping into houses. Ill-contrived water-closets indoors; offensive midden-steads close to houses. Excrement accumulation. Public water-supply liable to contamination by sewer air. Water also obtained from polluted wells and streams. Nuisances from slaughter-houses and pig keeping. Overcrowding.
1880	Melton-Mowbray. (Leicestersh.)			Dr. Blaxall.	Due to infected sewer air. Unwholesome privies discharging into large and uncovered cesspits. Water supply from wells exposed to pollution. Nuisance from pig-sties, slaughter-houses and refuse accumulations. Sewers defective and badly ventilated.
1880	Millbrook. (Cornwall.)			Dr. Ballard.	Epidemic due partly to infected sewers, partly to polluted water supply, and partly to contaminated milk supply from a house invaded by the fever. Entrance of sewer air into wells. Public and private wells polluted by excremental soakage.
1880	Newlyn-East. (Cornwall.)			Dr. Ballard.	"A sudden, extensive and fatal outbreak of enteric fever in an utterly neglected and filthy mining village." Water supply scanty and mainly from a well with which the village drain freely communicates. Epidemic partly due to use of the well water, partly to privies and collections of filth subsequently infected, and partly to distribution of milk from infected houses.
1880	Pemberton and Orrell. (Lancashire.)			Dr. Airy.	Extensive outbreak of typhoid during drought after heavy rain, probably due to polluted spring water. Water supply from rain-water butts, or from springs and surface wells exposed to pollution.

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1880	Southend. (Essex.)			Dr. Thorne.	Considerable epidemic of typhoid at Prittlewell, due to use of polluted water supply. Great want of drainage, and aggravated nuisances from cesspit privies in the village. At Southend, drainage incomplete. Sewer ventilation imperfect or absent.
1881	Blackburn.	266 (from January to June).	24 (up to April 16th).	Dr. Airy.	Due to contamination of water-supply by soakage from drain conveying discharges of a fever patient at Guide on line of conduit. Sanitary administration good. Old midden privies being replaced by tub privies and water-closets. Excreta taken by canal to manure works. Sewage utilized for farm irrigation; other refuse destroyed in furnace.
1881	Bodmin Urban Sanitary Dist.			Dr. Parsons.	"Severe epidemic in 1881." Original source not traced. Sewers and drains badly constructed, leaky, and unventilated. Water-supply partly from springs and wells exposed to sewage pollution. Reflux of foul matters from closet into public water-supply possible. Nuisances from surface filth and pig-keeping.
1881	Bridlington.			Dr. Parsons.	"Sudden and extensive outbreak of typhoid." Especially affected houses supplied with milk from a particular dairy. Dairy well-water polluted and possibly specifically infected. Some localities badly drained, with fever persisting. Nuisances from cesspools, defective house-drains, and foul open water-courses.
1881	Hinckley. (Leicester and Warwick.)			Dr. Airy.	Water from wells in danger of pollution and liable to drought. Nuisances from bad drainage, privies, middens, and pig-sties.
1881	Howden Rural Sanitary Dist. (Yorks.)			Mr. Spear.	"Outbreaks of typhoid in different villages." Water supplies from shallow wells much exposed to excremental pollution. Streams polluted by privy contents. Specific pollution of school-wells followed by outbreaks.

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1881	Ilkeston. (Derbyshire.)			Dr. Blaxall.	"Extensive epidemic." Due chiefly to infected sewer air escaping within and about dwellings. Groups of cases referable to infected privies and polluted water. Storage of excrement in large unwholeseme privy-pits. Half the town water supplied by wells sunk in a filth-sodden soil, and from tanks in direct communication with sewers. Deficient drainage.
1881	Tawton. (North Devon.)			Dr. Blaxall.	"Limited epidemic due to specifically contaminated water." Water supply from wells and other sources, both exposed to dangerous pollution. Sewage discharged into watercourse. General excremental nuisance. Privies filthy and dilapidated. Bad drainage.
1881	Tavistock Rural Sanitary District.			Dr. Blaxall.	"Typhoid endemic with occasional severe epidemic outbreaks." Drinking water often exposed to dangerous pollution. Excremental nuisances frequent. Sewerage and drainage defective.
1881	Uckfield.			Mr. Power.	"Outbreak of enteric fever." Wells sunk in soil befouled by soakage from privies, cesspools, ashpits, and drains. Sewers unventilated. House-drains unventilated and in connection with sewers.
1882	Bangor and Bethesda.	548.	42.	Dr. Barry.	The attacks limited to the consumers of water obtained from the Bangor water-works: case of typhoid at Llwyurhandir; excreta from this patient passed into drain, thence to a small stream from which Bangor water-supply is drawn, and thus to the filtering reservoir. Even if the filters could have arrested infective matter, many of the plugs were defective: fully one-third of the water passing unfiltered into the water-main. Cesspit privy at Llwyurhandir is below level of infected drain. Spread of disease promoted by connection between houses and ill-ventilated sewers, and filth accumulation near houses.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1882	Galgate. (Lancashire.)			Dr. Barry.	Outbreak among persons drinking water obtained from a well contaminated with excremental matter. Insufficient water supply. Wells of doubtful purity. Midden privies a source of nuisance.
1882	Millbrook. (Cornwall.)			Dr. Ballard.	Same causes operating as caused the epidemic in 1880 q. v. "Renewed outbreak."
1882	New Shoreham (Sussex.)			Dr. Thorne.	"Prevalence of enteric fever." Water drawn from polluted wells. House drains in communication with public sewers.
1882	Norwood. (Middlesex.)	35.		Mr. Power.	Sudden dissemination of typhoid in fourteen dwellings supplied with water from the same well. Infected cesspool contents were deposited in a hole some 40 feet from the particular well, upon higher ground than, and in the line of natural soakage to, the well. Intervening was a porous gravelly soil.
1882	Southborough.	Twenty-four houses.			Outbreak of typhoid in a circumscribed locality. Drains admitted of contents escaping into surrounding soil, and often of gas discharging into houses. Water entirely from local wells, often in close proximity to drains.
1882	Ebbw Vale Urban District.			Mr. Spear.	"An almost house-to-house prevalence of typhoid in small detached hamlet in 1881." Due to excremental pollution of atmosphere from privy and other nuisances. Public water supply had failed, and inhabitants had largely resorted to questionable sources. Prevalence of sewage nuisances.
1882	Clapham. (Surrey.)			Dr. Parsons.	"Outbreak of typhoid fever." Attacked (with one exception) only persons getting milk from a particular dealer at Clapham. Mode of milk infection unascertained, but there had been cases of fever some months before in the place (Axminster), whence it came, and the well water at the two milk farms there concerned was contaminated with sewage products.

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1882	Dartford Registration District.			Mr. Spear.	"Prevalence of enteric fever." In parts invaded the sub-soil water stands 3 or 4 ft. only from the surface, and into this water-level wells and cesspools are sunk indifferently. In the part of the town attacked, 40 per cent. of houses were supplied from local wells, and in these houses 80 per cent. of the fever attacks occurred. Cesspool and other nuisances very common.
1882	Ulverston. (Lancashire.)			Mr. Spear.	Considerable prevalence of typhoid in the Autumn of 1881. Water mains water often so turbid that inhabitants resort to local supplies. Outbreak confined to users of a certain one of these local supplies. Insufficient sewer ventilation.
1883	Hitchin. (Herts.)	100 (about).	7.	Mr. Power.	Public water supply liable to pollution by reflux of water from the river Hiz to the reservoir and pumping well. The river receives refuse water and sewage; and "it is impossible not to admit that, in all probability, there has been direct relation between the circumstances of pollution on the 30th December, 1882, of the public water service, and the outburst of fever in mid-January." Defects of public sewerage and private drainage.
1884	Beverley.	231.	12.	Dr. Page.	Water supply chiefly from borings into the chalk which are occasionally polluted by direct percolation from a sewage-polluted soil. Water on analysis found highly charged with sewage matter. Sewerage antiquated and bad. Sewers unventilated, and having catch-pits at intervals to retain solids. Cesspools compulsory where water closets are in use, being made in the course of the house-drain before this latter enters the public sewer—the sewer thus receiving only the putrid out-flow of the cesspool. Privy middens of large size uncovered, often connected with drains, and sunk below the surface level. Main feature of outbreak was specifically contaminated general water supply of Waterworks Company, derived from deep well in chalk. Company's well and

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1884	Beverley (*Con.*).	231.	12.	Dr. Page.	reservoir close to sewage-irrigated field belonging to East Riding County Lunatic Asylum, in which cases of typhoid had occurred antecedent to outbreak in Beverley. The outfall of the Asylum drains is into a settling tank in the corner of a 7-acre field next to the Water Company's premises. Once a fortnight the settling tank is emptied by an intervening drain into an adjacent cesspit—this being simply an excavation in the clayey soil. It was not proved that soakage could occur from the cesspit to the well. Experiments negatived its possibility. Frequent chemical analyses of the Company's water during the epidemic repeatedly proved its purity and fitness for domestic use. Thus, the method of contamination was probably the broad irrigation practised on the field.
1884	Colne. (Lancashire.)			Dr. Airy.	"Sharp epidemic of typhoid." Origin undiscovered. Drainage very bad. Sink pipes in untrapped connection with drains. Nuisances from ash-pits, refuse heaps, and cow-sheds. Pollution of river Colne. Water supply fairly pure.
1884	Kidderminster.			Dr. Parsons.	"Extensive outbreak of typhoid over the whole town." Public water supply in large part derived from an artesian well in dangerous proximity to sewage-pumping station. Intermittent water service—hence possibility of accidental contamination of water by foul matters sucked into pipes during intermissions. Arrangement of sewers favours the distribution of infected sewer air. House drains badly trapped, unventilated, and often in connexion with interior of houses. Bad scavenging. Refuse accumulations: offensive trades. Outbreak owing either to inhalation of spray from sewage-polluted river water, or to drinking water of a well contaminated by soakage from the same.

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1884	Romford Dist.			Dr. Parsons.	Outbreaks of typhoid at Dagenham, due to drinking polluted well water, and to effluvia from foul ditch, in 1883 and 1884. At Ilford in 1882—3, due to infected milk supply, and subsequently spread by sewage effluvia from cesspools and defective drains.
1884	St. Albans.	January 2. February 2. March 4. April 0. May 93. June 38. Total for May and June, 131.	23 (during May, June, and July).	Mr. Murphy.	"Simultaneous outbreak of typhoid fever during June and July at St. Albans and London among the consumers of milk coming from a farm near St. Albans." Absence of evidence that the milk at the farm had become infected in any of the commonly-believed ways. Some reason for believing that this farm milk which had given rise to a serious outbreak of typhoid in St. Pancras in 1883, had retained, though to a slight degree, power of infecting its customers in the interval between the two outbreaks.
1884	York.	315.	54.	Dr. Airy.	Not due to water contamination. Milk supply exculpated. The outbreak was apparently due to exhalations from the sewers after an exceptionally dry hot summer. Sewers unventilated; their outfalls covered by, and admitting backflow from, the River Ouse. Sink pipes generally disconnected from the drains.
1885	Faldingworth and Barlings. (Lincolnsh.)			Dr. Greswell.	Faldingworth: small outbreak of typhoid traceable to pump-well water polluted by washings from a fever case imported from Newark. Filthy ditch sewers. Barlings: outbreak of typhoid traceable to pollution of the village water-supply by sewage. House drainage defective. Vault closets in dangerous proximity to dwellings. Chief supply of water obtained by imperfect filtering of the sewage-polluted village brook.

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1885	Hebden Bridge			Dr. Greswell.	Outbreak of typhoid, affecting chiefly cottagers using excrementally polluted water from the "Birchcliffe stone cisterns." Bad house drainage. Old open middens in dangerous relation to dwellings and open water-courses. Springs used for domestic purposes in almost all cases open to pollution.
1885	Kidderminster.	35 (in second half of 1885).		Dr. Parsons.	Cases existing in places where defective house drains existed—*vide* 1884.
1885	Lower Sheringham. (Norfolk.)			Dr. Airy.	Severe outbreak of typhoid under circumstances pointing to contamination of milk supply. Origin of infection uncertain. Water supply from land drainage and rivulet in danger of pollution. Drainage defective. Nuisances from privy-pits, net tanning, whelk boiling, and from ponded sewage, ordure, and fish offal.
1885	Market Weighton. (Yorks.)			Mr. Royle.	"Prevalence of enteric fever." Due to drinking water from surface wells in a porous soil, contaminated by soakage from defective sewers, cesspools, &c. Accumulations of excrement.
1885	Newark.			Dr. Parsons.	"Typhoid prevalent in 1884." An old and closely-built town. Sewers mostly unventilated. Sewage discharged unpurified into the Trent. Company's water-supply derived from gravel bed in neighbourhood of this river. Shallow wells also in use liable to contamination. House drains with loose iron traps, permitting escape of drain air into and near houses. Offensive midden privies. Refuse accumulations.
1886	Swanage. (Dorset.)			Mr. Harvey.	"Outbreak of enteric fever." First case in January; assumed an epidemic form from July to September. Water-supply largely from impure wells. Drainage system consists almost entirely of square rubble sewers, many of them joining a highly-polluted and almost stagnant brook. Large uncemented

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1886	Swanage (*Con.*).			Mr. Harvey.	privy pits on and in permeable sedimentary rocks dipping steeply towards the town. No public scavenging beyond street-sweeping. The epidemic associated at its commencement with the use of milk from a dairy situated on the polluted brook and without water-supply on the premises.
1887	Eastry Rural Sanitary Dist. (Kent.)			Mr. Spear.	"Mortality from typhoid 16 per cent. higher than elsewhere in England and Wales." Water supplies of most of the villages subject to pollution. Cesspits and privy-pits in close proximity to dwellings and wells, polluting both air and water. No proper means of sewerage. Refuse and excrement accumulations.
1887	Margate.			Dr. Page.	"Increasing mortality from enteric fever." Deposit of sewage and excrement in deep cesspools and cesspits sunk into the chalk. Pollution of air and soil by excremental accumulations. Water supply pumped from a well in the chalk, beside a populous neighbourhood. Water of bad quality and exposed to contamination by soakage of sea-water and from cesspools. Water-closets getting water directly from mains.
1887	Mountain Ash. (Glamorgansh.)	518.		Mr. Spear.	"A sudden and severe epidemic of typhoid, 518 cases occurring between July and October, 1887." The specific poison was distributed by water delivered through one particular water-main. Of the 396 houses supplied from this main below a certain point of its course 57 per cent. were invaded by fever. Near this point (where evidence of specific contamination commenced) defects in the main were discovered, which would lead during intermissions of water supply to insuction of air, and probably of liquid, from old drains. Earlier history shows that since the water-main in question was laid in 1855, an endemic prevalence of typhoid has

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1887	Mountain Ash (*Con.*).	518.		Mr. Spear.	existed in the district supplied by it. Analysis of the water showed that a sample taken before the nightly intermission of service was pure; that taken from the same tap after intermission gave evidence of animal contamination and of the appearance of low forms of life. Sanitary conditions in other respects fair.
1888	Buckingham.			Dr. Parsons.	A sudden outbreak of typhoid in January and February, confined at first to a poor suburb of the town, and especially affecting persons drinking water from a particular "spout," the water conduit to this spout exposed to pollution from a leaky drain which had received specifically infected excreta from a previous case of typhoid. Scattered cases later on referable probably to infection derived from defective drains and foul closets. Water generally from wells exposed to risk of pollution by leakage from cesspools, drains, &c. Sewers and house drains very defective, allowing deposit, leakage, and entrance of drain air to houses. Old privies with large deep vaults: foul hopper closets.
1888	Flint.			Mr. Spear.	Fourteen cases of typhoid fever in seven houses, between August 11th and 20th: subsequently general over the town. Water supply intermittent and discoloured when turned on in the morning. Method of excrement disposal in infected locality such as to cause fæcal fouling of air and soil.
1888	Keynsham Rural Sanitary District. (Somerset and Gloucester.)			Dr. Blaxall.	"Recurring prevalence of epidemic typhoid." Conveyed in the bodies of persons attacked from one part of district to another. Spread of the disease by specific excremental pollution of water. No proper sewerage provision. Cesspit privies in vogue. Water-supplies exposed to dangerous pollution.

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1887 and 1888	Mytholmroyd. (Yorks.)	(1887) 66. (1888) 29. Total 95.	10. 5. 15.	Dr. Page.	Prevalence of unwholesome conditions of water-supply, drainage, and excrement disposal. River Calder highly polluted with sewage and excremental matters, in fact little better than an open sewer. Twenty-two of the fifty-five houses attacked are situated in the immediate vicinity of this river, inhaling the effluvia arising therefrom. The local sources of water-supply are from small streams descending the hill-side. Washings from meadows and manured lands, and excremental filth pollute these streams. The water is conveyed in pipes from a spring on the hill-side. This spring water is reinforced by sewage from a manure heap. No system of sewerage exists. Bad scavenging. Midden privies flowing over, &c.
1887-8	New Brighton. (Cheshire.)	21 (during 1887-8.)		Mr. Spear.	"Typhoid fever prevalent." The fever prevalence had no relation to the water supply, nor to the milk supply. Faulty sewer ventilation. Drains are commonly carried beneath the floors of dwellings, without any special precautions. Gullies having unbroken communication with the drain, and so with the sewer, often exist in cellars. "The appearance of typhoid, at New Brighton has been found so constantly associated with specially grave defects of drainage, as to create a strong suspicion that this condition has been the cause of the mischief."
1887-8	*New Clee and °Gt. Grimsby.	*120. °140. Total 260.	*21. °31. Total 52.	Dr. Page.	General water supply good. Some of the households drew their water supply from local wells, which were subject to risk of specific contamination. Some cases were due to the use of a box privy, into which the infected discharges of an earlier case had been thrown. More frequently, however, such discharges were thrown into the yard drain-inlets and catch-pits, and so infection of some of the smaller and defective drains occurred. Unventilated public sewers, along with faults of private drainage, led to ventilation of sewer air into private dwellings. "The pollution of wells by excremental matters must be considered to have played a part in the epidemic."

YEAR.	PLACE.	NUMBER INFECTED.	DEATHS.	INVESTIGATOR.	CAUSE.
1888	Stourbridge Rural Sanitary District. (Staffordshire.)			Dr. Parsons.	"A severe outbreak of enteric fever in third quarter of 1888 in Pensnett and Bromley." Affected specially young adult males employed at ironworks, their chief beverage being ginger beer, made often at home from the water of polluted wells not wholly boiled. No sewerage; slop-water nuisances prevalent; privies with wet open ash-pits; pig-keeping nuisances; wells exposed to pollution from these sources.
1888	Standish-with-Langtree. (Lancashire.)			Dr. Page.	"Prevalence of enteric fever." Ventilation of sewers obstructed. Midden privies drained into sewers causing nuisance. Water-supply from local sources, one of them exposed to excremental pollution; incidence of fever chiefly in families using this supply, but spread of disease due also to privy defects. No system of scavenging. Prevalence of nuisances from undrained yards and from pig-keeping.

Sir Douglas Galton (London), in proposing a vote of thanks to Dr. Poore for his valuable paper, remarked that, as an engineer, he could not at all agree that the point of getting rid of refuse matter was not an engineering question. The engineer, he held, had a distinct influence upon every part of science if he manipulated and completed the work which the chemist, the geologist, and all other heads of science began. For this reason therefore he maintained that the matters to which Dr. Poore had referred were entirely engineering questions. With respect to the argument about the living earth he held that water was as great a purifier as the earth, and reminded his audience in this connection that if refuse was turned into a stream, and they went some few miles down the stream, they would find that every trace of the refuse had vanished, having been taken up either by minute animals or plants, or consumed for food by fishes. A report recently issued on the disposal of the sewerage of Paris distinctly bore out this argument, the document tracing out the processes of purification throughout the entire length of the river's course. With regard to the argument about the waste of throwing sewage into the Thames, one of the ablest persons who had to do with agricultural and sewage questions (Sir John Lawes) had, in giving evidence before the Royal Commission, called attention to the fact that the quantity of fish taken on the eastern coast of England far and far exceeded that taken on the western, and he raised the question whether it was not that the extra food which was provided by the sewage of London was not mainly the cause of this. With respect to the question of water carriage he was quite in favour of this course being taken in country districts, but he gave the following statistics to show that in towns the water-closet system was certainly the more healthy. In Brighton, for example, where water-closets are everywhere used, the death-rate was only 15 per thousand, the percentage rising in Bolton, where the refuse was carried away, to 22 per thousand. He considered, too, the modern methods in sanitation were in a great degree responsible for the diminution of fever cases. In 1868 the death-rate from fever was 78, in 1878 it was reduced to 37, in 1888 to 17, and last year this had still further been reduced to 14. With the few exceptions he had ventured to take he considered Dr. Poore's address most charming and comprehensive; and, in conclusion, he could pay no higher compliment to it than in saying that it was eminently worthy of Dr. Poore.

Mr. A. G. Henriques, J.P. (Brighton), who seconded the vote of thanks, mentioned that the rivers of Sussex had suffered much from pollution. As chairman of the River Pollution Prevention Committee of the East Sussex County Council, this fact had been brought prominently under his notice. He had himself seen beautiful streams absolutely polluted and destroyed as useful drinking water by the sewage of trifling villages, without any disguise or concealment, being drained into them. This system of pollution, he found, had been going on for years. With regard to another point of

Dr. Poore's address, he mentioned that he should be sorry to see the disestablishment of engineers and men who carried out the execution of sanitary problems. It might be true that they had put too much faith in water, but they in towns could hardly afford the time to substitute for water anything that Dr. Poore had suggested, and until some other and better means than had yet been suggested were found, he thought it would be a long time before their engineers gave up the use of water in cleansing towns and giving health to cities.

Dr. Poore (London), in reply, admitted that, so far as they went, the criticisms were just, but he reiterated the statement contained in his address that his remarks were directed almost solely to country districts. Mr. Henriques had told them something of the streams in Sussex being filthy, and his (Dr. Poore's) advice was, "Go to the cottagers, and make them do their duty." It was imperatively necessary that every village, however small, should have its sanitary arrangements carefully directed, for out of the small villages of to-day would come, in many cases, the great towns of the future. With regard to his remarks about the engineers, he of course meant nothing unkindly. Her engineers, there could be no doubt, were England's greatest glory. But the engineer was in the position of Hercules, for the king to-day was Augeas—and his remarks were addressed to Augeas—who, if he did not keep his property in a satisfactory sanitary manner, would be obliged to get Hercules to show him the way. He had every admiration for Hercules, but his counsel must be taken as addressed to Augeas!

On "Some Points in relation to Septic and Infectious Diseases," by James Turton, M.R.C.S.E., &c., Chairman of the Sanitary Committee, Brighton Town Council.

The subject of those diseases which owe their origin or their propagation to insanitary conditions, is one of overwhelming interest to all those who are engaged in the study or practice of State Medicine, in fact, one might say, that in itself it embraces, directly or indirectly, almost the entire range of sanitary science; that being so, it forms some excuse for me in bringing forward a few remarks on some points which seem to me to be of particular interest.

In the first instance, I will propose that any insanitary condition which leads to the contamination with organic matter, of air food or drink, may of itself be the cause of disease, or, on the other hand, may be the means of conveying the germs derived from pre-existing cases of disease; for example, a water supply which has become contaminated with sewage, may, in the individuals drinking it, give rise to symptoms, such as fever,

sickness, and diarrhœa, which are of a more or less indefinite nature, and which cease as soon as, or shortly after, their cause is removed; or may convey the germs of a definite disease, such as typhoid fever, which runs a certain course, even after the removal of the insanitary condition which enabled it to spread.

Dr. Marston, of the Medical Staff, gives a striking illustration of the simultaneous occurrence of these results, in his paper on the Fever of Malta, published in the Army Medical Reports for 1861, wherein he states that when enteric fever broke out at the Fort of Lascaris, from the opening of a drain, other affections were simultaneously developed, viz., diarrhœa, dysentery, slight pyrexial disorders, and diseases of the primary assimilative organs.

It is obvious therefore, that here we have two distinct results which may reasonably be attributed to distinct causes.

The one is of a simple or septic nature, and the other of a specific or infective character, and it is to the former of these conditions that I wish particularly to draw attention in my remarks.

Cases of septic poisoning resulting from sanitary defects are familiar enough to all those who are engaged in the practice of either preventive or curative medicine; and although they present a great variety in the grouping and the violence of the symptoms, they all show a more or less strong family likeness; the symptoms most commonly present being general malaise, fever, sore throat, sickness and diarrhœa.

They usually result either from the contamination of inspired air by sewer gas, emanations from leaky drains, cesspools or other foul accumulations, or from an impure water-supply; and, generally speaking, when the poison is conveyed by the air, the throat symptoms are predominant; when the water is at fault, the gastric troubles are uppermost. Obviously the tissues or organs brought chiefly into contact with the morbid agents suffer the most, at any rate that has been my experience; but the sickness and diarrhœa so commonly present in these cases may also be regarded as efforts of nature to eliminate the poison. A patient of mine discovered that the water-bottle in her bedroom was being filled with water from the cistern supplying the water-closets, from the fact that it made her sick each time she drank from it, and in all probability the prompt rejection by the stomach of the offending fluid prevented any further ill-consequences.

But the point I wish specially to draw attention to is the *etiology* of these conditions: What is the cause of the symptoms, and wherein does it differ from the cause of zymotic disease, in which we recognize the operation of a distinct virus?

The answer to this question must of necessity be of a speculative nature, and I do not profess to bring forward anything more than mere general conclusions based upon analogous conditions.

I may here mention that in Parkes' Practical Hygiene it is stated, that some years ago Dr. Herbert Barker submitted the question to experiment by conducting the air of a cesspool into a box containing animals. The air contained carbon dioxide, hydrogen sulphide, and ammonium sulphide, but the presence of organic vapours was apparently not sought for in the analysis. Three dogs and a mouse were experimented on. The three dogs were confined in the box, they all suffered from vomiting, purging, and a febrile condition, which, Dr. Barker says, "resembled the milder forms of continued fever, common to the dirty and ill-ventilated homes of the lower classes of the community."

Dr. Barker attributed the results, not to the organic matter, but to the mixture of the three gases, particularly the latter two.

I believe the condition in these cases to be one of septic intoxication, due to the entrance into the system of the products of putrefaction, and that it is directly analogous to the surgical fever which sometimes follows the infliction of wounds, and which in pre-Listerian days was infinitely more common than it is at the present time; in the former case the products of putrefaction enter the body through the natural channels of the respiratory and alimentary tracts; in the latter, through the blood-vessels and lymphatics leading from the wound.

I say products of putrefaction, because I think that in the present state of our knowledge, it is unsafe to attempt to specify any particular poison or poisons, and such products as are already known are very numerous; speaking generally, however, one may say that the organic compounds known as ptomaines, are more poisonous than the simpler chemical compounds, such as the sulphides.

In this connexion the following extract from Billroth's work on Surgical Pathology is of interest:—

"Of late, many attempts have been made to determine what substance in decomposing animal tissues is the true poisonous principle, and for this purpose putrid fluids have been treated chemically, till some one body should be found which in the smallest dose should excite the symptoms of septic poisoning. Thus, Bergmann has produced a body of this nature from decomposing yeast, which he calls sepsin. To prove that this body *alone* (whose presence Fischer could not prove in decomposing serum or pus) is the poison, it would be necessary to prove the innocuousness of all other bodies chemically formed

during putrefaction. But this cannot be done; sulphuretted hydrogen, sulphuret of ammonium, butyric acid, leucin, and some other substances formed during the putrefaction of organic bodies, also act as septic poisons when injected into the blood; so that I cannot enter into the laborious search for one body in the putrid fluids which shall bear all the blame of the injurious effects. It is very probable that in decomposing fluids according to their qualities, degree of concentration, temperature, &c., very many different poisonous substances may form, which I further imagine as going on changing, till they reach some final terminal stage."

Amid so much that is uncertain it is however clear, that the morbid agents in the class of disease we are considering, are capable both of suspension in the air and of suspension or solution in water.

It must be remembered that in house drains, which are the chief offenders, are present in a peculiar degree all the conditions essential to putrefactive changes; there are the putrescible matters, the water, oxygen, and micro-organisms, while the excreta themselves supply the necessary temperature. But healthy excreta cannot be regarded as possessing any peculiar poisonous property apart from their putrescibility, for it is well known that the introduction into the body of the products of putrefaction of other organic matters produce similar results, and I would instance the following:—

(I.) The dissecting-room sore throat common among medical students.

(II.) The well-known evil effects of a water-supply contaminated by soakage from burial grounds.

(III.) The effects of effluvia from decomposing animals; an instance of this is recorded by Parkes as occurring in the French camp before Sebastopol.

(IV.) The effects of a water-supply containing decomposing vegetable matter.

(V.) The results of inhaling the products of putrefying vegetable matters; as an instance of this I quote the following from Parkes' Practical Hygiene:—

"Occasionally, outbreaks of disease occur from impurities of the atmosphere, the nature of which is not known, though the causes giving rise to them may be obvious. Dr. Majer records the case of a school at Ulm, of sixty or seventy boys, where the greater number were suddenly affected, on a warm day in May, with similar symptoms:—giddiness, headache, nausea, shivering, trembling of the limbs, sometimes fainting. The attack occurred again the next day, and a common cause was certain. The room was enclosed by walls, in a narrow

space, where the snow had lain all the winter; the wall was covered with fungous vegetation and with salts from the mortar. From the sudden entrance of warm weather fermentation had set in, and a strong, marshy smell was produced; the substances, of whatever kind, generated in this way accumulated in the narrow, ill-ventilated space. Removal to a healthier locality at once cured the disease."

And the following cases occurred in my own practice last year. I was called to attend several members of a household suffering from general malaise, headaches, and occasional vomiting. The house drainage was good, but an unpleasant smell was noticed in the kitchen, and the symptoms attacked only the servants and those members of the family who were in the habit of entering the kitchen. I had the flooring taken up, when several of the joists were found to be rotting in places, and emitting the odour complained of. The putrid wood was removed, and a better provision made for ventilating the space beneath the floor. Since then there has been no illness in the house.

Other instances might be mentioned, but I think I have adduced sufficient evidence to show that all collections of putrescent organic matters, of whatever kind, are equally capable of producing symptoms of septic poisoning; although, for very obvious reasons, the putrefaction of sewage is by far the commonest cause.

Although septic and infective conditions are distinct etiologically, yet clinically the dividing line is in some instances a very narrow one; thus, some cases of septic sore throat may very closely resemble diphtheria, and are in fact often styled diphtheritic, although I think this term when so applied a misleading one. But this fact only bears out the analogy I have sought to draw from surgical practice; for there, many cases of septic intoxication occupy the borderland of septicæmia and pyæmia, which latter are generally regarded as diseases of a truly infective type.

Further, I believe that septic intoxication is not infrequently combined with the infective process; if this be so, it may account for some of the atypical cases of the latter which one not seldom meets with in practice. I would suggest that cases of typhoid with sudden onset, or cases of scarlet fever with severe throat symptoms, may possibly bear this interpretation.

Finally, the state of ill-health induced by the introduction into the system of the products of putrefaction, must be regarded as a powerful predisposing cause of infectious disease.

Another point which is worthy of discussion, but to which time will permit me only very briefly to allude, is the question

of the action of the eliminating organs in the various zymotic diseases.

We are accustomed, from clinical experience, to associate certain functions, almost exclusively, with the elimination of the *materies morbi* in the different infectious diseases, *exempli gratia*; the skin and kidneys in scarlet fever, the bowels in typhoid.

Without questioning the fact that in certain diseases, certain organs are the most active, it appears to me very probable that, with a poison so generally disseminated throughout the body as that of the infective diseases, all the eliminating functions are called into action, in a greater or lesser degree, to get rid of the offending material.

And this view is quite consistent with the fact which modern research appears to establish, viz.: that the symptoms in infectious disease are due to the chemical products of the activity of certain specific micro-organisms, and not to the organisms themselves.

I will take, as one instance, scarlet fever; we assume, and in all probability rightly so, that the poison is chiefly eliminated by the skin and kidneys, but the breath is also very infectious in the febrile stage, and although the throat symptoms may account for this, yet we cannot exclude the lungs as a source of infection, in other words we cannot assert that in the febrile stage of scarlet fever, the lungs are not actively engaged in eliminating the poison, and similarly with regard to the bowels.

And with reference to measles, although the pulmonary system is the most active agent in the work of elimination, yet it is a fact that the other organs assist, witness the desquamation which so frequently follows.

I attended a case of severe measles recently, in which diarrhœa was a prominent symptom, and I could not help regarding it as an additional means of eliminating the poison.

Again, with respect to typhoid fever, unquestionably the bowels are the principal means of extruding the poison, but does not the pneumonia, which is such a frequent accompaniment of typhoid, point to increased functional activity on the part of the lungs?

And as it is well recognised that the poison of typhoid may be conveyed in inspired air, there is obviously no physical or chemical reason why it should not be eliminated in the expired air.

These points, although necessarily matters of speculation, have a very practical bearing on the question of the spread of epidemics, and the necessity for the proper isolation of patients, and thorough disinfection of the excreta in all cases of infectious disease.

On "The Sanitary Advance of Brighton," by Alderman Joseph Ewart, M.D., F.R.C.P. Lond., J.P.

Site—Environs—Climate.

As regards the site on which the town of Brighton stands, it would be difficult to find any locality endowed with so many physical advantages or impaired by so few defects. Of the latter there are none which have not already been, or which cannot be, either mitigated or removed. Thus, whilst there is no part which does not furnish an admirable fall for drainage, the alluvial and marly Steine and Level, to which slight objection has been taken by some authorities, is mainly utilised as open spaces and recreation grounds. There is, it is true, a fringe of houses on each side of this valley, whose foundations may not dip down as far as the chalk, but the populous districts extending to the eastern and western boundaries of the borough, have a basis of chalk approaching within a few inches of the surface. Some parts of West Brighton or Hove, such as Furze Hill, Brunswick and Palmeira Squares, the Stamford and Aldrington Estates are built upon clay; but many of the splendid mansions in the vicinity of the railway stand upon chalk. Owing mainly to a chalk basis—east and west of the Steine, Enclosures, and Level—the climate is comparatively dry and bracing, less so on the alluvial and clay soil just mentioned. But the drainage fall is everywhere so efficient that any defects of soil here and there, especially in Brighton proper, are scarcely appreciable in adversely affecting the public health; whilst in Hove and Aldrington, the influence of the clay is greatly modified or neutralised by well-built houses and wide streets. Still, its existence is on a scale sufficient to impede, to some extent, absolutely free drainage, and, in part, to account for the less bracing character of the air here, particularly in the summer months. Artificial drainage, where required, would remedy, as far as it is possible to do so, these conditions; still more so if coupled with asphalting or cementing the foundations and basement floors of houses. There is no oozy or swampy ground in the immediate vicinity. Add to these signal advantages, the salubrious Downs to the north; the standing forth of the town on chalk cliffs approaching more or less closely the shingle, beach, and sea; a southerly or south-

westerly aspect; an ozone and health-laden prevailing breeze; an unusually large proportion of sunlight, during the season, from October to December inclusive, when the Metropolis and many of our great inland cities and towns are liable to be enveloped in smoke and fog; a moderate mean annual temperature of 49·8 degrees (F. E. Sawyer, F.S.A.); greater coolness in summer, and warmth in autumn and winter than in inland towns; a moderate mean daily range of 11·8 degrees, especially in October, November, December, January, and February, when it only amounts to 10·9, 8·8, 8, 7·7, and 8·3 degrees in these months respectively (*loco. cit.*); a mean barometric pressure of 29·970 inches, a mean degree of humidity of 81, saturation being 100 (*idem*); a rainfall of only 28·35 inches (*idem*); very few days in the year in which exercise may not be taken in the open air in our parks, on our spacious and well-kept pavements and promenades, and you have set forth in brief the leading reasons why the physical climate of Brighton stands deservedly so high, both from a prophylactic and curative point of view.

There is no part of Brighton and its environs not materially influenced by sea air when the breeze blows from the south or south-west, as every part is affected by the atmosphere of the Downs when the current sets in from the north and north-east. The variations of climate are well defined. Thus, along the sea front, a stretch of four miles or more, from Black Rock to Aldrington, a pure marine atmosphere is encountered, modified, in strength and intensity, by temperature, barometric pressure, humidity, rain, wind and the direction of the same, electro-magnetic conditions, sunlight, clouds, fog and smoke, or both. From Black Rock to the Aquarium, owing to the shelter of the cliff from the north wind, the air is so mild and genial in good weather, even in the winter, as to approach that on the shores of the Mediterranean or of the Island of Madeira. Hence, the lower drive and promenade here have been appropriately named, at the suggestion of the late Alderman Lamb, "The Madeira Road." A commodious shelter hall and terrace, approached from the cliff above by means of a hydraulic lift, opened a few months ago, will, it is hoped, add much to its utility and attractions to visitors, residents, and invalids, of this bright, sunny, mild, and health-giving retreat. When the current of air is moving from the south or south-west, the whole of the sea-front from the Aquarium to Aldrington, in fine weather, participates in the mildness of the Madeira Road, but not quite to the same degree. On the cliff protecting the Madeira Road, and to the north of which Marine Parade, Kemp Town, and the Queen's Park are situated, the climate is strong, bracing and exhilarating. The same may be said of the

Montpelier District. The northern parts of the town are permeated by the crisp, dry and pure air coming from the Downs. Generally speaking, the climate is extremely beneficial in the earlier phases of tubercular, and in most forms of pulmonary and bronchial disease, both in adults and children. Conditions, characterised by weak and disordered digestion, poorness of blood, debility, want of nerve-tone, whether resulting from recent illness, occupation intrinsically unhealthy, or employment in insanitary, overcrowded, or ill-ventilated workshops or offices, high pressure, or over-work, are rapidly repaired by the rest, exercise under the best hygienic circumstances, good food, and ozone-charged air available at Brighton. Preston, an outlying suburb and recent acquisition, is singularly favoured. Thoroughly sheltered on the north, east and west by spurs springing from the Downs; enriched by an abundance of the finest trees and well-cultured gardens; ornamented by many handsome villas and mansions; provided with a gem of a park, greatly improved in beauty and attractiveness by a generous development of the art of landscape or pictorial gardening; endowed with a soft and soothing, yet invigorating climate of its own, sometimes modified by the stimulating air wafted from the neighbouring ocean, at other times tempered by the exhilarating air coming from the Downs—it is one of the prettiest, cosiest, and healthiest villages in England.

Arterial Drainage.

The whole of the sewage of Brighton, Preston, and Hove is carried by means of well-constructed sewers into an intercepting sewer, the outfall of which is at Portobello, about four miles to the east of Kemp Town. Its ventilation is materially promoted by means of a furnace at Roedean, the influence of which is felt at the Steine—a mile and a half or so to the westward. In his Report, pp. 7 and 8, dated 27th June, 1882, Sir Joseph Bazalgette wrote "that the ventilation at the time of his visit was quite satisfactory. The flow in this sewer is sufficient to remove all deposit, excepting a few inches in depth extending for a short distance above the Portobello outfall."

In an extensive survey of this sewer throughout, Dr. B. W. Richardson says, "The air of the intercepting sewer is much less offensive than would be expected . . . There was very little solid matter under foot. The masonry of the sewer is of brick, well laid, and seemed to be good in every part. By means of several storm overflows, ample flushing, and free

ventilation, this main sewer is maintained in a condition of wonderful purity." (Report p. 56, September, 1882). The surveyor informs me that in dry weather about 30 gallons per head, or over 4,000,000 gallons pass through it daily! All the tributary sewers at their upper ends are flushed twice a week by filling capacious man-holes "with water from the mains, and letting it go through them with a rush." As much as 428,420 gallons of water per week, or 22¼ millions per annum, are used for flushing purposes in this way. Connections with the sewers are made under the direction of an expert belonging to the Surveyor's office. "Altogether," Dr. Richardson sums up, "I found the working of the sewerage and drainage of Brighton entirely different from what I had been led to expect. I found no sewage deposit in the sewers, no leakage in the intercepting sewer, no special indications of escape of sewer air into houses. . . . I found, in short, nothing whatever that would lead me to believe in the occurrence of any special disease or mortality from bad drainage. I should add to this account that I experienced no ill effects from being so long in it while making my inspection, and that since it has been in use none of the surveyors or inspectors have ever suffered from using the air within it." (*loco. cit.*)

Ventilating shafts, carried to the tops of high buildings, have been constructed in numerous cases in suitable situations, and I trust these will be continued to be multiplied until all the street gratings can be safely dispensed with. So effective is the system now pursued in all its parts that disinfectants are not needed. It would, however, be an easy matter at the approach, or during the prevalence of an epidemic, to wash out every sewer, large and small, with a strong solution of any disinfectant that might be selected.

House Drainage.

But arterial drainage is not everything. Next, if not before it in importance stands the drainage of the house. Both systems are intimately correlated, and should be as complete as science and engineering can enable us to make them. To this ideal standard the Health Officer and Sanitary Committee direct their aims and aspirations. A house to house inspection is in constant operation. House sanitation is materially facilitated by the provisions of the Brighton Improvement Act of 1884, which arms the sanitary authority with several special powers in addition to those conferred by the Public Health Act and its amending Acts. The Sanitary Committee, ably advised

by Dr. Arthur Newsholme, are now seeing that every house is provided with a separate water supply for domestic use; that water set apart for flushing closets cannot be otherwise utilized; that the pipes leading from sinks, duly trapped underneath the same, are made to open through a wall in the open air over a channel leading to a properly trapped gully grating; that pipes of baths are similarly trapped and directed; that all badly placed stack pipes are thoroughly disconnected from soil drains; that properly ventilated, trapped, and flushed closets are employed; that the soil pipe at or near the point of issue from the closet trap is ventilated by means of a four-inch pipe (outside) leading above the top of the house, well away from chimneys, windows, and skylights; that the soil drain is effectually cut off from the sewer; that an air inlet to the chamber of the soil drain is applied of approved make (as yet we have no power to enforce this); that all cesspools discovered are closed, and the houses to which they belong are properly connected with the sewer; that houses found to be drained on the joint system are, with rare exceptions, each to be decided in committee on its own merits, separately drained; that new drains or old ones renewed are constructed of the best earthenware material, each jointed, laid all round in six inches of concrete, and only passed by the surveyor after having been proved to be watertight; that, as regards new buildings or old houses rebuilt, the adjoining sewer is, in suitable cases, ventilated well above roofs of such houses, whenever practicable; that all old wells are closed and filled up; that dust bins (portable zinc ones are the best) are kept as free as possible from putrid vegetable matter, emptied at least once a week or oftener, as in the case of hotels or other large establishments. Thus we are striving, as we have been doing during the past six years or more, to place all kinds of house property on the same level as regards the essentials of sanitation.

The Death-rate.

The census in Brighton is taken on the 1st of April, when the visiting community is at a minimum. It fails to take into account the 40,000 strangers daily present in October, November, and December, or an average daily number of 10,000 souls or more spread over the whole year. The death-rate, therefore, cast by the Registrar-General is greater than the true circumstances of the case justify. Then, as regards the fixed population, we have the high authority of Dr. Richardson for declaring "that no town in the kingdom is so subject to residence of

advanced and worn-out lives, and that it is fair to assume an increase of at least 1 per 1000 to the annual mortality from this social cause alone." Moreover, it suffers, in common with other health-resorts, but disproportionately, from the importation of persons who are sick and die, both in the public institutions and in the town, as also of those afflicted with the germs of transmissible disease. When, however, anyone is struck down with this kind of disease, the prospects of recovery are enhanced by the health-invigorating climate of the place. But in spite of the fact that the death-rate, as given by the Registrar-General, is higher than the true conditions warrant, it is, nevertheless, very satisfactory. The steady diminution of mortality extending over a long series of years revealed in the following statement indicates, in language which cannot be misinterpreted, the attainment of a large measure of sanitary progress:—

The (average) Death-rate.

During the two decades 1851-60 to 1861-70 was 22·01 per 1000.

„	decade	1871-80	„ 20·2	„
„	„	1874-83	„ 20·0	„
„	„	1875-84	„ 19·8	„
„	„	1876-85	„ 19·3	„
„	quinquennium	1882-86	„ 18·6	„
„	quatrennium	1883-86	„ 17·8	„
„	triennium	1884-86	„ 17·4	„
„	biennium	1885-86	„ 17·1	„
„	annum	1887	„ 16·9	„
„	„	1888	„ 16·07	„
„	„	1889	„ 15·04	„

Illustrating a decrease of 6·97 per thousand. This is not all. "It has been found," says Dr. Farr, "that in England, to *one annual death* in a body of men, two are on an average constantly suffering from sickness of some severity. . . . Although this exact relation is, perhaps, not preserved in infancy or old age, or where the mortality deviates much from the standard, it may be safely assumed as an approximation to the truth." Thus, according to Farr, for every annual death, there is disabling illness amounting to 730 days. Hence, it follows that the saving of 848 lives in 1889 signifies a diminution of sickness equal to 1696 years or 619,040 days. At a wage of fifteen or twenty shillings a week, this saving of life represents in money £66,144, or £88,192 per annum. And this does not take into account the saving of those unavoidable expenses contingent upon illness. The result implies a measurable increment in the

average duration of life, of reproductive labour, and an all round improvement in the condition of the public health. Viewed as a whole, it is one of the most striking, as it is certainly one of the most satisfactory instances of a steady and progressive response to sanitary reforms on record.

How much this reduction of mortality is due to the success of sanitary measures in diminishing the frequency of, and deaths from, infectious and tubercular disease, is well illustrated in the following statements, for which I am indebted to Dr. Newsholme:—

I.—*Showing the influence of better sanitary conditions in lessening deaths from infectious and tubercular disease.*

	1861-70.	1871-80.	1889.
Mean population	83,852	94,551	121,807
Total deaths per annum	1,846	1,934	1,833
Deaths from Small-pox	18	8	0
„ „ Measles	35	26	46
„ „ Scarlet Fever	53	37	18
„ „ Diphtheria	22	8	10
„ „ Whooping Cough	51	43	27
„ „ Fever*	44	23	18
„ „ Diarrhœa	102	100	64
„ „ All Tubercular Disease	328	308	278

II.—*Showing the total number of deaths from all causes and the number of deaths from infectious and tubercular disease which would have occurred in an average year,* 1861–70, *had the population been as large as in* 1889:—

	1861-70.	1889.	Decrease per cent. in 1889, as compared with average in 1861-70.
Population	121,807	121,807	
Total deaths per annum	2,681	1,833	about 32 per cent.
Deaths from Small-pox	26	0	„ 100 „
„ „ Measles	51	46	„ 10 „
„ „ Scarlet Fever	77	18	„ 76 „
„ „ Diphtheria	32	10	„ 69 „
„ „ Whooping Cough	74	27	„ 63 „
„ „ Fever	64	18	„ 72 „
„ „ Diarrhœa	148	64	„ 57 „
„ „ All Tubercular Diseases.	478	278	„ 42 „

* Fever here means mainly enteric fever. Before 1871-80 it was not separated from typhus in the Registrar-General's Returns.

The percentages of decrease in the year 1889, as compared with the deaths which would have occurred from the several diseases in an average year of 1861–70, had the population been as large as in 1889, and recorded in the fourth column of this statement, are very striking. They mark the great success with which preventible diseases have been met and dealt with by the sanitary authorities of Brighton. They encourage us to anticipate even greater achievements in the near future.

Having briefly indicated some of the chief tests of the onward march of sanitation in Brighton, I now propose, in conclusion, to draw attention to a few reforms which are needed to secure her future position as a health resort.

1.—The most important of all is the effectual dealing with certain unhealthy areas. The ball has already been set rolling. The temper and feeling of the burgesses and their elected representatives regarding this matter are now flowing at full tide, and in the right direction. Doubtless the movement will be maintained with increasing momentum until all unhealthy houses and areas are swept away, and the houses of the artisans and other sections of the working and industrial classes are made as clean, bright, cheerful, and healthy as it is possible to make them.

2.—There is still room for improvement in the more frequent removal of dust, rubbish, and ashes. The prime objects to be aimed at are: (1) the transport of all decomposable material from the homes of the people before the process of fermentation has begun, thus depriving the germs of infectious disease of one fertile nidus in which they may germinate, grow, and multiply; (2) to get rid of odours erroneously attributed to imperfect house drainage; (3) to perceptibly reduce sickness and mortality, especially in the poor districts, and so increase the reputation of the town. In connection with this subject, the next object to be held in view is to have this refuse effectually burnt by means of a destructor situated at a safe distance from the inhabited parts of the Borough.

3.—The construction of an Abattoir (possibly more than one will be required) is a reform of the first magnitude. All that is now required is a good and convenient site. This having been secured the Council stand practically committed to a scheme for providing a public slaughter-house. With reference to this question, Dr. Letheby said, "There are advantages in every possible way to be gained (by having public Abattoirs) in the diminution of nuisance, better slaughtering of animals, better condition of the meat, in the better disposal of the offal, and also in the better supervision and examination." If, in addition, meat Inspectors were attached to see that none but healthy animals

were slaughtered for food, "visitors coming to Brighton would then be assured that they had there an advantage which has for so many centuries been of much important service to the Jewish people, an assurance which alone would be a great attraction." (Dr. B. W. Richardson.)

4.—All dairy stock should be accommodated outside the town. As things are now the animals must soon fall into indifferent health.

5.—Such an extension of baths and wash-houses as will meet the urgent wants of the inhabitants of St. Peter's and Preston districts.

6.—The construction of a grand swimming bath, comprising separate accommodation for the sexes, so situated as to meet the convenience of the people of the town generally. Here, all the boys and girls of our elementary schools should be taught the art of swimming as an integral part of their physical training, so that the rising generation of young men and women would have the great hygienic benefit accruing from this invigorating exercise, and be as much at home in the water as they are expected to be in reading, writing, and arithmetic, and other useful subjects of instruction.

In the sweeping away of (*a*) unhealthy houses and areas; (*b*) the reconstruction of the worst forms of tenement property; (*c*) the more frequent removal of ashes and rubbish; (*d*) the provision of an efficient destructor; (*e*) the housing of dairy cows beyond the boundaries of the borough; (*f*) such a further extension of baths and wash-houses as to minister to the needs of the inhabitants of the northern parts of the town; (*g*) the construction of a grand swimming bath, so planned as to give separate accommodation for the sexes, and so situated as to comply with the demands of the people of the town generally—there is, it must be admitted, still a wide field open for the further improvement of the public health. The execution of each of these reforms would be signalised by a well-defined reduction of the sickness and mortality. By adopting them all in their integrity, the death-tax would certainly fall from 15·04 to at least 10 per 1,000, or even less. Such a death-rate as this would enable Brighton to compare favourably with any of her genuine rivals, and to stand forth pre-eminently as the largest and healthiest seaside health-resort in the British Dominions.

Appendix.

Brighton Improvement Act, 1884.

Sec. 107.—Absolute power to close all cesspools.

Secs. 108-110.—Power to insist on provision of waste pipes

and special water supply to W.C.'s without service of notice. (Action, however, is seldom taken without serving a notice.)

Sec. 116.—Power to prevent filling up any land within Borough with offensive matters (made soils).

Sec. 118.—Power to purchase by agreement any houses which are unfit for human habitation.

Sec. 120.—Power to revoke slaughter-house licence if occupier convicted of selling, &c., diseased meat. This power is vested in the Magistrate's Court.

Sec. 121.—Power to prosecute in cases where unsound or diseased food is sold to customers before its condition was detected.

Sec. 122.—Power to open boxes, &c., for purpose of inspection of food.

Sec. 99.—No new house to be occupied until drainage and water supply has been completed, and surveyor's certificate given.

Sec. 100.—Height of new buildings shall not exceed distance from opposite side of street.

Sec. 55.—Corporation on certificate of M. O. H. may demand list of milk owners' customers. [This, at least in one case in my experience has led to the detection of a serious outbreak of disease.]

Sec. 58.—Penalty on those persons ceasing to occupy houses without disinfecting them if necessary, or not giving notice to owner, or making false answers.

Dr. POORE (London) expressed the indebtedness of the section to Dr. Ewart for his able paper, and said that the lessons he had conveyed to them showed how well the authorities looked after the sanitation of the town of Brighton. He thought it was extremely interesting to note the improvement mentioned in the last two tables, and he hoped that many of them would, on their return home, convey to their friends that Brighton was one of the healthiest as well as most popular seaside resorts on the coast of England.

Sir DOUGLAS GALTON (London) pointed out the inestimable advantage of complete isolation in cases of infectious disease by showing that London, since it had established at Long Reach, down the river Thames, a small-pox hospital, whither all small-pox patients were speedily removed, had never at any time had more than one, or perhaps two, cases of small-pox to record, so that in this case, at any rate, effective legislation was doing a great deal to stamp out a disease. With regard to the disposal of dust, he referred to a visit

he had paid in the spring to a place on the Thames near Chelsea, where an apparatus was used which in various ways made every particle of dust collected of some distinct use; some of it, after going through several processes, was made into brown paper; some was sold as breeze, and even for the old and broken crockery, when ground up, a good use was found. The apparatus was used, amongst other bodies, by the Chelsea Vestry, and he strongly recommended all towns who were thinking of a method of disposing of their dust to inspect this apparatus for themselves.

Mr. HENRIQUES (Brighton) did not think with regard to house drainage that the present state of the law between landlord and tenant was conducive to good sanitation. House drainage had certainly greatly improved in recent years, but very few knew the difficulties that had to be overcome, difficulties which had been enormously increased by the strained relation between landlord and tenant. Tenants who were very highly rented were unable to carry out improvements, whilst landlords did not choose to incur the expense. In this condition of affairs it was the custom of public authorities with regard to sanitation in houses to make the owner liable for so much, and also to saddle the tenant with certain responsibilities. As this had an unsatisfactory result he recommended that the Sanitary Institute should consider the expediency of introducing a Bill into the next Session of Parliament, rendering the owner alone liable for all sanitary improvements. It would sooner or later, he held, become a legal question that no landlord should let a house until it was pronounced thoroughly fit for occupation, and there was no better method of attaining this great end than to make the landlord responsible. If the liability was thrown upon the tenant, the tenant was unable to pay because of his high rent. On the other hand the landlord could indemnify himself if the rent was low, whilst if it was high that of itself was a complete answer why no additional burden should be thrown upon the tenant.

Mr. Henriques' recommendation having been held to be quite in order, Dr. EWART seconded it *pro forma*, and it was carried unanimously.

Mr. W. WHITE (London) said, with regard to the remarks of Mr. Henriques as to the transfer of liability in regard to all sanitary matters in a house from the tenant to the landlord, that it was an arrangement very much to be desired, and he hoped that the Sanitary Institute would be able in due course to take the matter in hand with that object in view. The whole subject of legislation affecting sanitation was in a most disadvantageous condition as regarded the tenant.

On "The Value of Hygienic Knowledge to Women," by Dr. A. T. Schofield.

ABSTRACT.

Introduction.
Importance of subject.
Quotations from Herbert Spencer, Lord Derby, &c.
Present state of sanitation.
Storage of life.
Premature death.
Needless sick beds.
Money loss to Nation.
Value of public sanitation.
Deficiency of private sanitation.
Leading diseases.
Carelessness and ignorance.
Present apathy among the laity.
Necessity of general instruction.
Illustrations of this.
Three forms of ignorance—harmless but disgraceful; hurtful and injurious; active for evil.
Remedies.
Value of hygienic knowledge in care of children.
Illustrations of this.
Value in emergencies.
Value in houses.
Value in poor visiting.
Hints on preventive hygiene.
Doctors as Health Officers.
Present condition an anachronism.
Women's education still deficient in this science.
Remedies.
Value to teachers of young.
Value to nurses.
Money value.
Life value.
Conclusion.

On "House Sanitation from the Householder's Point of View," by Prof. W. H. Corfield, M.A., M.D.

ABSTRACT.

Prof. Corfield said that he had not intended to speak at a meeting of this Section, but to confine himself to judging at the Exhibition. He was, however, asked by the Congress Committee to make a speech upon House Sanitation, but he did not propose to treat the subject from a technical point of view.

In the first place, they knew that the result of defective house sanitation was the production of diseases of one sort or another. Bad ventilation or overcrowding resulted in the production, or at any rate in the spreading, of consumption. No matter under what conditions, if they had bad ventilation and overcrowding, and people breathed the same air over and over again, they would have consumption spread. When they had overcrowding beyond that which caused the spread of consumption they had typhus or gaol fever. Where overcrowding had been abolished this fever did not exist, and again, it did not spread where there was no overcrowding. He had known of cases of typhus fever being removed from overcrowded places to places which were not overcrowded, but had not known of an instance in which a second case was produced by the introduction of the patient, although it was one of the most communicable of all known diseases. This showed that it only existed and spread under one condition, and that was overcrowding. In consequence of bad drainage they had a fever known as typhoid or enteric, and this was only known to spread where the removal of excremental matters was not properly carried out, and the excretal matter fouled either the air or the water.

The Spread of Diphtheria.

Diphtheria had been attributed to defective sanitary arrangements, but now they were told they must not attribute it to any one cause, as one epidemic was the result of a different cause to that which led to another. However, there was a strong feeling that defective sanitary arrangements had to do with it. It used to be confined to villages, but now it was attacking London and other large towns. Sore throats often arose from gas from drains or escape of coal gas from defective

taps into bed-rooms, and there could be no question that a great variety of other diseases were made worse, and in many cases they might be caused, by defective sanitary arrangements. When disease appeared in a house it was the fashion to get the house inspected and have the sanitary arrangements put to rights, but now some were getting wiser, and having their drains inspected before the disease broke out. He now proposed to tell them what a householder could do to ascertain for himself if there was anything very wrong in the sanitary arrangements of his house. He did not propose that every man should be his own sanitary inspector, but he should have knowledge which would lead him to call in aid when it was wanted. The senses of smell and of sight must be employed; a bad smell in a house indicated bad sanitation of some sort or other.

A Word about Dust-bins.

Whenever they had bad ventilation or overcrowding, and when the air had been breathed over and over again, there was a smell of what they called stuffiness, and when they entered a room from the outer air and smelt this, they might be sure the place was not fit to live in. Stuffiness, too, was often produced by too much furniture and too many carpets and druggets. He need hardly go into details now as to how air in a room could be kept sweet. Another smell frequently noticed about a house came from the dust-bin. A dust-bin should not contain anything that would smell, but it was a well-known fact that in towns they frequently did. Dust-bins, too, should never be constructed against the wall of a house, as the smell got into the walls and was conveyed into the lower apartments, and often spread through the walls to the upper floors. The small tubes containing bell-wires which ran from floor to floor were often the means of conveying smells from the basement of a house to the drawing-rooms and bed-rooms. In many houses if they lit a piece of brown paper in the boot-hole, through which the bell-wires passed, or in some other place in the basement which was not particularly sweet, they would be able to detect the smell of it in upper rooms.

Defective Flues, and Gas in Bed-rooms.

Another smell arose from defective flues. The lining of flues was often cracked off and the brickwork laid bare, particularly where fierce fires were burned, and then the smells got through the walls into the rooms above. This smell was peculiar, but it was known at once to those who were accustomed

to it, although until they got used to it it appeared very much like the smell of a drain. The escape of gas in a bedroom, although it might not be detected by the gasfitter when he applied a light, was often not noticed except by the person sleeping in the room, who got a sore throat, and he (Dr. Corfield) thought it a mistake to use gas in a bed-room at all. He had known quite a sore throat epidemic springing up in houses, and especially in country houses, through the escape of gas.

Drain Pipes and Overflows.

Another cause of smell was the connection of overflow pipes with the drains, which pipes, as well as the waste pipes from sinks and lavatories, should discharge over traps in the open air. Even when they were disconnected smells sometimes arose through air coming from the outside up long pipes, which must necessarily become foul, and traps should be used to prevent this air coming into the house. A simple bend in a pipe—like the one he produced—was the best plan to adopt, as it was the most simple, and the trap was continually flushed by the water passing through it. No complicated form of trap should ever be used. Continuing, he said bad smells were often caused through water-closets and sinks not being next to the external walls, so that they could be ventilated from the exterior, although it might be thought that closets with a shaft running to the top of a house was properly ventilated. The building of a closet in the middle of a house was a far more serious matter than it appeared to be, for the pipes had to be carried down inside the house, and drains had to be laid underneath it, when this could often be avoided. He pointed out the great necessity of ventilating soil pipes, and then, alluding to the way in which the sense of sight must be used, said every occupier should make an inspection and see that all waste and soil pipes were carried direct to the outside of the house, and see that soil pipes had ventilating pipes of the same size running from them to above the top of the house and free from windows, and also from chimney stacks, which caused a downward draught when the wind was in a certain quarter. In conclusion, he pointed out the necessity of separate cisterns for the supply of drinking water and for closets, and also the necessity for a disconnecting chamber for the drain, with an inlet for fresh air not blocked with talc flaps or any such contrivances.

On "The Bearing of School-Attendance upon the Spread of Infectious Diseases," by ARTHUR NEWSHOLME, M.D., D.P.H.UNIV.LOND., Med. Officer of Health for Brighton.

SCHOOL life forms such a large portion of that of the nation, and engages such a large proportion of the total population, that its bearings on the public health are of the utmost importance to the whole community. I shall, in the remarks which follow, omit all consideration of private and other schools which are not under government inspection, and which do not receive grants of money from the Education Department. My remarks apply only to public elementary schools (board or voluntary). On the 31st August, 1889, there were 19,310 such schools in England and Wales, having accommodation for 5,440,441 scholars, and having on their registers 4,755,835 scholars; and an average attendance during the year of 3,682,625.

It is important for us in the first place to *ascertain whether these schools have caused an increased prevalence of infectious diseases.* Let me say at the outset that I am fully cognisant of the great benefits which will accrue to the whole community from a universal system of elementary education, that I have the utmost admiration of, and sympathy with, the teachers in their noble work; and that I value such education so highly that I should regard it as justifiable to incur considerable risks of increased prevalence of infectious diseases, were this necessary, in order to secure the advantages to be derived from universal elementary education.

Of the infectious diseases occurring at school ages, scarlet fever, diphtheria, measles, and whooping cough are the only four which need occupy our attention. Compulsory school attendance began soon after the passing of the Elementary Education Act in 1870, and the accompanying table shews the mortality from these four diseases before and since 1870.

Annual Death-rates per Million of the population from several Diseases.

	5 years, 1861—65.	5 years, 1866—70.	5 years, 1871—75.	5 years, 1876—80.	5 years, 1881—85.	4 years, 1886—89.
Measles	456·6	428·4	373·2	384·8	410·2	455·3
Scarlet Fever	982·4	959·8	758·8	679·6	434·0	238·3
Whooping Cough	515·8	545·0	498·6	527·2	456·6	430·0
Diphtheria	247·6	126·8	120·8	121·8	155·6	157·3

It will be seen that measles and whooping cough have altered but little in their rate of mortality, during the period stretching from 1861 to 1889; that the mortality from scarlet fever has greatly declined; while that from diphtheria, though at the present time not so high as in the period from 1861-65, is higher than in the intermediate years.

Let us compare with this result the increased numbers who attend elementary schools. It will be seen from the following table, that while only 5·12 per cent of the total population were in attendance at elementary schools in 1870, the proportion steadily rose to 12·69 per cent in 1889; or stating the number in proportion to the entire population aged 5 to 15, it increased between 1870 and 1889 from 22·7 per cent. to 55 per cent.

Years.	Number in Average Attendance.	Per cent. of Total Population.	Per cent. of Population aged 5—15.
1870	1,152,389	5·12	22·7
1876	1,984,573	8·12	35·7
1880	2,750,916	10·77	46·7
1885	3,371,325	12·26	53·1
1888	3,614,967	12·62	54·5
1889	3,682,625	12·69	55·0

Compulsory school attendance begins at the age of 5 years. It usually terminates in the 13th year, or earlier. It will therefore be more satisfactory to compare the present death-rate from these four diseases at school ages, with the average death-rate from the same diseases in the decennium ending with the year in which compulsory school attendance became a part of the law of the land. I cannot obtain the death-rates for the ages 5-13, but the group 5-15 obtainable from the Registrar General's reports is sufficiently near for our purpose.

Death-rate per Million living, aged 5 to 15 years.

	10 years. 1861—70.	4 years, 1886—89.	Percentage Increase or Decrease.
Measles	141	162	+14·9
Whooping Cough	84	65	−22·6
Scarlet Fever	1387	309	−79·9
Diphtheria	272	247	− 9·2
From all Four Diseases	1884	783	−58·4

It will be seen that in the case of measles the rate of mortality has increased by 14·9 per cent.; in the case of whooping cough it has declined by 22·6 per cent.; and of diphtheria by 9·2 per cent. *at school ages.* The figures are on such a large scale that they are not open to the fallacies caused by accidental variations in different parts of the country or in single successive years. If we take these remarkable figures in conjunction with the fact that whereas in 1871 the number of scholars in average attendance at the elementary schools of the country formed 22·7 per cent. of the total population, aged 5 to 15, in 1889 they formed 55 per cent. of the population, aged 5 to 15, it will be evident that the association between school attendance and the spread of infectious diseases is not so close as is usually supposed.

It might, with a superficial show of reason, be argued from the preceding figures that school attendance has no tendency to increase infectious disease; and I think my figures prove that this tendency has been exaggerated in the popular mind, and even in the minds of many sanitarians. But it would be a serious error to conclude that school attendance has no such influence for evil. It is a matter within the experience of every Medical Officer of Health that the occasional attendance at school of children who are convalescing from, or in the earliest stages of an attack of an infectious disease, is a not infrequent cause of the spread of such disease; and in the case of measles we have seen that the present death-rate is higher than the death-rate which obtained during the ten years before compulsory school attendance began.

It becomes therefore an interesting and important inquiry to ascertain *how any such possibilities of evil may be still further diminished in the future;* and this will form the main enquiry of my paper. And in pursuing this inquiry I would say that first and foremost the Medical Officer of Health must have a complete and early information of every case of infectious disease. Now that compulsory notification of infectious disease has become so general (one might almost say universal), this object is attained in most districts in the case of scarlet fever and diphtheria. I am of opinion that similar knowledge should be attainable for measles and whooping cough, as either of them is more fatal to the community than scarlet fever or diphtheria. Such knowledge would enable us to educate the general public, and by judicious pressure gradually enforce the *complete isolation of all infectious cases* and the quarantine of healthy children in infected houses. It would appear, however, that in regard to whooping cough at least, the necessity for isolation has not been sufficiently grasped even in sanitary circles. This is

brought out by a letter addressed by the Society of Medical Officers of Health in April, 1886, to the clerk of the London School Board, in answer to a letter addressed to the society by the Board asking for information concerning certain infectious diseases. I must enter a mild protest against the following statement in the letter in question: "Again, in the case of whooping cough. If a child itself is suffering from this disease, it ought certainly to be excluded; but having regard to the fact that the danger from the disease is not so great at school-attending ages, the society would not prohibit the attendance of healthy children coming from infected families." In order to support my objection to the plan allowed in the passages quoted, I must make a somewhat detailed statement. The age of the scholars in elementary schools has an important bearing upon the point in question.

Now, in 1889, of the total number on the school registers—
31 per cent. were under 7 years of age.
66 „ „ between 7 and 13 years of age.
and 3 „ „ over 13 years of age.

I am obliged to assume that the *mortality* returns furnish a fairly reliable indication of the relative prevalence of the four infectious diseases under consideration at different ages, as no very complete figures of the total number of *cases* of any one of these diseases are available.

The following table shows the proportion of the deaths from these diseases occurring at different ages during the year 1888 :–

	Total Deaths at all ages.	Percentage of Total Deaths occurring from each Disease.					
		Under 1 year.	1—3	3—5	5—10	10—15	At all Higher Ages.
Measles	9784	20·2	54·9	16·3	7·6	0·5	0·5
Whooping Cough	12287	44·0	42·3	10·2	3·3	0·1	0·1
Scarlet Fever	6378	5·7	30·9	29·3	25·3	5·1	3·7
Diphtheria	4815	5·1	24·1	26·8	31·2	5·7	7·1

It will be noted that the largest percentage of deaths from all these infectious diseases occurs between the ages of 1 and 5, and this applies especially to Whooping Cough and Measles.

It is usually supposed that the number of children attending school at these ages is very small, and this impression was evidently shared by the Society of Medical Officers of Health, when the letter which I have quoted was written. As a matter of fact, in 1889, 464,144 children on the registers were below 5 (or 9·3 per cent of the total scholars at all ages), while 1,031,626 were between 5 and 7 years of age (21 per cent. of the total scholars).

I have no figures giving the proportion of deaths from the above four diseases between 5 and 7 (the smallest group given by the Registrar-General being 5 to 10); but an examination of the above table will show that whooping-cough has, at least, 13·5 per cent. of its total mortality between the ages of 3 and 10, and 10·2 per cent. of its total mortality between 3 and 5, when a large number of children are in attendance at school. That *a very considerable proportion of the mortality from whooping-cough occurs at school ages*, is further shown by the following table taken from the 51st Report of the Registrar-General, and founded on the experience of the whole country, from 1848 to 1887.

Annual Death-rate per Million living at each age or group of ages.

		Period taken for Calculation.	Under 1 year.	1—2	2—3	3—4	4—5	5—10	10—15
Measles.	Males	1848—87	3011	5812	2883	1599	926	236	25
	Females ...	Do.	2515	5462	2935	1680	956	259	32
Whooping Cough.	Males	1848—87	6769	4930	2071	1086	584	118	5
	Females ...	Do.	7306	6223	2954	1629	859	179	10
Scarlet Fever.	Males	1859—87	1664	4170	4676	4484	3642	1667	346
	Females ...	Do.	1384	3874	4491	4332	3556	1613	381
Diph-theria.	Males	1859—87	464	720	675	757	690	337	100
	Females ...	Do.	356	665	731	835	782	434	147

It will be evident from this table that although the death-rate from whooping cough is not so high between 3 and 5 as that of scarlet fever, it is higher than that of diphtheria, and if, as is generally acknowledged, it is desirable to keep apparently healthy children in an infected household away from school in the case of diphtheria, there is no valid argument against the same course being adopted for whooping cough. I would maintain that "having regard to the fact," that 10·2 per cent. of the total deaths from whooping cough occur between the ages of 3 and 5, at which ages (or at least at all ages below 5; some are even younger than 3 years, which would strengthen my case) 9·3 per cent. of the total scholars on the registers of English Elementary Schools are attending school, it is the bounden duty of all Medical Officers of Health to use their best endeavours to prevent the attendance of children at *infant* schools, so long as a case of whooping cough remains in the same house. I do not think we should be justified in keeping *all* children in the infected house away from school; but I would commend to your favourable attention the practice adopted in Brighton, *of keeping all children away from the infant school* who come from a household where whooping cough exists.

In regard to the other diseases named, I believe there is no discrepancy of opinion. It is recognised that whether the disease is scarlet fever, diphtheria, or measles, the parents must be warned against allowing other children in the house to attend school. I fear it is not an equally universal procedure to warn the teacher against admitting children from infected houses to school. Parents will persist in sending their children to school, notwithstanding advice from their medical attendant or the sanitary officials; and the fact that this occurs every day, is one of the strongest arguments for the compulsory notification of whooping-cough and measles, as well as of scarlet fever and diphtheria.

The intimation should be sent direct from the Sanitary Office to the head teacher of the school, and not indirectly to the School Board, as has been suggested. It is only by the former plan that the tedious delays of officialism can be avoided, and the efficacy of the intimation as a preventive measure secured.

In some towns, I believe, the plan which I have introduced in Brighton is adopted; but, as it appears to be rather the exception than the rule, I append a copy of the circular letter which we forward to the head teacher when an infectious case occurs in a house from which children attend school. If children from the same house attend in the boys', girls', and infants' departments of a school, a letter is forwarded to the head teacher in each of these departments. The plan works smoothly, and with little expenditure of time and labour, and I have reason to believe that it is very efficient in preventing infection. It also leads to friendly relationships with the teachers, and to their giving every possible information on points relating to the public health.

"Health Department,
Town Hall, Brighton.

PRIVATE.

.....189

Dear.....

.....

of ..... is now ill at home suffering from .....

He should not be allowed to return to School for..... days, and during the same period no other children from the same house should be allowed to attend School.

Yours very truly,
ARTHUR NEWSHOLME, M.D.,
Medical Officer of Health."

I cordially acknowledge the help which I have always found teachers ready to render in preventing the children of infected households from attending school. But on another point I must enter an emphatic protest against a practice which is, I believe, fraught with danger to the public health. This is the practice of sending scholars to enquire the cause of absence of absentees. The usual practice adopted is for the teacher to enquire of his or her class, "Who lives in the same street as John Jones?" (naming an absentee). "Then will you take this note and enquire why he is not at school this morning?" In cases which have come under my own observation, children thus sent by their teacher have been ushered directly into the living-room, in which children suffering from scarlet fever or measles or some such disease are lying. The answer usually given by teachers when I have protested against this practice has been, "Oh! we do not send children when we know that there is infectious disease in a house." Of course not! But then there are the 99 out of every 100 cases in which the cause of absence is unknown; and I am in a position, from personal experience, to say that the practice is highly dangerous and most objectionable. It is easy to understand why the teacher is so anxious to secure the regular attendance of his scholars. Even if his income does not directly depend on the percentage of passes he secures (and I am glad to find that this system of payment by results is steadily tending to become obsolete), yet his professional reputation and future promotion are largely influenced by the results he obtains; and these results are in a great measure determined by the regular attendance of his scholars. In addition, a large proportion of the Government Grant is given on the basis of the average attendance, and there is therefore every inducement for both teachers and school-managers to urge the early return of absentees to school. In one case which came to my knowledge, two children, just convalescing from measles, were offered one penny each if they would be sure and come for the Government Inspection on that day!

But it will be said, there are special school-attendance officers whose duty it is to look up absentees. This is true, but their number is quite insufficient to cope with irregularity of attendance. They can only deal with the more persistent truants, whose parents may need magisterial interference. The rule in Brighton is for these officers to look children up who have been absent 3 or 4 times out of 10 possible attendances per week. That they can do no more is shewn by the fact that in Brighton there are only six attendance officers, while in May of this year there were 16,951 on the rolls of the

elementary day schools of the towns, and 13,351 in average daily attendance. This means a daily average of 3,600 absentees, divided among 23 boys' schools, 33 girls' schools, and 35 infant schools, and implies 600 visits per diem for each officer, if complete and daily oversight is to be maintained.

Then again, such visits of the attendance officers are only made after 3 or 4 days' absence; and what the teacher is anxious to ensure is that any scholar who is absent from school for half-a-day shall be looked up, and the parent urged to enforce regular attendance.

Several years ago, in consequence of a report by me, this subject was brought before the London School Board, and the Board, I believe, announced that they "discouraged" the practice of which complaint was made. But it is notorious that the practice is almost universal, and that something more than "discouragement" is required. I can scarcely blame the teachers for doing as they do under the circumstances. The only remedy which appears to me to be practicable, is to have a special officer in connection with each board school and voluntary school appointed by the school board, whose duty it would be to look up absentees morning and afternoon. His duties would in no way clash with those of the present attendance officers. It would be his duty to hand over obstinate cases to the latter, to be dealt with by legal measures or otherwise. Some such plan as I have suggested would remove a great danger from our midst, and would I believe, if combined with an absolute veto against home visitation by scholars, relieve teachers from their present anxiety to secure by every means a good average attendance.

I began this portion of my subject by inquiring how the danger of infection, in connection with school life, may be reduced to a minimum; and I have advocated in this connection—(1) the compulsory notification of measles and whooping cough, as well as of scarlet fever and diphtheria; (2) the complete isolation of infectious cases and the quarantine of children in infected houses; (3) that whooping cough in a house should be no exception to the rule, but should preclude all children of the same house from attending infant schools; (4) that the Medical Officer of Health should give prompt and direct intimation to the head teacher, of any case of infectious disease among his scholars, and instruct him as to the duration of the infectious period; (5) that teachers should be strictly forbidden to send children to enquire the cause of absence of absentees, and that a special officer should be appointed for each school to visit such absentees.

Two other measures remain to be considered.

(6.) The importance of instructing parents and scholars in the

laws of health. Much mischief in spreading infection is done in ignorance, an ignorance which is so crass and pertinacious that it is difficult to realise that the sin is not being committed against light and knowledge. As I shall have something to say on this evil and its remedy on Thursday, I need not further dilate on it to-day.

(7.) The closure of schools, owing to the presence of infectious disease among the scholars, is a step which has been frequently taken of late years, but it is one the frequent necessity for which I very much doubt. If we had compulsory notification of whooping cough and measles, as well as of scarlet fever and diphtheria; if the sanitary staff in each district were efficient in numbers and sufficiently energetic, such a measure would, in my opinion, be only required under one condition, viz.:—when insanitary conditions in the school itself had given rise to disease. But as matters now stand, an epidemic of measles not uncommonly reduces the average attendance of a school by one half before the Medical Officer of Health is fully acquainted with its existence. Under these circumstances it is sometimes necessary to recommend the closure of a school, especially when there are reasons for believing that the children meet chiefly if not solely in school. What we require is prompt and complete information of every case of measles, and then it would, I believe, be seldom or never necessary to close a school on its account. Let erysipelas and puerperal fever be expunged from the list of notifiable diseases (or at least the first of these), and let measles take their place. It is true that considerable expense would be incurred at first by such notification, as measles so rapidly spreads; but its rapid spread is largely due to our ignorance of its presence, and to the fact that we have hitherto scarcely attempted to cope with it. We have, in scarlet fever, an instance of what preventive measures can effect; if measles be more difficult to deal with owing to its infectiousness before the rash appears, let us not be daunted by the task, but do our utmost to secure complete and prompt information in regard to it, and we shall then have done much to add it, as well as whooping cough, to the list of diseases which are becoming steadily diminished by sanitary measures.

Dr. Strong (Croydon), in commencing the discussion, said the lecturer had not denoted whether the mortality arising from whooping-cough was divided at all as to the time of year, because that would have a vast influence on the number of deaths. As to the

question of constituting teachers administrative officers under the conditions suggested, he was opposed to the idea, and held that there should be an Infectious Diseases Officer, who should himself go to the house of illness and investigate the circumstances of the case. The spread of measles he thought might be traced to the fact that the working classes thought so little of it. Then, although people were so particular in not allowing their children to go with others when those others were recovering from illness, yet when their own children were unwell they thought they could not possibly give their companions anything.

Dr. Sykes (London) dwelt upon the case mortality, which had an important bearing upon the relative value of various diseases. The mere whoop did not constitute whooping-cough. He was doubtful of whooping-cough being as prevalent as it was stated to be. With regard to measles, that ought to be notified because it was a specific disease. If each disease was allowed to stand on its merits the case would be met.

Mr. H. H. Collins, F.R.I.B.A. (London), as Chairman of the Sanitary Committee in Paddington, was glad to learn that there was unanimity of opinion in including measles among the diseases which ought to be notified. A curious circumstance had been encountered in making investigations into the outbreak of diphtheria in Paddington; it was, that in almost every instance, upon measles had supervened diphtheria. It was not for him to say that the causation of diphtheria was measles, but certain it was that diphtheria had supervened, and with very disastrous results. At all events, the circumstance showed the absolute essentiality of making measles one of those diseases which should be notified. That the remarks which had been made were justified was shown by a recent report of the Local Government Board, in which, out of six cases of diphtheria outbreak which had to be inquired into, in every instance the cause of the dissemination of disease had been through schools. He also insisted upon the necessity of obtaining information at once.

Dr. Armstrong (Newcastle) said that in the town he represented measles was most fatal. Schools were always blamed by poor people, sometimes rightly and sometimes wrongly, as the source from which the children had caught the disease. He considered the principals of schools should be informed that various diseases became infectious and the time they continued to be so. With regard to scarlet fever especially, school principals and others had very little knowledge of its period of infectivity; he favoured certificates of health being required at the opening of each session in schools.

Dr. Kempster (London) took it that the practical outcome of the paper and discussion had rather tended to show that the Medical Officers of Health were unanimously of opinion that measles should be included in the list of notifiable diseases. He was sorry he could not agree

with Dr. Sykes as to the character of whooping-cough, for the mortality arising from the two diseases combined had greatly exceeded all other mortality from zymotic diseases. He thought it would be a great thing if some expression of opinion could go from them that measles should be included in the notifiable diseases, and he should like to move a recommendation to that effect.

Dr. A. Newsholme, in answering the comments which had been made upon his paper, said he thought it should simply be the duty of the head teacher to prevent the children from an infected house from coming to school. He thought it would be better, perhaps, to consider measles and whooping-cough apart, to first make measles notifiable and let whooping-cough come afterwards.

On "A National Health Service," by The Hon. F. A. R. Russell.

ABSTRACT.

The objections to the exercise of a strong and uniform State control and supervision do not hold in respect to infectious diseases. These evils arise from causes which are well known, and can be greatly reduced by the application of certain well-known principles by a central authority, having the advantage of full information concerning the distribution of infectious diseases throughout the country from day to day, and of the services of sanitarians of the highest skill and ability. Most localities do not take much interest in bringing their districts to a high degree of salubrity, and many medical officers receive so small a salary that their occupation as such is disregarded in comparison with their private practice, which they are still allowed to pursue. In fact, the Sanitary Acts in the rural districts and in very many small towns are a failure, and through this failure the whole nation suffers. A neglected village may be the cause, through milk, water, or ordinary intercourse, of destructive epidemics in neighbouring or even distant towns or counties. Infective diseases ought, like fire, to be under the constant and effective supervision of an authority for the whole area over which the destructive power is likely to spread if unchecked, and this area, in the case of infection, is the whole country. A Ministry of Health might learn, from the notification already adopted by over three-fourths of the

country, the distribution and progress of various diseases, and its officers might be continuously conducting a campaign against them by the best known means.

The conditions which favour the spread of infection are so well known that there would be little difficulty in arresting an outbreak at its inception. The experience of the Westminster Sanitary Aid Association was that even in the midst of a crowded population, and in the case of so easily caught a disease as scarlet fever, it was possible to confine the fever within very narrow bounds. The Sanitary Aid Association of Hastings almost put an end to infectious illness in that town, although of course many visitors must have resorted thither before being perfectly safe. In fact, few Local Authorities have attained the degree of immunity from zymotic disease which is really possible for the whole nation to reach, if willing to conform to certain rules which are beneficial both to the sick and the healthy. Diseases arising from impure conditions of water, or air, or milk, can be easily reduced in their places of origin, and prevented from spreading by isolation and disinfection. But the amount of knowledge, training, and authority required to deal adequately with them is such that no body, other than a Government or National Department, could fitly undertake the task. And when these infections are constantly travelling beyond county boundaries, even a County Council cannot keep their ramifications within view. Rabies was never put down with very much success except by State Authorities, for the same reason, that it is carried rapidly from place to place, for the rabid dog runs. But where the Government deals seriously with rabies, by general muzzling and care respecting imported dogs, hydrophobia ceases to exist. It is also becoming apparent that the only right way of dealing with the pleuro-pneumonia of cattle is to place the responsibility altogether in the hands of the Central Authority, and to obtain thus the prompt and scientific treatment which was not always given by the counties.

The plan recommended by the Joint Committee on State Medicine, of the British Medical and Social Science Associations, still appears the best which can be devised. By it there was to be created, instead of the many local authorities now existing, one elected and representative body, clothed with all executive functions, whether municipal or sanitary, within the area of its jurisdiction. The Health Officers of the County Boards were to be men of high scientific attainments and acknowledged ability; paid adequate salaries for superintending the whole or a division of a county; to these were to be added medical officers of districts, and all were to form one great Department of the State, under the presidency of a Minister of

Health, but all these officers were to be under central control, so far as making up one great body of workers for general State medical purposes.

The fact is, infectious disease is not merely local, and cannot be dealt with effectually by Local Authorities, because if one is active, another is negligent, and because such separate and uninformed Authorities cannot attack the enemy with anything like the force or precision of a trained brigade. There is no escape from the urgent need of State control in respect of epidemic and spreading diseases, for a single neglected district is a danger to the whole nation.

On "The alleged danger to Public Health, arising from effluvium nuisance from Gas Works," by WALTER HEPWORTH COLLINS, F.C.S., F.R.M.S., &c.

FROM time to time public attention has been drawn by various means to the offensive smells emanating from the process of gas manufacturing and other operations incident thereto, and such odours have been credited with producing or encouraging various ailments of a more or less serious character.

The influence on the death rate by many of our manufacturing industries carried on in large populated towns, is a department of public health which appears to have been somewhat neglected by our various sanitary authorities; when however, either by some accident or design, their attention is directed to the subject, they attribute, perhaps through misinformation or ignorance as to precise nature of the so-called noxious industry, so many and peculiar causes of sickness as to render the suggestion absurd.

Recently, however, it has been suggested by eminent sanitarians that the effluvia from gas works are of a most injurious nature, and in fact absolutely deleterious to health; and further, that they are a most important factor in considering the high mortality of some of the larger manufacturing towns in this country.

This suggestion is of great importance, and as there does not appear to be any recent data of a reliable nature as to the condition of the air in the immediate vicinity of, and the alleged injurious effluvia arising from, works of the character in question,

one of the objects of this investigation has been to secure such data and place it on record in the Transactions of this Institute, where it will be readily accessible for reference.

The gas works of such towns are, as a general rule, situated at the lowest accessible level, and, particularly in the case of old works, are surrounded by cottage or other property of an indifferent character; the adjacent neighbourhood being tenanted usually by the lower labouring class, whose sense of smell would not appear to be of a cultivated or refined type.

The process of gas purification is subject to constant change and improvement, and therefore it may be as well to briefly state at this stage the ordinary cycle of operations usually carried on in a large modern works, in the neighbourhood of which these investigations were carried out.

The crude gas from the retorts and hydraulic main is first conducted to the condenser, and its temperature reduced to about 60° F., when much of the watery and tarry matter is thrown down. It is desirable not to reduce the temperature of the gas below 58° F., so as to avoid depositing the naphthalene and other valuable illuminants, and consequently impoverishing the gas.

The gas is then led on to the exhauster, which is a mechanical contrivance for reducing the pressure on the retorts, for helping the gas forward through the purifying apparatus, and for other purposes which it is unnecessary to describe in detail here, inasmuch as the machine plays no part in the specific purification. The gas at this stage is very crude, and any leakage or escape would undoubtedly cause a most offensive nuisance, as it contains large quantities of sulphuretted hydrogen, ammonia, carbonic acid, carbonic oxide, and cyanogen compounds. Most of these are affected, and some removed in the next process of purification—washing and scrubbing. The apparatus generally consists of a large chamber (of various forms) mechanically arranged so as to offer a large surface, constantly "sprayed" with water, to the gas. The water in this apparatus practically absorbs the ammonia, and, when not saturated with this gas, such quantities of the carbonic acid, cyanogen, and sulphur compounds as the ammonia can combine with, and thus forming carbonate, sulphide, and sulphocyanides of ammonia. The water is then the "gas-liquor," or ammoniacal liquor of commerce. The gas is then led on to the "purifiers," which are either of lime or hydrated oxide of iron, or both, and here the carbonic acid is removed, and the noxious sulphur compounds reduced in the gas to a practically non-injurious quantity. The cycle of purification is thus complete, and the gas passed on to the holder ready for consumption.

We now come to consider the character of the nuisance arising from the retort house, and also from the purification processes above referred to, and their general bearing on the public health. The greatest nuisance is undoubtedly due to the smoke given off during the charging and drawing of retorts; to the generation of "water-gas," when the red-hot coke is quenched with water; to the escape of crude-gas from the mouth-pieces of the retorts; to the smoke given off from imperfectly "carbonised" charges; to the firing by the stoker of the tarry matter and dust accumulated in the retort mouth-piece during distillation; and to the long smoky flame emitted from the retort when the lid is removed on account of a stoppage in the ascension pipe.

All these operations, when indifferently carried on, are offensive, and undoubtedly cause a most dangerous nuisance.

The following analyses show the condition of the air flowing from the ventilators of the retort-house roof. The samples were taken from different gas works, A being in a densely-populated town, B being a small works situated in the country. Both samples were highly charged with fine dust of a carbonaceous character.

TABLE A.

	A.	B.	
Carbonic Acid	2·29	7·31	Per cent.
Carbonic Oxide.....	4·26	9·36	„
Ammonia	6·23	9·41	Milligrams in cubic metre.
Sulphuretted Hydrogen	7·16	12·5	„ „

The air outside the gas works, 250 yards away in each case, had the following composition:—

TABLE B.

	A.	B.	
Carbonic Acid	2·03	Trace.	Per cent.
Carbonic Oxide.....	None.	None.	„
Ammonia	0·095	Trace.	Milligrams in cubic metre.
Sulphuretted Hydrogen	Trace.	None.	„ „

The above analyses show how rapidly the noxious gases are dissipated, and also indicate the precise source of the nuisance.

Both samples in table A. are of a foul and highly dangerous nature, and should be utilized or conducted into a "destructor" or chimney stack. The following analyses are of a sample of air taken in the gas works yard, four yards from the "condenser":—

TABLE C.

	A.	B.	
Carbonic Acid	1·93	Trace.	Per cent.
Carbonic Oxide.....	None.	None.	„
Ammonia	0·16	Trace.	Milligrams in cubic metre.
Sulphuretted Hydrogen	Trace.	Trace.	„ „

From this table it appears that no appreciable nuisance arises from the "condenser."

The "washer" or "scrubber" does not appear to pollute the air very much, as the following analyses show:—

TABLE D.

	A.	B.	
Carbonic Acid	1·96	0·09	Per cent.
Carbonic Oxide.....	0·03	0·04	„
Ammonia	0·03	0·06	Milligrams in cubic metre.
Sulphuretted Hydrogen.....	0·04	Trace.	„ „

The purification house, however, is a source of nuisance, the smell being most offensive, especially where lime is used for the removal of those sulphur compounds which have not been intercepted by the condensing and scrubbing operations. When lime is used for absorbing the carbonic acid alone, no nuisances whatever are caused; but when it has been used for the removal of both carbonic acid and sulphur compounds, it proves a most offensive nuisance. Being in the form of sulphide, sulpho-carbonate, or polysulphides of calcium, most of these are liberated when this purifying material is exposed to the atmosphere, by the action of the carbonic acid and oxygen in the air; the sulphuretted hydrogen and bisulphide of carbon are consequently released, and create a really disgusting and poisonous nuisance. When, however, natural oxide of iron is used, either alone or in conjunction with lime, the nuisance is

reduced to a minimum—the lime being used for absorption of the carbonic acid alone, and the iron-oxide for securing the sulphur compounds.

The following analysis indicates the state of the air issuing from the ventilator holes in the purifying house where lime alone is used:—

TABLE E.

Carbonic Acid	None.	Per cent.
Carbonic Oxide.....	None.	„
Ammonia	1·61	Milligrams in cubic metre.
Sulphuretted Hydrogen.....	41·93	„ „

The following table shows the state of the air in the purifying house where lime and iron-oxide are used separately:—

TABLE F.

	Lime.	Oxide of Iron.	
Carbonic Acid	Nil.	Trace.	Per cent.
Carbonic Oxide.....	Trace.	Trace.	„
Ammonia	Trace.	Trace.	Miligrams in cubic metre.
Sulphuretted Hydrogen	0·04	0·009	„ „

Another alleged source of nuisance is the utilization or "working up" of the ammoniacal water or "gas liquor" containing the polysulphides of calcium previously referred to, and its subsequent manufacture into sulphate and other salts of ammonia. I have made analyses of the air adjacent to a large sulphate of ammonia plant, with the following results:—

TABLE G.

No. of Sample.	Grains per 100 cubic feet.			
	Carbonic Acid.	Ammonia.	Sulphuric Acid.	Hydrochloric Acid.
17	0·46	16·7	56·3	16·3
21	0·49	16·5	40·2	16·1
27	0·46	16·1	41·6	16·9
24	0·43	16·9	51·9	17·0

This analysis shows that the air is highly charged with

chemical vapours of an irritating and noxious kind. The plant was of the most modern construction, and turning out a large quantity of ammonia salts per annum.

Having before us the foregoing tabulated results of analyses of the air from various parts of the gas works, we are in a position to trace any nuisance to its source, and also have sufficient data as to the condition of the air on which to base an opinion as to its action on health. These results also show that the larger works situated in populous places cause less nuisance than the small works situated in the country; probably the latter presume upon their position, and conduct their operations in a more or less careless manner. There can, however, be no doubt whatever that if the operations referred to in this paper are not carefully carried out and stringently overlooked, they will be a most prolific source of nuisance and danger.

The Sanitary Institute has done most valuable work in directing attention to and suppressing many evil nuisances and dangers to public health, and its action in regard to smoke abatement, of course, includes the abatement of noxious fumes or smoke from gas works.

Dr. Ballard in a report to the Local Government Board in 1878 states, "In the various processes of distillation of the coal, purification of the crude gas, and disposal of the condensed matters and refuse, offensive emanations are apt to be given off, such as to cause the neighbourhood of gas works to be shunned by all who can afford to reside elsewhere. Medical men are usually ready to certify that the effluvia are injurious to public health, probably referring the effects produced on those who are exposed to their influences in a diluted form, to the operation of the sulphuretted hydrogen as a poison. It is certain that exposure to the diluted effluvia from sulphate of ammonia works, does in many cases induce feelings of depression, headache, loss of appetite, nausea or vomiting, and sometimes some oppression of breathing."

With reference to this statement of Dr. Ballard's, it will be noticed that in the appended table of air analyses, the sample from the centre of the town of Bolton, highly polluted by smoke, is actually worse than the sample from the sulphate of ammonia works on the outskirts of the town.

I would refer to the following authorities who have observed the action of these and similar gases on public health. The air of towns may be vitiated by respiration, combustion, effluvia from the soil, sewers and trades. The movement of the air tends however, to continually dilute and remove these impurities, and the heavier particles deposit, so that air even of manufac-

turing towns is purer than might have been anticipated[1]. Manouvriez[2] says, that workmen in the coal and tar distillation works suffer from melanodermy, cutaneous eruption, and affection of the eyes, ears, and nose; bronchitis with pulmonary pseudo melanosis, and gastro-hepatic disorders. Hirt[3] also mentions a similar state of things due to the same cause. The[4] normal quantity of carbonic dioxide being ·4 vols. per 1,000, it produces fatal results when the amount reaches from 50 to 100 vols. per 1,000; and 15 to 20 per 1,000, produces severe headaches.

Of[5] the effect of carbon monoxide there is no doubt. One per cent. has been fatal, and less than half per cent. has produced poisonous symptoms. This[6] gas replaces oxygen in the blood, volume for volume, and cannot be again displaced, so that the person dies asphyxiated; Powrowski[7] has shown that it may be converted into carbon dioxide. The evidence with regard to the effect of sulphuretted hydrogen is not of a conclusive character. Hirt[8] has noted the following symptoms of chronic poisoning in men working in the neighbourhood of gas-works: slow pulse; weakness and depression; furred tongue; mucous membrane of mouth pale, as also the face; emaciation and head symptoms "like a case of slow-running typhus." Josephson and Rawitz[9] found two forms of disease produced: narcotic and convulsions, and tetanic symptoms. Spasms, tremblings, and even tetanus sometimes followed. *Carburetted hydrogen*[10] can be breathed for a short time, but it eventually produces symptoms of poisoning, convulsions, and vomiting. *Ammoniacal vapour*[11] has a marked and irritating effect on the conjunctiva, but there is no reliable evidence of any other action. *Sulphur dioxide*[12] causes complaints of bronchitis. *Carbon disulphide*[13], referred to in the early portion of this paper, seems to act on the nervous tissue with a direct anæsthetic effect in so far as it produces giddiness, headache, pains in the limbs, depression, loss of appetite, deafness, dyspnœa, and even amaurosis.

1 Parkes' *Hygiene*, p. 122.
2 *Annalis d'Hygiene*, March 1876.
3 Hirt-*Die Krankheiten der Arbeiter*, and also Eulenberge - *Gwerbe Hygiene* 1876.
4 Taylors' *Jurisprudence*.
5 *De Sanguine Oxydo-Carbonico infecto*—Lothar Meyer.
6 Virchow's *Archiv.*, Band xxx., p. 525.
7 Op. cit., Band xxxii., p. 450.
8 Op. cit.
9 Schmidts' *Jahr*, Band cx., p. 334 et seq.
10 Hirt, op. cit.
11 Parkes' *Hygiene*, p. 132.
12 Parkes' op. cit.
13 Constatt's *Jahresb*, Band vii., p. 76.

TABLE II.—BOLTON.

	Carbonic Acid.	Ammonia.	Organic matter.	Solid matter.
Air—Lum Street	0·36	16·1	29·4	61·0
" Gas Street	0·41	16·4	29·9	71·2
" Town Hall Square	0·62	16·9	33·1	16·9
" Trinity Street Station	0·71	16·7	33·6	17·4
" Bradshawgate	0·49	17·1	31·4	20·1
" Farworth	0·96	17·6	29·7	21·6

TABLE I.—MANCHESTER.

	Carbonic Acid.	Ammonia.	Organic matter.	Solid matter.
Near Rochdale Road Gas Works	0·39	13·1	21·0	14·3
Queen's Park	0·061	6·1	6·2	4·3
Central Station	1·31	26·0	9·9	42·3
Victoria Park	0·006	0·91	7·6	16·9
Deansgate	0·613	2·46	29·3	46·4
Piccadilly	0·714	3·10	27·6	61·0

TABLE J.—MICRO-ORGANISMS.

	Bacteria.	Moulds.	Total Micro-organisms.
Lum Street, Bolton	16	5	24
Gas Street, Bolton	17	11	28
Town Hall Square, Bolton	31	106	137
Near Rochdale Road Gas Works, Manchester	19	20	39
Central Station, Manchester	29	76	105
Victoria Park, Manchester	36	69	105

On "The Relations between Taxation and Sanitation," by S. M. BURROUGHS.

As it is the desire of the Sanitary Congress to consider matters likely to encourage the construction of healthful, commodious, and substantial dwellings, I venture briefly to point out the

relations which undoubtedly exist between taxation and sanitation.

Sanitation science has already done very much to improve the healthfulness of our houses, but still in many cases much remains to be done, and everything tending to promote the erection of better buildings will be of interest to our members. The hindrance to the building of good houses is chiefly in the matter of the expense of first cost, but the question of taxes is an important one, because, in the course of time, the amount of taxation may exceed the amount of the initial cost of construction.

Everyone building, buying, or leasing a house at the present time must consider that the taxes will be levied upon it in proportion to its size, healthfulness, and the desirability of its position.

If the rooms are sufficiently large, and are suitably ventilated, if the walls and roof are substantial, if the house contains a bath room, with hot and cold water, and with suitable sanitary arrangements for securing the comfort and health of the occupants, the taxes to be paid will be much higher than if the house be small, or badly built, or lacking a bath room and other sanitary arrangements.

Taxation is thus seen to be a hindrance to the erection of good houses, and sanitation would doubtless be much promoted if the burden could be removed or mitigated.

I remember once seeing in a northern town a remarkably well-built house, roomy, healthful, and well situated, which was empty because the builder and owner could not afford to live there on account of the heavy taxes he would have to pay upon it if occupied, and for this reason he was obliged to live in a small and less healthfully constructed house.

In the interests of the public health it therefore appears desirable to encourage the building of good houses, by making the tax on good and healthful houses no higher than on insanitary houses. In fact, I believe that taxation on houses can be remitted altogether without hardship toward anyone, by simply transferring the tax from the house and the improvements to the land value.

Let us, for instance, suppose the case of a man who buys a piece of land for £1000, and erects upon it a house costing £1000. The present rating is on the improvements, and depends upon whether occupied or not. The rental value of such a house and lot would be, say £100, and the rates would amount to, say £30.

Let us now suppose the entire taxation transferred from the house or improvement value to the land value alone. It is no

hardship to the owner, for his taxation is not increased, or his right of possession interfered with in any way, but as the tax is now solely on the land value, he is free to extend his house, add to its sanitary arrangements, and improve its comfort and healthfulness, without being taxed or fined for doing so.

The exemption of manufacturing and industrial establishments from taxation has frequently been the determining cause of their foundation and prosperity in particular spots, and the result has of course been a marked increase in prosperity in those parts of the United States offering such advantages. Moreover, history informs us that the reason why manufactories of various kinds are so much more numerous in the northern than in the southern parts of England, is, that in early times such industries were entirely exempted from taxation in the north, while they were liable for rates in the south.

The encouragement towards construction of good houses is apparently as important as the presence of manufacturing industries, and there appears no good reason why both should not be equally exempted from taxation, especially as the unearned increment, which is created by the growth, industry and thrift of the public, is the most anciently accepted as well as the most convenient and easily assessed subject of taxation.

This simple procedure would be beneficial in many ways: for example—

1st. It would greatly encourage the construction of good houses, with all necessary sanitary appliances.

2nd. There would be a considerable increased demand for labour in consequence of building, etc., which would advance wages, and consequently the purchasing and consuming power of the community, resulting in an increase of the general prosperity.

3rd. If the land values created by building of roads and railways were taken in taxes to pay for them, and for the expense of running and maintaining them, then travel would be free, town and suburban lands would tend to equality in prices, congestion in towns would be greatly relieved, and the country would be more thickly populated in places where space and fresh air are plentiful.

Briefly, a long vista of beneficial reforms conducing to the social and sanitary welfare of the people would follow upon the removal of taxation from industry, and the transfer of all taxation to unearned increment or land values exclusive of improvements; that is to say, values not directly created by those who now profit thereby, but indirectly resulting from the energy and enterprise of the public.

Lastly, the disuse or nonuse of lands or houses should be rendered a costly luxury by discontinuing to offer a premium to the speculator waiting for a rise in the shape of exemption. Land which is deliberately rendered unproductive should be coaxed back into the domain of usefulness by making it a burden to the possessor. This can readily be done by assessing all lands at their value for use irrespective of improvements which would amount to the exemption of improvements from taxation and give the greatest incentive to industry and progress.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS

By Prof. T. ROGER SMITH, F.R.I.B.A.

PRESIDENT OF THE SECTION.

"BATHS."

The Queen of Watering-places hospitably receives the Sanitary Congress this year; accordingly some topic growing out of the material circumstances which make life at a watering-place so different in its conditions from life in an ordinary town, seems not inappropriate as the subject of the address which I am to have the honour of delivering before the members of the section of Architecture and Engineering.

There is ample matter for both the architect and the engineer to deplore to consider and to improve, as there is also much that may be recognized as admirable, in the Architecture and the Engineering of our health resorts. But I do not propose to attempt a critical examination of all this, but rather to deal with a more compact and manageable topic, and one which has the advantage of carrying part of the benefits of a watering-place to our own homes and our own neighbourhoods. I will therefore ask you to consider, during the time at our disposal, the subject of Baths, especially such baths as may be accessible to the people.

A general and well-founded impression prevails that the Romans were skilled in the construction of baths. Indeed, in most places where Roman remains exist, some traces of a bath are to be found; but the practice of the Romans was so