

SANITATION AND SMALL-POX.

As the new Vaccination Act may possibly give the opponents of vaccination the opportunity for testing their own theories for which they have long asked, it may be useful to consider what we have to face in the near future and to see what protection the public have to rely upon in the face of a probable outbreak of small-pox. Recent epidemics have shown us that we have nothing to expect from any beneficent change in the disease itself; when it has the opportunity it can be as malignant, as infectious, and as fatal as it ever was. To what have we to look to check its diffusion?

There are only two means suggested, outside vaccination, by which it is confidently hoped by some that its diffusion may be prevented—these are sanitation and isolation. Though in these days isolation is looked upon as a part of sanitary science, it ought to be considered distinct from sanitation in general; for one reason, it has only been adopted in practice in recent years, and therefore could not have contributed to the enormous decline in small-pox which took place before its introduction. It is also doubtful whether many towns and townships in the kingdom are even yet prepared effectively to isolate every case of small-pox which may appear in them, and even if so, the best laid schemes may be defeated and the infection get at large from small-pox patients who are not properly isolated.

We shall, therefore, in this paper only consider sanitation properly so-called; and by sanitation we mean personal and public cleanliness, an efficient drainage system, and an adequate supply of pure water. The dissentient members of the Royal Commission on Vaccination describe what they meant by sanitation in almost similar terms; they say: "In speaking of sanitation we use the word in its widest sense; we are not speaking merely of drainage improvements, but we include the prevention of overcrowding on areas, or within houses and rooms, the proper construction of dwellings, so as to permit thorough ventilation, the promotion of cleanliness by adequate water supply, and the prompt removal of filth accumulations."

Confining ourselves then to sanitation proper, we shall try to find out if improvements in sanitation have caused or largely contributed to the decline of small-pox, and whether there is evidence that the prevalence of small-pox generally at certain times—say

in England in the last century, for instance—and in recent epidemics in particular, can be attributed to the absence of sanitation.

We are strong advocates for sanitation, and welcome every advance in the direction of it that is made; we readily admit that sanitary improvements have raised the general health, have reduced the death-rates, have saved us from repetitions of the cholera epidemics of former years and other evils. At the same time it is at least wise to try to determine within what limits, if any, its influence can act; and whether it can be relied upon to exterminate small-pox as it has exterminated cholera, and as no doubt it would exterminate enteric fever if it were perfect in every place and at all times.

And it ought to be remembered that other causes have assisted in promoting the general healthiness of the people besides those which may strictly be called sanitary. Amongst these causes are the decrease in the cost of food and the general raising of wages, in consequence of which the bulk of the labouring classes are much better fed than they used to be; the shortening of the hours of labour; the regulation of the employment of children, universal education with healthy school premises, the spread of temperance, and other causes, some of which are not so apparent.

We think that, often enough, sufficient credit is not given to the first fact mentioned—that the people are much better fed than they were fifty years ago and more. People who are comparatively well fed can stand the effects of harder work, can resist the influences of weather, dirt, and bad air much better than those who are not so well fed. A great deal of the improved healthiness of the people is probably due to this cause alone. In a much lesser degree, but no doubt in some degree, the same cause helps people, especially children, to resist the attacks of special diseases, perhaps even such diseases as typhoid fever and small-pox; but this is not so certain, as in some cases robust health does not seem to confer any protection or immunity.

When small-pox was prevalent in the last century, and no special means of protection were in use, scarcely any one appears to have escaped. The relative risk of an attack must in the first instance depend, all other things being equal, upon the risk of exposure to infection. Where there is no exposure there is no risk. No matter how insanitary the state of a population may be, small-pox has never been known to arise spontaneously; and so, in an isolated community where there is no small-pox, it will never occur until it is introduced.

Leaving out vaccination, isolation, and other things which affect or are alleged to affect the diffusion of small-pox, we will for the present confine our inquiry to sanitation. This paper makes no claim to be a complete survey of the subject, but it *may suggest* further inquiry.

As to the theory that insanitary conditions are responsible for the prevalence of small-pox and for occasional epidemics, it is scarcely necessary to prove that it is generally held by anti-vaccinators, and that practically "sanitation" is the only thing that now comes into the field as a rival to vaccination. But we may as well give the opinions of a few opponents of vaccination. The opinion in its crudest form is stated by Mr. John Pickering, of Leicester, in a pamphlet on *The Small-pox Epidemic in Gloucester*, 1896. This gentleman submits for the consideration of the reader a series of propositions, the first of which runs: "That infection, in its natural form, is invariably produced by uncleanness of person, house, or surroundings, and that infection is a law of nature punitive in its character."

We do not know exactly what this means, but we can see what is intended.

Dr. Alfred Russell Wallace, in *Vaccination a Delusion*, says, "Among the greatest self-created scourges of civilised humanity are the group of zymotic diseases, or those which arise from infection." After naming the best known of these diseases, including small-pox, he continues, "The conditions which specially favour these diseases are foul air and water, decaying organic matter and other unwholesome surroundings, whence they have been termed 'filth diseases.'"

Mr. A. W. Hutton says: "Small-pox is known to be a dirt disease, one that haunts ill-drained, ill-ventilated, and uncleaned tenements."

A well-known anti-vaccinationist lecturer says: "Small-pox is a sewer malaria and insanitation is at the bottom of it."

We could multiply such expressions of opinion, but it is unnecessary. "Sanitation" is the anti-vaccinator's card, and it is based upon the theory that small-pox is either caused or propagated by insanitary conditions and can be exterminated by the removal of those conditions. This is the theory. We ask for evidence, and evidence of a kind is freely offered us; which generally amounts to this and no more—that when an epidemic of small-pox occurs the anti-vaccinators cry out "insanitation," call it a "filth disease," a "sewer malaria," and swear that there must be something wrong with the drains!

A favourite form of this kind of argument is to compare Leicester with Gloucester. In 1893 Leicester had an outbreak of small-pox, and Gloucester in 1896 an epidemic of far greater severity. Since then, Leicester, with the anti-vaccinators, is almost as blessed a name as Mesopotamia was with the traditional old lady. The limited extent and mildness of the outbreak in Leicester in 1893 they assert was due to the clean condition of the town, while the severity of the Gloucester epidemic was occasioned by the "total neglect" of sanitation and isolation. We dealt with the case of Gloucester in a former article,¹ and showed how unfounded such a

¹ THE WESTMINSTER REVIEW, June 1897.

statement is. Since the publication of that article, Dr. Sidney Coupland's report on the epidemic in Gloucester has been published, and we are glad to find that eminent authority justifies all we said. But beside the Gloucester report, Dr. Coupland's Leicester report is also now in our hands, and a careful study of it does not show us that in the matter of sanitation Leicester was in any way in advance of Gloucester. We shall not discuss the question of the rival merits of these two places, but taking the general death-rate as a test of healthiness the advantage is on the side of Gloucester. The general death-rate in Gloucester for the ten years preceding the epidemic of 1896 was only seventeen; while that of Leicester for the ten years preceding the outbreak of 1893 was nineteen. After that no one can say that Gloucester is not as healthy as Leicester.

Dr. Wallace in *Vaccination a Delusion* instances London, and "proves" his case by a diagram (I) which, so he says, shows that small-pox goes up and down with the increase or decrease of sanitation, with the general death-rate, and other zymotic diseases.

This is worth examination. The Commissioners, in their *Final Report*, say

"that there is no proof that sanitary improvements were the main cause of the decline of small-pox";

and further that

"no evidence is forthcoming to show that during the first quarter of the century these improvements differentiated that quarter from the last quarter or half of the preceding century in any way at all comparable to the extent of the differentiation of small-pox."

To these declarations of the Commissioners Dr. Wallace replies:

"To the accuracy of these statements I demur in the strongest manner. There is proof that sanitary improvements were the main cause of this decline of small-pox early in the century—viz., that the other zymotic diseases as a whole showed a simultaneous decline to a nearly equal amount, while the general death-rate showed a decline to a much greater amount, both admittedly due to improved hygienic conditions, since there is no *other known cause* of the diminution of disease; and that the Commissioners altogether ignore these two facts affords, to my mind, a convincing proof of their incapacity to deal with this statistical question.

"And as to the second point, I maintain that there is ample direct evidence, for those who look for it, of great improvements in the hygienic conditions of London quite adequate to account for the great decline in the general mortality, and therefore equally adequate to account for the lesser declines in zymotic diseases and in small-pox, both of which began in the last century, and only became somewhat intensified in the first quarter of the present century."¹

If the story ended there, or if the succeeding chapters told the same tale, it would look as if Dr. Wallace had something like a case. But, unfortunately for Dr. Wallace's theory, and unfortunately for

¹ *Vaccination a Delusion*, pp. 38, 39.

the inhabitants of London, it did not end there. The next chapter was a very different one. It is referred to by Dr. Wallace in the continuation of the sentence just quoted—"only to be followed, twenty years later, by a complete check, or even a partial rise." This second period therefore begins about 1845, and is thus explained by Wallace :

"In 1845 began the great development of our railway system, and with it the rapid growth of London from a population of 2,000,000 in 1844 to one of 4,000,000 in 1884. This rapid growth of population was at first accompanied with overcrowding, and as no adequate measures of sanitation were then provided, the conditions were prepared for that increase in zymotic disease which constitutes so remarkable a feature of the London death-rates between 1848 and 1866."¹

This is in accordance with the facts, though, if the sanitary conditions of London were so bad after 1845, one wonders how they could have been so very good before 1825 ; but we will let that pass.

These sentences of Dr. Wallace's scarcely convey a sufficient idea of the insanitary condition of London during the period to which he refers—1845—1865. It may be interesting to look at the picture a little more in detail, and ample evidence is to be found of the insanitary condition of London during this period, which also shows that there was much more than overcrowding to account for the rise in the death-rates.

Without having to look very far for something to throw light upon the subject, we took the first that came to hand, in the shape of a copy of the *Illustrated London News* for September 24, 1853. The first article in this paper is "What London Requires for the Prevention of Cholera." Its general object is a plea for the better government of London, but its suggestions are sufficiently informing :

"Now that cholera is in the land, the warnings of sanitary reformers are found to have been entitled to more respect than they have received. Local functionaries think it possible that there may be danger to the public health in dirt, stenches, and malaria. . . . It is easy to see that all which can now be done will fall very far short of what the circumstances require. There will be a house-to-house visitation of the densest and most unwholesome parts of the metropolis. Overcrowded lodging-houses will be compelled to disgorge a portion of the superabundant misery, beggary, and vice that crawls into them to rot and fester, like maggots in thick corruption. Reeking alleys will receive a scanty but welcome ablution ; squalid tenements will be whitewashed ; pigsties will be removed from their disgusting contiguity to the sleeping apartments where tramps and vagrants do all they can to imitate the habits of the animals with which they are so often found to associate. A few cesspools will be cleansed and a few drains will be flushed."

The same article proceeds to refer to the Parliamentary Commission then sitting to inquire and report upon the state of the Corporation of London, with a view to its reform, and says :

¹ Wallace, p. 37.

"It did not need the cholera to inform two millions and a quarter of people that are congregated together on the northern and southern banks of the Thames that, for want of a central and complete authority, the science of public health was practically unknown and almost utterly disregarded. But perhaps the visitation of the pestilence will impress the fact with sufficient distinctness upon the public mind, and enlist public opinion on behalf of the only remedy sufficiently large to cope with evils whose name is legion. . . . London requires an abundant and cheap supply of water, not only to the rich, but to the poorest of the poor; a complete system of drainage; the purification and embankment of the noble stream that now runs through it, bearing miasma on its tide."¹

And so it goes on with a list of evils which needed to be abated.

These lines suggest what London was like less than fifty years ago, when "the science of public health was practically unknown and almost utterly disregarded;" the words are not ours, but those of a contemporary writer. It is not without reason, then, that Dr. Wallace says, as we have quoted above, that the decline in the death-rates shown in the first quarter of the century "met with a complete check or even a partial rise twenty years later." Only, what he calls a partial rise in the death-rates during this period we should call a very serious rise.

If, then, Dr. Wallace is right about the decline of small-pox in London during the first quarter of the century being due to hygienic improvements, we should naturally expect that the reversal of these conditions would have brought about a revival of small-pox as well a rise in the general death-rate, corresponding also with "that increase in zymotic disease which constitutes so remarkable a feature" of this period.

We turn to his diagram to see if this corresponding rise in the small-pox death-rate occurred, and, may we say, to our surprise—a surprise caused only by Dr. Wallace's confidence in his own theory—it did not occur. Dr. Wallace may say what he likes, but without he has blundered in his diagram, there was no increase of small-pox, but *it continued to decline*. From 1848 to 1866 it was lower than it had ever been before, and in some years was remarkably low. The average death-rate from small-pox in the ten years 1841–1850 was 40 to the 100,000 living; from 1851 to 1860 it was only 28; and from 1861 to 1870 it was 27. Which shows a fall of 30 per cent. within the period under consideration. In the year 1853, in which the *Illustrated London News* article was written, it actually fell to 9, and in 1858 to 6.²

But during this thirty years the general death-rate was at least 25 per cent. higher than it was between 1820 and 1830, when the small-pox death-rate was more than double. That is to say, the general death-rate had increased 25 per cent., and the small-pox death-rate had decreased more than 50 per cent. And yet we are

¹ See also Dr. Farr, *Vital Statistics*, p. 341.

² Final Report—Table p. 32.

asked to believe that the death-rate in both cases is affected by the same general causes.

These facts evidently entirely overthrow Dr. Wallace's hypothesis, for the small-pox death-rate ought to have risen with the other death-rates and the insanitary deterioration of London. Dr. Wallace is so convinced of the necessity of this for the vindication of his theory that, in the face of his own tell-tale diagram and the figures given above, he actually says it did. With a supreme disregard for facts that almost compels our admiration, he says :

"This rise was equally marked in small-pox as in other diseases, and thus proved, as clearly as anything can be proved, that its decline and fluctuations are in no way dependent upon vaccination, but are due to causes of the same general nature as in the case of other diseases."¹

We have given up this discrepancy between Dr. Wallace's diagram and his text as an insoluble puzzle. He is not the kind of man we can suspect of bad faith ; but there it is, and perhaps he can explain it ; we cannot.

After the above was written Dr. Wallace's attention was called to this point, and the only explanation he has to offer is that we omit to average the great epidemic with the preceding ten years. A delay in the printing of this paper has given us an opportunity of considering this criticism. We can only ask what has the epidemic of 1871 to do with the deaths from small-pox which occurred during the previous thirty years? It did not make them any more than they actually were. You may include an epidemic in an average, but it is an occurrence by itself, and the death-rate during an epidemic is distinguished by its being in excess of the average. For purely statistical purposes Dr. Farr averages the epidemic of 1871 with the next and not the preceding ten years, but this does not suit Dr. Wallace. But even this is misleading. The small-pox death-rate in London in 1871 was 242 (per 100,000 living), in 1873 it was 3, in 1874 it was 2, and in 1875 it was 1 ; an average between 242 and 1 bears no relation to the actual facts.

But, for the sake of argument, we will grant Dr. Wallace all he asks, and more than he asks ; we will take the period of thirty-four years, beginning with the epidemic of 1838 and ending with the epidemic of 1871, and throw in both epidemics, and even then the average for the whole period is still only 44, or about half of that of the period with which we are comparing it, when the general death-rate was at its lowest.

We have thus two London periods brought before us. The first quarter of the century, when (we are following Dr. Wallace) small-pox declined in a corresponding ratio with other diseases, and with the improvement in the hygienic conditions of London.

A second period, 1848-66, when there was a deterioration in the

¹ *Vaccination a Delusion*, p. 39.

sanitary conditions of London, with a corresponding increase in the death-rate and in zymotic diseases, *but no corresponding increase in small-pox.*

We now come to a third period, beginning with 1866. Says Dr. Wallace :

“At the latter date commenced a considerable decline both in the total mortality and in that from all zymotic diseases, except measles and small-pox, but more especially in fevers and diphtheria; and this decrease is equally well explained by the completion in 1865 of that gigantic work, the main drainage of London.”¹

Surely this is a significant admission—*except measles and small-pox!* That is to say, two diseases of the class which are not influenced by sanitation.

Though it stares him in the face, Dr. Wallace cannot see the consequences of his own admission, and yet he might have seen why measles and small-pox do not respond to the fluctuations in sanitary conditions, for he says :

“Cholera, typhus, and enteric fever are believed to be communicated through the dejecta of the patient contaminating drinking water,”

but

“the other diseases (exanthemata) are spread by bodily contact, or by transmission of germs through the air.”

Precisely so; and that is why sanitation does not control the diffusion of small-pox and measles as it does cholera, typhus, and enteric fever.

We have, then, presented to us by Dr. Wallace himself, in defence of his own theory, three instances—(1) London from 1800 to 1825; (2) London from 1848 to 1866; (3) London after 1866 (say, to 1885). The first instance in a measure is consistent with his theory; the other two are inconsistent with it, and therefore knock the bottom out of it.

We will not hasten to say that these instances alone settle the question, though we should be entitled to say and “thus proves” exactly the reverse of the conclusion to which Dr. Wallace has been led by a neglect of the very facts which he himself has collected for our information.

The Commissioners considered this question of the relation of small-pox to sanitary conditions, and we have seen how Dr. Wallace replies to them, and no doubt it will be claimed by the anti-vaccinators that he has completely demolished them. But the Commissioners did not rely upon a solitary instance; granting that hygienic improvements might have taken place in London, they say :

“Moreover, it must be remembered that the decline of small-pox mortality was observed in Western Europe in countries where the sanitary

¹ Wallace, p. 37.

conditions were widely different. Whatever may have been the sanitary improvements during the first quarter of the century in England and in some other countries, there seems no ground for supposing that throughout Western Europe the period was marked by great changes in the direction of improved sanitation. Indeed, in many countries down to a recent period, in some, it may perhaps be said, even down to the present time, insanitary conditions have continued to prevail."

We will make Dr. Wallace a present of London in the first quarter of the century. What has he to say to the other cases referred to by the Commissioners? We shall not have to ransack the history of Western Europe to find an instance of a city in which small-pox declined in the absence of sanitary improvements. We can find one nearer home.

Dr. John McVail, in an article in *Public Health*, May 1896, which has since been republished in the form of a pamphlet entitled *Vaccination or Sanitation*, gives an account of the remarkable decline of small-pox in Glasgow in the early years of the present century. We will pass by what Dr. McVail has to say about vaccination beyond mentioning that the practice of it was adopted at the time in that city, as this does not concern our present inquiry, for we are not asking why small-pox declined, but whether its decline was caused by sanitary improvements. For what immediately follows we are indebted to Dr. McVail.

We have two facts set forth in his pamphlet: first, that small-pox did decline enormously in Glasgow from about the beginning of this century; and secondly, that there were no sanitary improvements to account for this decline.

The facts relating to the decline of small-pox were recorded by Dr. Robert Watt, of Glasgow, in 1813. These statistics cover thirty years, from 1783 to 1812. For convenience, Dr. Watt divides the thirty years into five periods of six years each. There is no means of determining the death-rate from small-pox in relation to the population; but Dr. Watt found that out of every hundred deaths from all causes occurring from 1783 to 1800 inclusive about 19 were due to small-pox. The actual figures are—total deaths, 31,088; and from small-pox, 5958. After 1800 there was a great change; the actual figures for the five periods are given as follows;

Period.	Small-pox death-rate per 100 deaths from all causes.
I. (1783-88)	19.55
II. (1789-94)	18.22
III. (1795-1800)	18.70
IV. (1801-06)	8.90
V. (1807-12)	3.90

Of course Dr. Wallace might describe this as a decline which began in the last century and was only somewhat intensified during the first quarter of the present one, but such language would very

inadequately describe the great decline from nineteen to four. That this decline took place we presume will not be denied; but we have to see whether there were any such hygienic improvements in the condition of Glasgow as to account for it on the hypothesis that it must have been due to sanitation. There is no lack of evidence in this case, but it is evidence which proves there were no improvements of the kind in Glasgow.

Dr. Russell is the authority quoted by Dr. McVail for the particulars of the sanitary history of the city.

One of the first things noticeable in this history is the rapid increase in population from about the year 1780 onwards. In that year the population was 42,832; in 1791 it was 66,578; in 1801 it had increased to 83,000, and 1811 to 110,000, and so on.

The earliest description of the sanitary condition of the city given by Dr. Russell is from a statement made by Dr. Robert Graham, then Professor of Botany in the University, in 1818. We give a few sentences from Dr. Graham's report:

"If any man wonders at the prevalence of continued fever among the lower classes in Glasgow, or at its spreading from their habitations, let him take a walk which I did to-day with Dr. Angus, one of the district surgeons. Let him pick his steps among every species of disgusting filth, through a long alley four to five feet wide, flanked by houses of five floors high, with here and there an opening for a pool of water, from which there is no drain, and in which all the nuisances of the neighbourhood are deposited in endless succession, to float and putrefy and wash away into noxious gases. Let him look as he goes along into the cellars which open into this lane, and he will probably find, lodged in alternate habitations which are no way distinguished in their exterior, and very little by the furniture that is within them, pigs, cows, and human beings, which can scarcely be recognised till brought to the light, or till the eyes of the visitant get accustomed to the smoke and gloom of the cellar in which they live."

There is more to the same purpose, but this will suffice from Dr. Graham.

In 1837 Dr. Cowan, Professor of Medical Jurisprudence in the University, reported:

"Many of the causes of the production and propagation of fever must be ascribed to the habits of the population; to the total want of cleanliness among the lower orders of the community; to the absence of ventilation in the more densely peopled districts; and to the accumulation, for weeks and months together, of filth of every description in our public and private dunghills; to the overcrowded state of the lodging-houses resorted to by the lowest classes, and to many other circumstances unnecessary to mention."

This report was followed by others from Mr. Symons, Dr. Neil Arnott, and Mr. Chadwick. In 1842 the latter wrote:

"It might admit of dispute, but, on the whole, it appeared to us that both the structural arrangements and the condition of the population of Glasgow was the worst of any we had seen in any part of the kingdom."

It certainly appears to us that Dr. McVail is justified in saying, after quoting these descriptions and others even more revolting :

“It is evident that we are here dealing with a population in which sanitation is unknown, a population, moreover, whose health conditions appear to have been steadily going from bad to worse, owing to the rapid growth of the city.”

How does this fit in with the hypothesis that the decline of small-pox is due to sanitary improvements? It is manifestly impossible that it could have been due to that cause in the city of Glasgow. From 1783 to 1800 inclusive small-pox contributed about nineteen out of every hundred deaths; from 1801 to 1806 the rate fell suddenly to less than one-half of the previous average, the contribution being only 8.90. In the next period, 1807-1812, it again fell to less than one-half of its rate in the preceding six years.

“Thus, while insanitation was hurrying from bad to worse, till the startling conditions described in 1818 and later years were being approached, and while other infectious diseases of infancy were on the increase, small-pox was diminishing by leaps and bounds.”

Whatever the cause of the decline, it could not have been due to improvement in the sanitary conditions or the lessening of overcrowding. If small-pox is a “filth disease” which “haunts ill-drained, ill-ventilated, and uncleaned tenements,” why did it decline when the state of the ill-drained, ill-ventilated, and uncleaned tenements of Glasgow was going from bad to worse?

A supplementary piece of evidence bearing upon this question is to be found in a paper read by Dr. Priestley at the Congress of the British Institute of Public Health, which is quoted at length in Dr. Sidney Coupland's *Report on the Leicester Outbreak*. The subject of the paper was the aerial diffusion of small-pox, and Dr. Priestley describes some investigations he conducted in Leicester in 1893. In the Newfoundpool district, adjoining the Leicester Infectious Diseases Hospital, a number of cases of small-pox occurred which could not be accounted for—that is, their pedigree could not be traced—and Dr. Priestley came to the conclusion that the infection was probably air-borne. We prefer to regard this as at present an open question. Dr. Priestley also put to a test the question whether germs of small-pox might not also pass through the drains and be drawn by the ascensional force of evaporation through the sewer-gas into the houses. This is an important question, considering how great a part the “drains” play in anti-vaccinationist speeches. We need not give the details of the tests applied by Dr. Priestley; they can be read in the report; but his concluding words on the subject are as follow :

“The only conclusion (if any) to be drawn from the above facts is that

an insanitary state of the house drainage does not *per se* give rise to small-pox even when near to a small-pox hospital."

It may be a disappointment to some of our readers to be made acquainted with the facts which we have presented, and the conclusion to be drawn from them, that sanitation will not check the spread of small-pox; it seems so natural to believe that because small-pox is a repulsive disease, it is also a filth disease, and that improvement in sanitation ought to eradicate it. But perhaps if they will try to realise the nature of small-pox infection, and how it is diffused, the difficulty will disappear. As we always prefer to accept the views of our opponents as far as we can, we again turn to Dr. Wallace, who himself tells us that small-pox differs from zymotic diseases like cholera, typhus, and enteric fever, which are believed to be communicated through the dejecta of the patient contaminating drinking water.

It is obvious that sanitary measures can control such diseases and prevent their spreading.

But small-pox is "spread either by bodily contact or by transmission of germs through the air."

It is equally obvious that sanitation cannot prevent the communication of infection which is diffused by these means.

Let us consider what happens when a person "catches" small-pox. A "tramp" (it is so often said to be a tramp) comes from a place where small-pox is prevalent to another place where there is none. He either carries the infection in his clothing or is himself infected, and after a few days the disease develops. He is in a lodging-house, some other person comes in contact with him, or breathes the air he has infected, and also "catches" the disease. What have the drains to do with it?

And this is the usual way, if not the only way.¹ It may happen in any class of society and in any class of house; but if any person comes within the range of the infection which is being diffused from the body and breath of the patient, he is also liable to be attacked by the disease. Where does sanitation come in? It is easy to see where isolation comes in, but that is another matter.

Multiply such instances by tens and you have an outbreak; multiply them by hundreds and you have an epidemic.

It is of course possible, as Dr. Priestley suggests, that where there is a great mass of infection caused by the congregation of a number of patients together, as in a hospital, the infection may float through the windows and ventilators and be borne some distance, and thus affect persons who are not very close to the patients, but we are not yet convinced that this cause operates except within very narrow limits; but even if it does sanitation cannot control it. Divergent

¹ Of course, infection may also be spread by articles of clothing, &c., which have been in contact with a person suffering from small-pox.

views are expressed as to the effect of the weather on small-pox germs; some declare that rainy weather is unfavourable to their diffusion, others with equal confidence declare that sunshine robs them of vitality. Whoever is right matters little so far as our point is concerned, for sanitation cannot control the weather. One lecturer tells us that rain put an end to the epidemic in Sheffield in 1887, but the epidemic in Gloucester in 1896 came to an end in the middle of a long-continued drought.

We are left to the conclusion that none of these external influences can be credited either with the diffusion of small-pox or the prevention of its diffusion. Universal experience shows that small-pox is only diffused from person to person in the way we have described, and an epidemic only occurs when this diffusion goes on, to some extent, unchecked; when there is comparatively free intercourse between small-pox patients and other people; when persons suffering from small-pox, or persons in direct communication with them, mingle freely with their neighbours, when they visit shops, schools, clubs, places of worship, &c.; when, as sometimes in the case of an outbreak amongst the poorer classes, a general recklessness prevails, a recklessness which we do not hesitate to say is often encouraged by the erroneous theories of anti-vaccinationist lecturers, who make light of the danger of infection and exaggerate the right of people to do as they please.

The anti-vaccinators have staked their case upon sanitation. We think we have proved that as far as small-pox is concerned sanitation can do very little, if anything, either to destroy the power of infection, or to prevent its casual introduction developing into an epidemic. Something more directly capable of arresting the spread of infection is required. No doubt isolation is the ideal method, but in view of its partial breakdown even in Leicester in 1893, and its more serious failure in Gloucester and Middlesborough, it is certain that at present it is not to be relied upon with safety.

The extraordinary decline of small-pox during the present century is an incontestable fact; having seen that this decline cannot have been due to sanitation, it follows that it must have been due to the practice of vaccination. There remain, therefore, only vaccination and re-vaccination, which provide what is required to meet the case by conferring a protection upon the individual, which enables him to resist the influence of infection when, either by necessity or accident, he comes within its range.

WALTER LLOYD.