DISCUSSION ON
IS THE INTERCEPTING TRAP A
FAILURE ?

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(FELLOW.)

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BEFORE answering such a question as this, it will be necessary to consider the purpose of the interceptor in a modern system of drainage. And it may be desirable to go to the root of the matter and consider first the primary hygienic and physical principles which underlie modern methods of sanitation as applied to the removal of human excreta and slop waters by a water-borne system. It may be said that they simply aim at the removal, as rapidly and efficiently as possible, of all foul or waste decomposable organic matter from the neighbourhood of human dwellings; and that equally important with the rapid removal of sewage matter is the prevention of any accumulation and escape of the gases of decomposition or of polluted waters near to the house. Whatever view be taken as to the *modus operandi* by which these agencies produce disease, it will be conceded that the admission to the house of such gases, or the pollution of the site by liquid filth, is wont to be followed by outbreaks of disease often explosive in character, and is in any case calculated to impair health. The aim of modern drainage is simply to secure the dwelling from these untoward results, and upon the degree of success which in practice attends this aim must the means currently adopted be judged.

I shall endeavour to show that a drainage scheme in which the drain is disconnected from the sewer is as mischievous in practice as it is faulty

in theory. It is based on the assumption that it is safe to have a condition of things in the public sewers that it is unsafe to have in the house drains which communicate with the sewers, and that you may recognise the existence of a danger zone on one side of a trap against which the other is assumed to be safely secured by a water seal.

It must of course be conceded that the inside of a sewer can never be regarded as a sanitary situation, but from this to the assumption that its gaseous contents may be contemplated as so potently charged with danger that they may not even be admitted to a gas-tight system of tubes having no unsealed opening save to the outer air above the housetops, is a most serious confession of sanitary failure. The truth is that accumulations of considerable volumes of sewer gas are dangerous and insanitary, whether they be permitted to stagnate in the sewers or in the house drains. If the sewers are efficiently ventilated, as they should be, there is no ground to suppose that the atmosphere of the sewer is more harmful than that of the house drain, and the disconnection of one from the other is not only harmful, but irrational also. For it presupposes what sanitarily cannot be presupposed, namely, a dangerous atmosphere in the sewers; and it is an attempted defence, by means of a trap, against this danger, which in its very adoption casts doubt upon the efficiency of the means, since the same are used in the defence of the house against the still dangerously regarded atmosphere of the house drain. But it may well be urged that academic objections to the intercepting siphon are little likely to disturb so trusted and respectable a contrivance of the practical sanitarian. I will only answer such an objection by saying that the siphon had its origin less in a practical need than in a faulty theory, and that academic criticism alone should have prevented the extensive adoption of what many regard as a mischievous appliance.

Perhaps the most universally objectionable feature of the siphon is that it prevents the efficient ventilation of the sewers. That the public sewers are inefficiently ventilated in those cases where their communication with the soil-pipe ventilators of the house drains is intercepted, is shown in many ways. It is a common experience with municipal officers that daily complaints are received, during the summer months, of the offensive smells proceeding from the openings to the sewers in the crown of the roadway, placed there originally with the intention of acting as fresh-air inlets to the sewers, and now in many districts being sealed off because they are found to act as vents for the foul gases of an insufficiently ventilated sewer. Visual demonstration of this fact may be had during

frosty weather, when a stream of condensed vapour may be observed proceeding from these openings into the sewers. It might also be shown with regard to most sewers that the number of upcast shafts which it has been possible to erect are insufficient to cause such a negative pressure in the sewers as shall result in anything like continuous aspiration of air into the sewers through the road openings.

But, short of effecting this, the road grids become a nuisance owing to escape from them of the gaseous contents of the sewer at the street level, and under conditions, owing to inadequate sewer ventilation, in which these gaseous contents are apt to contain a large admixture of sewer gas, I think it will not be disputed that what is most urgently needed in respect of most public sewers, is an increased number of exit ventilators intentionally so acting. And could these be provided in sufficient numbers—as practically at present they cannot be—the problem of sewer ventilation would be solved, and the atmosphere of the sewers would then be rendered as innocuous as rapid change in the aerial contents of the sewers can render it.

Such sufficient numbers of upcast ventilating shafts would be provided were each house drain and soil ventilating pipe in direct aerial communication with the sewers. The aspirating effect of so many outlet ventilators to the sewer, up which the lighter air of the sewer would tend constantly to ascend would be a rapidly inflowing current of fresh air to the sewers at all lower openings; and thus at one and the same time both the sewers and the house drains would be effectively ventilated and any accumulation of gases of decomposition, either in the sewers or the drains or their escape in improper situations, rendered impossible.

The interception of the drains from the sewers, however, has deprived the sewers of what should be their natural outlet and on occasion inlet ventilators. It has necessitated the provision on each house drain of an untrapped opening, in a large proportion of cases in immediate proximity to the doors or windows of the house, and acting, at least with a frequency un contemplated in the theory of its advocates, as an outlet ventilator to the drain. Further, to provide access to the segment of the drain between the interceptor and the sewer, another complication in the shape of a raking arm with a readily removable stopper has to be added. An inspection chamber is a proper equipment of every drain, but the interceptor, necessarily placed as near the sewer as practicable, has necessitated the placing of the manhole where the drain is deepest, and where, apart from the consequently increased cost, it necessarily forms a capacious reservoir

for the storage of gases at the very site where they are most likely to accumulate owing to the couple of gallons or so of stagnating sewage contained in the trap at the bottom.

Every one of these complications introduced into drainage systems to meet the exigencies of the interceptor is extremely apt to go wrong and produce nuisance. The interceptor itself is essentially insanitary. It retains within the precincts of the house premises between two and three gallons of sewage which is of that aggravated character resulting from the undue retention of solids, and thus breaks with the primal principles of domestic sewage disposal. It occasionally fails of its object of excluding from the house drains the gaseous contents of the sewers; for it was urged in defence of the system by the late Dr. G. Buchanan, in his Report to the Privy Council and Local Government Board, that should "the trap be ever forced by pressure of air in the public sewer, an immediate exit of the sewer air away from the house is afforded"—by the so-called inlet ventilator to the drains. The plating down of the street gratings to prevent the offensive smells from the sewers, which the introduction of the interceptors has occasioned, will, especially where shafts have not been erected in their place, make this forcing of the trap a more frequent occurrence than was contemplated. Where no facilities even for inadequate ventilation of the sewers are provided, the daily recurring increases of pressure of the imprisoned gases must necessarily force them through the yielding traps into the house drains.

And this contingency, to which every house drain disconnected from the sewer by a trap is subject, is a greater danger than is incurred when sewers and house drains are the channels for the constant flow of continuously renewed currents of air. This is a breakdown of the interceptor, the frequency of which it is impossible to estimate. But it fails in other directions. A straight pipe with a proper fall shows little tendency to choke, but if in the course of such a pipe an acute kink or bend be introduced, especially if it be of such a character as to remain filled with floating solids, the tendency to become choked at this point will have increased enormously. During last year, I had a systematic inspection made of all the readily accessible manholes in my district. These amounted to some 6,745, and comprised the inspection chambers of about a third of the houses in Willesden. In no single instance was a drain found to be choked but at the interceptor, but no fewer than 288 or $4\frac{1}{4}$ per cent. of all the drains inspected were discovered to be stopped at this point.

In 118 of these cases the manholes were filled with foetid sewage, emitting its foul vapours through the drain inlet ventilator close to the doors and windows of the houses, into which they were duly aspirated.

In the 170 remaining cases where the drain was blocked, the manhole remained free of sewage, because of another accident of the system, the unstopping of the raking arm, which permitted the escape of the drain contents to the sewer, and incidentally of the sewer gas through the manhole and drain inlet ventilator.

In 654 cases this accident was observed to have occurred. That is to say in nearly 10 per cent. of the drains examined the interceptor, apart from its incidental drawbacks, failed absolutely of its object, the drains in these cases being in direct communication with the sewers, the sewers being thus provided with exit ventilators in the forecourts of the houses. But for the drains to be accidentally in direct communication with the sewers in only 10 per cent. of the houses is much more serious than for 100 per cent. of the drains to be intentionally directly connected with the sewers. In the one case the sewer is adequately ventilated, in the other the sewer air is presumably 10 times more concentrated than where all the house drains ventilate the sewer. In the one case, moreover, the sewer air, diluted and comparatively innocuous, finds vent above the roofs, and away from all openings to the houses; in the other, a concentrated sewer air is laid on at the ground level of the houses. The untrapped opening to the drain, intended as an inlet ventilator, becomes in these cases a serious danger to health. But to such an extent is the inlet ventilator recognised as a common cause of nuisance, owing to its waywardness of acting as a vent for foul gases, that it has become common practice to fit it with a mica flap to prevent reflux currents from the drain. In 3,193 cases of those I investigated, however, the fresh air inlet was unprotected by any properly acting appliance. This may appear a trivial matter, since at its inception no valve was considered necessary. But it must be remembered that admission to the house of air from the interior of the drain is still, and I think properly, regarded as dangerous. Most people who would remain unmoved at the forcing of the intercepting siphon would feel alarm at the unsealing of the yard gully, and a crack in a drain pipe covered with two or three feet of clay is regarded as a most serious insanitary condition by people who are undisturbed at an unprotected gaping opening to their drains a couple of feet below their open window.

It might be thought that the result of the inspection of nearly 7,000

manholes yielded exceptional results due to accumulation of stoppages long unrecognised. It is true that in many of the stoppages there was evidence of antiquity in the insanitary condition discovered, but in many parts of the district there had been previous systematic inspections yielding results quite as bad, though in less numbers, owing to the more limited area of investigation. Nuisances of the character discovered are, moreover, constantly being abated, being the natural occasion of prompt complaint. I have, however, had a re-inspection made of about 500 manholes with a view to seeing whether the results yielded by the first inspection were confirmed. The re-inspection was made within eight months of the first survey, and included 216 manholes where originally no defects were discovered, and 288 where defects originally found had been made good. Out of the total of 504 re-inspections, 49 drains were found to be choked at the interceptor, and 41 to have the cap of the raking arm missing. Of those choked, in 30 instances the manholes were more or less filled with sewage, while in 19, in addition to the choking of the drain, the manhole was in direct aerial communication with the sewer, owing to the absence of the cap of the raking arm. Altogether in 71 instances the drain was choked, the cap of the raking arm missing, or both these conditions co-existed. Thus in nearly 15 per cent. of the manholes re-examined, the most serious defects were discovered. Both in these and in those primarily discovered the defects are traceable to the interceptor, and the modifications which it entails. In an examination of over 7,000 manholes it is found that in 9·5 per cent. the interceptor fails of its object of disconnecting the drain from aerial continuity with the sewer. It fails not only of this, but is directly responsible for a high percentage of blocked drains, and manholes converted into leaking cesspools.

The untrapped drain-opening in the forecourt which it necessitates, normally serves as an outlet for the emanations of the drain, and sets at ridicule all insistence on the need for effectual trapping of yard gullies and the elaborate precautions taken to secure a gas-tight drain.

In the very frequent abnormal conditions where the drain is choked, and the raking arm open to the sewer, it is an unmitigated nuisance. It is for these reasons that I am bound to answer the question we are discussing in the affirmative. It is perhaps beyond the range of this discussion to say what is the counter proposal; but, in conclusion, I may give what I consider the essential principles of sanitary drainage. A good drain should be so laid as to be self-cleansing; so as to be relied upon to remain gas-tight and water-tight throughout its course. It should have no untrapped

opening save at the top of the soil pipe above the roof. Both the drain and the sewer should be effectually ventilated. Access should be provided, but the drain should be hermetically sealed from the access chamber except when occasion arises for inspection.

These conditions will probably best be complied with by the provision of iron pipes with socketed joints, caulked with blue lead. The inspection chamber can be placed in the shallower part of the drain, in the absence of an interceptor determining its position in the forecourt, and the saving in cost thus effected will generally be more than sufficient to cover the additional expense of using iron pipes throughout the whole of the drain.

Drainage would thus be simplified and cheapened; theoretically it would be consistent in detail, and practically it would be efficient, little likely to get out of order or to require amendment. The provincial view that you could have a satisfactory drainage system for your house, while the public sewers at your doors must be regarded with suspicion, would give place to the more concrete view which alone is defensible, namely, that the drainage problem is *one* hygienically, whatever be the need for legal or administrative distinctions between public sewers and private drains.

R. READ, A.M.I.C.E.

IN the author's opinion the answer to the above question is yes. The intercepting trap is intimately connected with the larger question of the ventilation of sewers and drains, which has been the subject of controversy, more or less for the last 30 years, commencing after the illness of the King when Prince of Wales in 1872. In this controversy the author has taken a somewhat active part at various times.

The intercepting trap was patented by Mr. W. P. Buchan, of Glasgow, about 1875, and without any special investigation was adopted by the Local Government Board, and introduced into their model by-laws in 1877. Ever since then this official recognition has caused it to be taken for granted by large numbers of people, and has deterred many from investigating the question for themselves.

The controversy above referred to resulted in a general consensus of opinion that "sewer gas must be cut off from the house," and the intercepting trap was adopted by the Local Government Board with this

object, but this was trying to cure one evil by introducing another.

In its original form a 6-inch intercepting trap contained over three gallons of stagnant sewage; it took the place of and was the same length as an ordinary drain pipe, with from 2 to 3 inches difference of level between the inlet and outlet; its form has since been modified by various makers, in the vain attempt to perfect it, chiefly by contracting the body to increase the scour, and the contents are now about $2\frac{1}{2}$ gallons or 25 lbs. weight of decomposing sewage, or about an ordinary bucket full. The trap uses up the fall required by four or six ordinary pipes, it is inserted at the lower end of the underground portion of the house drain, forming an obstruction therein nearly 8 inches deep to the flow of the sewage, it causes the sewage to deposit from 25 per cent. to 35 per cent. of its solid matter in the trap after each discharge in dry weather, and paralyses the flow of the sewage through the whole length of the underground portion of the house drain. During dry weather the contents of the trap are always more or less putrid, and contaminate both the drain and the sewer to which it is connected.

The intercepting trap necessitates in the front of the house, near the front door or windows, the so-called fresh air inlet, which acts alternately as an outlet and an inlet with every discharge from the drain. A mica or aluminium flap valve is generally fixed to these inlets in order to prevent them acting as outlets, but the constant flapping action accompanying every discharge from the drain, very soon damages the flap to such an extent, that it becomes useless, and the result is that in most cases the householders promptly stop up the opening, to get rid of the nuisance. When the houses are built close to the public footpath, the trap has to be fixed below the ground floor or basement of the house, unless the Sanitary Authority allow it to be fixed outside below the public footway.

The trap is liable to frequent stoppage, and is provided with an inspection chamber, or man-hole, to facilitate its clearance; but these inspection chambers are, as a rule, only opened when a serious stoppage occurs, which causes the sewage to show above ground.

The great majority of stoppages in modern drains occur at the intercepting trap, and many are unknown to the householder, because they clear themselves by the accumulation of sewage in the inspection chamber and drain, until a sufficient head of sewage is produced to force the obstruction through the trap; the result of these temporary stoppages being that the brickwork of the inspection chamber, of about four to six square yards area, and a considerable length of the drain, become

plastered with a slimy deposit of decomposing sewage. When the pressure of the head of sewage is not sufficient to force the obstruction, of course the sewage shows at the yard gulleys, and men have then to be sent for to open and clear the drain.

The trap is introduced into the lower end of the house drain, on the erroneous assumption that it is a safeguard to the house, but it is no protection at all; on the contrary, it is a useless and dangerous obstruction, which provides at every man's front door the very conditions and dangers which it is the object of modern sanitation to prevent.

These traps now form part of many thousands of existing drains, and while they absolutely prevent the adoption of a proper system of ventilation, they also provide a reservoir of putrid sewage on every house drain to contaminate everything passing through it, and thus cause noxious gases and smells to be generated in the drains and sewers, which cannot be got rid of by any amount of flushing of the sewers alone, and the more numerous the traps the greater the nuisance. The trap necessitates the use of at least 50 per cent. more water in the flushing cisterns to the w.c.'s, and even a three-gallon flush is not sufficient to prevent stoppages. A series of experiments were carried out by a committee of this Institute in 1893, which proved that even with a three-gallon flush, through a properly constructed straight drain 50 ft. long, 6 ins. diameter, laid with a fall of 1 in 40, on trestles above ground, as the result of 600 discharges, 27 per cent. of the solids were left in the intercepting trap after each discharge, and with a two-gallon flush 35 per cent., and the committee recommended three gallons as a minimum. More recently the experiments of Dr. Porter on an actual 6-inch drain in connection with a factory, proved that the intercepting trap could only be entirely cleared out by a six-gallon flush.

The great object of a system of drains and sewers is to discharge the sewage at the outfall in the shortest possible time. Why, therefore, should we put an obstruction into every drain to defeat this object?

The intercepting trap is wrong in principle, and is no remedy for either a badly constructed drain, or sewer; it cannot protect the house from the action of a defective drain, and it is liable to be forced at any moment: the true safeguard to the house and its inhabitants being a sound drain laid with a good fall, gas-tight joints, and properly ventilated by a full size pipe to above the roof of the house. On such a drain the intercepting trap is a useless and dangerous obstruction, but its absence allows the drain to be laid with a better fall, to remove the sewage quickly while in a fresh state, and to keep itself clean; this in turn acts

upon the sewers in a similar way, enabling the sewage to be discharged at the outfall before decomposition can take place. No sewer gas would then be generated, but only the watery vapour which rises from every wet surface, especially in dry weather, and this could then be easily dealt with by the ventilation of the sewers through the ventilated house drains. Neither the drains nor the sewers would be under any pressure, the traps at the waterclosets and gullies would be amply sufficient to protect the houses, and a general improvement in the health of the community would follow, because the fresh vapour of the sewage would be promptly oxidised, in its initial stages, before it had time to become putrid or dangerous; the only object of sewer and drain ventilation, beyond relieving pressure, should be to deal with this fresh vapour, and it should not be asked to do so after this has been allowed to develop into sewer gas.

MR. H. ALFRED ROECHLING (Westminster), as one who had had a great deal of experience in the sewerage of towns, the ventilation of sewers, and the drainage of houses, observed that in considering this question two main principles must not be lost sight of: that prevention was better than cure, and that of the two evils—escape of sewer gas or sewer air in our houses, *i.e.*, in confined positions, and escape of sewer air in the streets, *i.e.*, in not confined positions—the latter was the less. Everybody was agreed on this. In the following remarks he would always assume, both in the case of public sewers and private drains, that they were properly designed, properly constructed, and properly maintained, as it was absolutely useless to argue the points on any other premises. Those who wished to convince them that the disconnecting trap was obsolete and had far better be abandoned, must in order to carry their case prove either the one or the other of the following contentions. They must either show that sewer gas was beneficial to health, or if that were incapable of proof, they must clearly demonstrate that the air in the public sewers must always be at least as good as the air in house drains, and further, that the disconnecting trap must in every case prove an unmitigated nuisance. If it could be shown that sewer gas was beneficial to health—and here the negative proof could not be taken to establish positive evidence—the necessity for the disconnecting trap, and as a matter of fact of all other traps, disappeared. The difference between the disconnecting trap and the traps in the house was one of degree only, the difference consisting in the depth of

the seal and the quantity of waste water retained. As the authors (at any rate one of them) had frankly admitted that sewer gas was dangerous to health, it seemed perfectly logical that they should do all in their power to prevent its being laid on systematically to our houses. In the absence of proof of the beneficial character of sewer gas, the opponents of the disconnecting trap had, therefore, to demonstrate that the air in public sewers could never be worse than the air in the house drains, and that further, every disconnecting trap must prove a very serious nuisance. To establish the first contention it would not do to say that the air in the public sewers *might* be as good as in the house drains, as in that case it might also be considerably worse, and as it was generally the unexpected that happened, it was plainly our duty to guard against the pollution of the air in the house drains from the public sewers. He then went on to discuss the conditions in a public sewer that had been carefully constructed on the separate system, and was carefully maintained, and showed that owing to the intermittent flow, especially in the more level parts of a town, one could never make sure of the air in it being perfectly sweet and free from smell. If sewer air carried pathogenic germs such as those of typhoid fever and of other preventable diseases, and if it carried volatile ptomaines, these would be more or less present in the air of public sewers, especially in large towns. With a house drain, especially where baths were in use, the case was altogether different, and here it was not overstating the case to say that in a carefully constructed and rationally maintained drain the air would be perfectly sweet. This was known to all those who had frequently examined good house drainage systems. The contention that the air in public sewers must always be at least as good as the air in house drains could, therefore, not be established, and hence it seemed perfectly reasonable to establish a barrier between them. But if it could be shown that the particular form of barrier now universally adopted—the disconnecting trap—was wrong in principle and must always be an unmitigated nuisance, it was high time to abandon it in favour of another form. The disconnecting trap had now been in existence for about twenty-five years, and there must be at a moderate estimate millions of it in use. Was it imaginable that if it had proved a failure in every case they would still go on employing it? On the contrary it would have, and that deservedly, disappeared from the scene long ago. This contention was strongly supported by the Willesden experience, mentioned in the first paper. For if he read the paper aright it was shown there that out of every 100 cases the trap had proved perfectly efficient in 90, so that the chances were as 9 to 1 in favour of the trap. This was, however, well on the road to dead certainty that it would prove perfectly satisfactory, and if for this reason they were bound to condemn it they would have to condemn every apparatus now manufactured. For there was no such thing as an apparatus, that however improper its use would not get out of order. It was not his province to explain the failure in Willesden of every 10 traps out of 100, but he might say from his experience that where a carefully constructed disconnecting

trap had not fulfilled its expectation this was in nearly every case due to gross sanitary neglect on the part of someone. Granting, however, solely for the sake of argument, that a disconnecting trap was not a necessity, his experience told him that the arrangements of a cast iron drainage as suggested in the first paper, and especially as shown in the diagrams on the wall, would not give them reasonable security against the entrance of sewer air into their houses. Even if all the house drainage systems in this country could be so well superintended that all the joints both below and above ground were absolutely gastight and remained so for say 50 years, that all the ventilated ends of soil pipes were carried above the roof without bends so that an accumulation of rust and dirt in them did not block the passage of air through them after a few years, it was well known that the water seals of the traps in their houses were subject to being broken either by pressure or siphonage, and that sewer air would escape at the point of least resistance wherever that happened to be, either inside or outside the house. If, for instance, the air in a long length of soil pipe was too heavy for the sewer gas to force, the latter would break through the water seals of the traps inside the house. Or, if the case was taken of a house let out on the flat system and they assumed that one of them stood empty for some time, which was by no means an unusual thing, would not in such a case, after the water in the traps had evaporated, sewer gas enter and unknown to the other inhabitants roam through the whole building without check or hindrance? But apart from this, what would be the responsibility of the authorities if it could be shown that sewer gas from the public sewers had entered a particular house and there caused serious or fatal illness? A case of this kind had been tried in August, 1896, at the Birmingham Assizes, in which judgment for £2,875 had been given against an Urban District Council. This was not a discussion on the ventilation of sewers, hence he could not discuss the subject, but he might perhaps be permitted to say that it was well known now that there was no such thing as constancy in the direction of the air currents in sewers. The movement of air would at one time be up-hill and then change to a down-hill one, and the only thing that they could make sure of was continual change. This held good not only for public sewers but also for private house drains, and in districts without disconnecting traps it had been amply shown that the air current was not permanently in the direction from the public sewer to the house, but frequently changed into the opposite direction. In this connection he might mention the Bristol sewers, which were not ventilated at all, and where as had been observed there was a strong down-hill current. It could, therefore, not be correctly maintained that in the absence of disconnecting traps the public sewers would always be ventilated by the private house drains. Was it not further also correct to say that should, in cases, the disconnecting trap prevent the ventilation of the public sewer through the house drain, its use was more than amply justified by considerations for the health of the inhabitants. From the foregoing remarks it would be clear, he hoped, that the contentions necessary for

the abandonment of the disconnecting trap could not be successfully maintained, and the position so far taken up by owners and occupiers of houses, that they with the use of the disconnecting trap should see to the ventilation of the house drainage system, and that the authorities must provide for the ventilation of the street sewers without recourse to the house drains would, therefore, seem perfectly logical, hence reasonable and justifiable. Engineers were accustomed to provide in all their constructions a factor of safety, that is, they designed their structures so that they could withstand a strain of from four to six times greater than the calculated one, and this was for the express purpose of meeting unforeseen accidental conditions over which they had no control. Why should they abandon a factor of safety in sanitary works, where it was doubly necessary? The disconnecting trap properly constructed and rationally maintained provided such a factor of safety, which was convenient and cheap, and he hoped it would not be abandoned except under very special circumstances. Was not an Englishman's home his castle, and why should they allow its invasion by sewer gas any more than by anything else?

DR. CHARLES SANDERS (West Ham) said he came with the object of lending his support, from the experience of West Ham, to the views enunciated by Dr. Butler and Mr. Read, but after the remarks of the last speaker he felt he should apologize for representing the views of a large town with apparently very inferior drainage. For if it were true, as stated, that a drain properly laid with an interceptor, inlet and outlet ventilators only contained pure air and did not stink, then he found it impossible to explain the reason why the drains laid by his colleagues the Inspectors of Nuisances, whose training the Royal Institute vouched for and whose ability and care he himself could vouch for, did in numerous cases result in most obnoxious odours at the so-called fresh air inlet—a condition generally remedied by the occupier who blocked it up. He would ask someone to describe the difference between drain air and sewer air. Personally he did not recognise any difference, for under the Public Health Act, 1875, as soon as two houses were drained by a single pipe, the pipe became a sewer; yet the advocates of the interceptor did not feel it incumbent upon them to place one at the top end of such a sewer, but allowed several houses to drain into one pipe sewer, and placed the interceptor between the sewer in the road and the sewer on private property, thereby allowing the sewer air above the interceptor to escape freely into the house drain at the top end. Dr. Butler had shown what actually did happen when intercepting traps were used: the only argument adduced in opposition to the abolition of interceptors consisted of opinions as to what might or would happen if they were abolished; but no instances of injury to health or nuisance were found in connection with the thousands of drains which had no interceptor. He trusted the result of the discussion would be to frighten away the bogey of the assumed danger arising from the ventilation of sewers by means of the house drains.

MR. C. CHAMBERS SMITH (Engineer and Surveyor to the Sutton Urban District Council) said he could not agree with the first two speakers, and after Mr. Roechling's remarks he thought it would be agreed that the bottom had so far been knocked out of their argument. The main objection to the intercepting trap was that it got blocked up. Well, there was no apparatus that did not. An intercepting trap was just as necessary as a gully trap, and which of them would say that because that got blocked up it should be abolished? As to the fresh-air inlet venting on to the windows of houses, that objection was met by carrying the pipe higher up the side of the building. Another point was that they had not yet proved the necessity of ventilating sewers. The danger of abolishing intercepting traps was one that they should not encounter. The risk attendant upon having sewer gas laid constantly on to houses, which would be the case if intercepting traps were abolished, was too serious to be lightly undertaken, and, as everyone knew, it was impossible to guarantee that a drain passed as sound would remain so for two years; therefore where, as for instance, drains ran under houses, the escape of sewer air could and would go on until it produced disease and possibly death. It was suggested that with free ventilation of sewers, the offensiveness and danger of sewer air would be practically abolished, but this could not be supported, and was not in accordance with facts. In the upper reaches of sewers, where the sewage was fresh, the odour was not so intolerable; but when sewage had travelled some distance in the sewer it became putrescent. No amount of ventilation could destroy its offensiveness, and one had only to remember as a case in point the condition of an absolutely open sewer, such as the River Aire at Leeds, to recognise that neither dilution nor oxidation could destroy such conditions. It therefore meant that houses adjacent to such sewers would be—as regards danger and offensiveness from sewer air being laid on to them—in an intolerable position. The objection to intercepting traps had been raised, he admitted, by municipal engineers in consequence of their inability to ventilate the sewers by themselves, and medical officers of health had hitherto, and rightly so, in his opinion, been adverse to their abolition. It was not, however, the duty of occupiers and owners to ventilate public sewers, and local authorities should find a proper remedy and not risk the menace to health which would be introduced if intercepting traps on house drains were abolished.

MR. F. WOOD (Fulham) said that, viewing the matter broadly, he thought the majority of those present would agree with what the authors of these articles had said. They had, however, to view this question from the "exception" point of view. Intercepting traps, if used properly and judiciously, were not a failure. When the trap was a failure, it was for the reason that its application was at fault. The w.c. was a trap, but no one would suggest that this should be dispensed with, and the pan left freely open to the main sewer. If the soil pipe from the w.c. had no anti-siphon pipe, then the interceptor at the foot of the

soil pipe was desirable and necessary—especially was this the case if there were series of w.c.'s one above the other; if one should be untrapped by the working of the w.c. on a higher floor, this trap would prevent the gases entering the house. The interceptor at the w.c. was properly worked and was satisfactory: every time it was used it was emptied of the previous contents. The only method of clearing an intercepting trap was to send down a large quantity of water in a short time—more than ever would go down from a single w.c. If the w.c. trap was with difficulty cleared by means of the quantity discharged from a two-gallon cistern, it must be impossible for this action to take place in regard to the larger intercepting trap placed at so great a distance as 30 feet away, with an approach of 1 in 30 instead of a vertical one. The water passed through a trap by displacement; if the velocity was small, one could easily imagine the water passing through, and the floating or solid matter being intercepted or held back by the obstructing trap. Any noxious gas generated by the matter in the trap would either remain in the house drain or escape by the so-called air inlets or air outlets. He could confirm the writers of the articles in their condemnation of the air inlets, which were placed immediately under windows and in positions where children might use them and tamper with the mica flap as if it were something placed there for their amusement. The trap intercepted the gases from the sewer; he believed it did this effectively. If this was the object, then it was not a failure. But if the trap was not in existence, the gas would still be intercepted from the house by the trap at the w.c. and gully. Then why place an interceptor in the sewer? The answer to this had been that there were people who did not use the gullies, w.c.'s, etc., and the water evaporated and the trap became an open ventilator, whereas the interceptor would always be full of water, and oftentimes clean water, from the rain-water that entered the drain, so that if the w.c.'s were not used, this trap was placed there in a position where it would always have water, and where there could be little or no evaporation. Many said that it was impossible to become infected with disease from sewer gas when it passed through the air, while others had agreed that there was danger, so the ordinary man in the street knew not what to do, and he took double precautions—as in this case he thought two interceptors were better than one.

MR. WILLIAM GREEN (Finsbury) said he advocated the abolition of the trap. If the intercepting trap were abolished ventilation could be improved by means of ventilating pipes or soil pipes being affixed to the drain of each house, whereby the gases generated in the sewers by decomposition would not only be carried away more quickly but would be distributed over a greater area. If sewer air was so bad they should protect themselves against it, and this could well be done by having a good drain, tested with water when constructed. He did not consider an intercepting trap was a necessary appliance, and if the drains were properly ventilated they would be much better without interceptors.

(1) MR. GEO. M. PETTIT (Kensington) said he should like to ask a few questions. Would Dr. Butler tell them:--If, in that part of the district where diphtheria was most prevalent, the houses were flooded by storm water from the sewers during heavy rains.

DR. BUTLER replied that that portion of the district referred to was one that was least flooded by storm water during heavy rains.

(2) In how many cases were the traps that were found to be choked, level traps, or traps that had a cascade? he asked this question because he believed that traps with a cascade impede the velocity and are the cause of many stoppages in the trap, especially in small tenement houses where hard paper was used. The paper opened wide in the water in the trap, and the next flush of water instead of sending the paper through the trap, fell on the outer edge of the paper and turned it over and over piece after piece until a ball was formed, with the result that the drain was choked. Many old drains had been opened up and an old fashioned siphon found placed therein, no one knew it was there until the drain had been exposed for the purpose of fixing a trap in it. This bore out his statement that traps with a cascade were at fault.

DR. BUTLER replied he was sorry he was unable to supply that information a note not having been made at the time.

DR. SYDNEY DAVIES (Woolwich) who was unable to attend, wrote saying he was decidedly opposed to the general abolition of intercepting traps. If all sewers were perfect in construction, perfect in form, and perfectly flushed there would be no need for the intercepting trap, which would in that case be nothing but an obstruction to the removal of house drainage, but he thought that until that ideal condition of the sewers arrived, of the two evils, escape of sewer gas in the neighbourhood of the houses, and the slight impediment to the getting away of house drainage offered by the trap, the first must be considered decidedly the greater. Occasionally no doubt some nuisance arose from an intercepting trap, but he found, on careful enquiry, that in his borough any such nuisance was exceptional. The Borough Engineers who advocated the abolition of the trap did so, he understood, not so much because they considered it objectionable in itself, as because they wish to ventilate the sewers through the house drains. Their very reason then for asking for its abolition was an argument against the proposal. If the sewers needed so much ventilation, the sewer gas must be decidedly objectionable, and should not escape in the neighbourhood of houses. The object of the Borough Engineers should be not to obtain general ventilation of sewers, but to so improve the sewers, and so flush them, that no ventilation was needed except for those sewers in which men must work. These of course must be separately considered, and special means taken for their ventilation, but not by tapping them at every house. He was surprised to find that Dr. Butler was a convert to the view generally held by the Borough

Engineers as to the desirability of making every house assist in ventilating the sewers. About ten years ago he (Dr. Davies) read a paper before the British Medical Association on Ventilation of Sewers, in which it was maintained that more ventilation did not mean less foul gas in the sewers, but rather the contrary. He quoted Mr. Baldwin Latham as follows: "If they allowed large volumes of pure air to pass through a sewer in contact with sewage, they had large volumes of foul air escaping at some point, and that the great secret in sewer ventilation was not to encourage these currents of air through sewers, but to give such an amount of vent as should prevent any pressure being exercised upon the traps of their houses, so as not to allow any escape into the house itself." He did then, and still endorsed this view, which he thought had of late years gained very general acceptance. Dr. Butler assumed just the opposite, that sewer gas could be made innocuous simply by unlimited ventilation. Let him examine any slowly flowing dirty ditch which was altogether exposed to the open air, and note whether this complete ventilation abolished smells. No doubt it would be better if intercepting traps could be dispensed with, but as long as the sewers were worse laid and worse flushed than the house drains they were a necessity, and to ask for their removal in order to improve the sewers was like a man asking his adversary to lay down his armour in order that the foeman's wrath may be appeased.

MR. P. SAUNDERS (Croydon) said he should like to say a few words on a point not mentioned by the previous speakers. Dr. Butler did not give them, as a result of his very exhaustive inquiries, the number of ventilation pipes that were found stopped; Dr. Butler was, he understood, an advocate for the abolition of the disconnecting trap, and Dr. Sanders was of the same opinion, "because they stink." Now in his experience, he had invariably found when an offensive smell was emitted from the fresh air inlet, it was because the ventilation pipe at the end of the drain was obstructed, or was too small. Years ago many 2 in. and 2½ in. zinc vent pipes were fixed, these were now frequently found bent over at the top, effectually sealing them; also the more modern 4 in. iron pipes are found completely stopped with rust, etc., in the bend at the foot. In these cases would it be advisable to do away with the disconnecting trap? He thought not: as any defect in the drain under the floor, or soil pipes in the house, would certainly be more dangerous.

MR. R. READ (Gloucester) remarked that the effect of the interceptor was to cause an obstruction something like 8 ins. in depth in the flattest length of the drain, the result being that the sewage merely dribbled into one end of the interceptor and out at the other. There was no rush because the interceptor was at the end of a comparatively flat gradient, and as long as they had that almost stagnant sewage in the trap they would have sewer gas in the drain. The sewers were what the drains made them, and the unfortunate borough engineer had to waste water in flushing otherwise clean sewers, to try and

get rid of smells created in the drains by the interceptor: it was like hunting a ghost, or will o' the wisp, for an hour later the smell would be as bad as before. If the valve of the so-called air inlet held tight, the drain air was forced through the water seal of the trap by every discharge from the drain, but if it did not hold tight, a portion of the drain air must be forced through it in front of the door and windows, and the remainder through the trap into the sewer. On the sewer side, if the sewage in the sewer rose over the mouth of the drain junction, the sewer air was forced through the water seal of the trap, or blew out the stopper of the raking arm, to escape either at the fresh air inlet, at the soil pipe ventilator, or both. But omit the trap, and the drain could be given a better fall, the sewage would have a clean run through both drain and sewer, with a good velocity, and the ventilation could be properly applied and adjusted. The trap in its present position was like a single policeman trying to stop an unruly crowd, he got knocked over, but its prototype the trap of the w.c. pan was in its proper position, and like a policeman directing the traffic quietly into its proper channel, that is, it prevented the drain air from passing through the w.c. pan, by directing it up the soil pipe ventilator. With the interceptor in its present position they could never secure proper or efficient ventilation, for in order to thoroughly control the ventilation of a sewer, the number of outlets must be largely in excess of that of the inlets, and so distributed over the whole system, that the manhole gratings on the surface of the road should always be made to act as inlets, by the combined action of the soil-pipe ventilating outlets.

DR. BUTLER wished to join with Mr. Read in expressing his appreciation of the manner in which their papers had been received. They could not complain of lack of criticism, but that criticism had left him more convinced than ever of the truth of the position he had taken up. It was true that if Mr. Roechling's standard of what would suffice to condemn the interceptor were adopted (namely, that in *every* case it must be proved an unmitigated nuisance) their task was a difficult one. But he submitted that the failure of the disconnecting trap to achieve its object in so large a proportion of cases as he had been able to establish, and its direct responsibility for the gross insanitary conditions he had observed, constituted a serious impeachment of the system. Mr. Roechling had urged that in the absence of the trap, sewer gas was systematically laid on to the houses. His (Dr. Butler's) position was a denial of this proposition, while he affirmed that the trap and the complications it necessitated were a contrivance by which sewer gas actually was laid on to the houses in an ascertained 10 per cent. of the cases. It was a pure assumption that drain air and sewer air were essentially different, and that the one was necessarily less dangerous than the other. As Dr. Sanders in his remarks had pointed out, they were discernibly the same, even while subject to distinction merely by a legal quibble. To admit the aerial contents of the sewer to gas-tight house

drains with no untrapped openings was not, he maintained, to lay on sewer gas to the houses, as had been contended. This assumption was at the root of the objections to doing away with this insanitary contrivance. So far from the intercepting trap being a tell-tale, as had been suggested, what so frequently happened (as Mr. Read had pointed out in his paper) was that upon the trap becoming choked, the head of sewage in the drain and manhole was sufficient after a time automatically to force the stoppage, and thus relieve the condition without anyone being the wiser. But the pollution of the site by the percolation of liquid sewage was an unsuspected danger that remained. He was aware of the fallacies that lurked in crude statistics, and when he came to the relative incidence of diphtheria upon the respective areas in his district in which the drains were and were not equipped with interceptors, he wished to give the facts only for what they were worth. But the facts were that in the older part of the district, built for the most part prior to 1875, where the housing conditions generally were much more insanitary than in anything to be found in the newer part, and where the general death-rate was considerably higher, the incidence of diphtheria had been materially less. If there was one disease more than another supposed to be associated with emanations from drains and sewers, that disease was diphtheria. And the fact was that in Willesden diphtheria had by far its greatest incidence upon the population living in houses provided with interceptors, notwithstanding that generally their sanitary conditions were otherwise greatly superior to those so unprovided. In the one class, that provided with interceptors, there was a particular provision in the form of an untrapped opening to the drain, situated near the ground level, in the forecourt, by which drain air and, very frequently, sewer air were laid on at the thresholds of the houses. In the other, no such ingenious device for polluting the atmosphere of the house existed. The different rates of incidence of diphtheria might not be significant of this difference, but their causal correlation would only be in accord with prevailing notions as to the relationships of diphtheria and exposure to the emanations of drains and sewers. What he wished particularly to insist upon, however, was that the interceptor and its appurtenances, when critically examined, were found to be devices for doing what they aimed at avoiding, namely, providing an escape near the openings to a house of the emanations from drains and sewers.

MR. W. D. SCOTT-MONCRIEFF (London) writes to express his regret that he was unable to be present at the discussion upon the two papers by Dr. Butler and Mr. Read, which he considers at any rate courageous if they are not conclusive. He thinks that in the first paper there are several statements that may be fairly met by a direct negative and a good many conclusions which are in no way justified by the facts. Dr. Butler says that the conception of a drainage system in which the drain is disconnected from the sewer is faulty in theory, because it is based on the assumption that it is safe to have a condition of things in the

public sewers that is unsafe to have in the house drains. Now this is simply not the case. The unventilated condition of town sewers is universally recognised as being for the most part unsatisfactory, and the trouble is how this defect may be remedied. The problem has proved difficult to solve, and until the remedy has been applied, the practice has been quite a sound one, of making sure that the conditions prevalent in the sewers should not be allowed to invade the interior of the dwelling. This position in the judgment of the great majority of experts is the best available, and it has been developed at an enormous cost to the community. The remedy advocated by the two writers of the papers is that of doing away with disconnecting traps, as an end of the trouble. The question is, have they proved their case? Proving the existence of defects in the system now in vogue by no means establishes their proposal for the abolition of disconnecting traps as a certain remedy. The problem of sewer ventilation is so complicated and so difficult of solution that it will be necessary for the writers to be able to point to a case carried out on a large scale not even upon average, but under exceptionally unfavourable conditions, in which the success of their proposals has been proved to the hilt; so far as the papers are concerned, they have not referred to a single case in which they have even been tried. While giving every credit to Dr. Butler for the investigation at Willesden, which involved no less than 6,745 inspections, it is obvious that even if the number had been doubled it would not have done anything to prove the efficacy of their alternative proposal. The defective character of one system does not by itself prove the efficacy of another. My own experience now goes back as far as an inspection of the original arrangement by the late Dr. Fergus at his own house in Glasgow, from which Mr. Buchan designed his well-known trap. This established the principle of house disconnection which I had already advocated, and which has since been almost universally accepted. There is not a shred of evidence in either of the papers to show that in certain states of the atmosphere there would be any movement whatever through the house drains and ventilating pipes of the emanations from the sewers, or that the street gratings would, under certain conditions prevailing during calm weather, be inlets for fresh air any more than they are at present. Under such conditions the emanations, however objectionable they may be, are at any rate better removed by the width of the pavement and half the width of the street from the houses, than hanging about the roof of the house itself and contaminating the atmosphere in the neighbourhood of bedroom windows. It is a matter for regret that Dr. Butler did not take the opportunity presented by the investigation at Willesden to provide information as to the causes of the large percentage of choking which occurred in the disconnecting traps. Presumably the houses are occupied by people who are not very particular about their drains, and certainly six-inch pipes are too large for that class of property. The general experience with regard to properly constructed disconnecting traps is that they contain clear water after they have been adequately flushed, and, in

any case, the objectionable contents mentioned by the writers do not disappear by discharging into the sewers, where they will still engender smells and gases, which the writers propose to pass through the soil-pipes and ventilate at points much nearer to windows than the street gratings. The disappearance of the plugs from the cleansing eyes of the disconnecting traps to which reference is made is a simple matter of carelessness. The objections raised to large man-holes have long been recognised, and are met by cast-iron manholes with covers at the bottom of the manhole. A much more serious question than the presence of offensive gases in the sewers is the system now in vogue of spraying enormous volumes of sewage into the air in districts that are densely populated.