

On the ventilation of public sewers, with special reference to those of Oxford : read at the meeting of the Ashmolean Society, November 28th, 1864 / by G.A. Rowell.

Contributors

Rowell, G. A. 1804-1892.
Royal College of Surgeons of England

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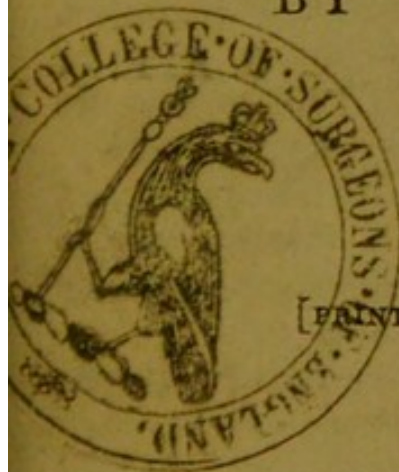
PUBLIC SEWERS,

WITH SPECIAL REFERENCE TO THOSE

OF OXFORD.

*Read at the Meeting of the Ashmolean Society,
November 28th, 1864.*

BY G. A. ROWELL.



[PRINTED FOR PRIVATE CIRCULATION.]

OXFORD:

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MDCCCLXV.

I have been induced to publish the following paper, from an opinion expressed by several to whom it has been submitted, that the *facts* given in it are important, and should be more generally known. In advancing my own views as to the means for ventilating the sewers, and in commenting on those of others, I may have laid myself open to controversion; but on this head I am careless: my chief aim being to raise discussion on the subject, and to call public attention to the evils consequent on the present system.

I am aware that there are several repetitions in the paper, but as it can be but of temporary interest, I have not considered it necessary to make any alterations.

G. A. R.

Alfred Street, St. Giles's,
Dec. 21, 1864.

The Ventilation of Public Sewers.

WHEN Mr. Ormerod's work on the *Sanitary Condition of Oxford* was first published, I noticed that very many close dirty courts and places in Oxford were passed over, while far more open, and to outer appearance healthy districts were shaded in his map as unhealthy.

This apparent anomaly induced me to investigate as to the cause; and in a letter published in the Oxford papers I showed, that in every locality marked as unhealthy the water was more or less bad, and that the healthiness of a district was generally in accordance with the quality of the water with which its inhabitants were supplied.

That such was the case is so fully borne out by facts given in Dr. Acland's elaborate and important work on *Cholera in Oxford*, and is so generally acknowledged, that I only now notice the water question, as I shall have to mention two or three facts which are in some degree connected with it.

During the prevalence of cholera in 1854, I noticed that most of the cases which occurred in the central parts of Oxford were in houses in the principal streets, and that cholera seemed especially to affect corner houses, or other houses in a similar condition, that is with little or no outlet; and as those parts of Oxford were almost free from this disease during the visitations in 1832 and 1849, I could only account for the singularity of the locality of these cases, as the effect of sewage gases, or the effluvium from in-door water-closets; and in a letter in the *Oxford Journal* of November 4th, 1854, I endeavoured to direct public attention to the facts connected with them.

I was fully confirmed in my opinion as to the effects of sewage gases, by an occurrence at Washington, in 1857; and I believe that the evils arising from this source will

be greatly increased in Oxford, if any system of drainage be carried out similar to that recommended by the late Sir William Cubitt, unless some efficient mode of ventilating the sewers be adopted.

Before I enter on the special cases as regards Oxford, I will explain my own views respecting the effects of sewage gases under different circumstances.

I believe that sewage gases, or effluvia from excrete or decomposing animal or vegetable matter, do but little if any harm when diffused in the open air, even if present to a degree that may be offensive to smell. This opinion I ground on the fact, that men can be employed in occupations where such gases may be present in an *excessive degree* and yet be uninjured in health. Men may be employed, for weeks in succession, in emptying cesspools or cleaning out sewers, but this must be where there is a tolerable communication with the open air; and whenever fatal cases occur from such employments, they arise from the neglect of proper precautions on this head. Tallow melting is a nuisance to a neighbourhood, still it is not an unhealthy occupation. The same may be said of tanner's work, although at times, in hot seasons, it is extremely filthy. Farmers' men may be employed in moving or distributing manures of a filthy character, or in cleaning out pigsties or the like in a highly offensive condition. Now such men are generally employed in the open fields, where they breathe the purest air, and such filthy work is only occasional; it therefore cannot be said that they are inured to it, and yet they do such work with impunity. But men could not be employed in any of the occupations I have named unless in communication with the open air.*

* It has been asserted that men in such employment drink spirits or other stimulants in excess, and are generally short-lived. This assertion may apply to such men in London, where they have comparatively high wages, but certainly will not to the lower paid labourers in Oxford, or to farmers' men. I have known men who have followed the occupation of nightmen for the greater part of their lives, and yet lived to a good old age; and I believe that men so employed live as long as the average of the working classes. At the present time the man I should select as the finest model for a Hercules, and as the strongest man in Oxford, is one who has been thus employed for many years, and with whom such employment may be said to be hereditary.

It is on such facts as these that I have formed the opinion I hold; and I repeat, that if men can thus be employed, day after day, or week after week, or, as with farm labourers, only occasionally, where such gases or effluvia are in excess, the diffusion of such gases in the air in a slight degree could not be injurious to the general health. But the effect of sewage gases, or offensive effluvia, is very different when they are generated in or find their way into dwelling houses, or places where there is no free communication with the open air. On this head, the occurrence at Washington, to which I have alluded, affords an important lesson. The account, of which the following is an epitome, is given in the *Times* of April 11th, 1857.

About the middle of January of that year, an epidemic broke out in the National Hotel at Washington, which was occupied at the time by from four to five hundred visitors; when within a few days about three hundred of them were taken ill, amongst whom was the President of the States, and several senators, with their families. The epidemic was not confined to the National, but prevailed generally in other hotels and large houses. There was considerable alarm excited on the outbreak of the epidemic, which was attributed to various causes; but, on a thorough investigation by the Board of Health, *it was found to be the result of trapping the drains in the streets.*

It appeared that the mouth of the drains in the street had been open, so that the sewage gases could escape freely into the air; but after their being trapped in the previous autumn, the rise of a high tide in the river, or a south wind blowing on the mouth of the culvert, drove the sewage gases back with such force that they made their way through the lighter trappings into the houses, and produced the sickness here described.

The effects of the sickness were *vomitings* and *diarrhœa*, together with *cramps*, and a *general prostration of the system*. This was in mid-winter, during an otherwise generally healthy time; and there can be no doubt that similar causes, in hot weather, would tend to induce cholera *if it were epidemic at the time*, and must be conducive to typhoid fever and sickness at all times.

I will now come to the question as regards Oxford, and

may premise that the following calculations are from data afforded by Dr. Acland's work, before alluded to, and it is chiefly by the aid of that valuable book that I am enabled to submit this subject for public consideration. The high number of 10,000 for comparison for the ratio is used so as to render decimals unnecessary.

During the visitation of 1832, the ratio of deaths from cholera, in all Oxford, was forty-three to 10,000 inhabitants; in 1849 it was as twenty-eight, and in 1854, as forty-nine to the like number. Now, as compared with these numbers, the ratio of deaths in the central parishes was very low; but from this calculation I exclude the parish of St. Peter-le-Bailey, for the following reasons. During the visitation of 1832, the deaths in that parish were only as eight to 10,000 inhabitants: but at the time of the visitation in 1849, the Jericho drainage was in progress, and from the depth of the cuttings in St. Peter's almost every well in the parish was drained; the inhabitants had to obtain water as they could, and the ratio of deaths from cholera rose to forty-five to 10,000 inhabitants, and in 1854 it was thirty to the like number.

Now taking the parishes of St. Peter-in-the-East, St. John, St. Mary, All Saints, St. Martin, St. Michael, Magdalen, and Holywell; the ratio of deaths from cholera in 1832, was as $8\frac{1}{2}$ to 10,000, in 1849, as only 3 to the like number; but in 1854, the ratio rose to 17 to 10,000 persons.

Thus leaving out the visitation of 1849, (when the central parishes were almost free from cholera), and taking only the returns for 1832 and 1854, the ratio of deaths in all Oxford was in excess, at the latter period, about one seventh; but the ratio in the central parishes was doubled.

But the doubling of the ratio is far from showing the real spread of cholera in the higher districts of Oxford during the last visitation. How far the increase was owing to the following circumstances, I now submit for consideration. In June, 1850, a most important change was made in the management of the Public Sewers. Previous to that date, and, of course, including that of the two first visitations, no person was allowed to turn any private drain into the sewers, without inserting a grating to prevent the passing of any but fluid matter; thus pre-

venting the deposit in the sewers of any great amount from which gases could be generated. But at that date, and just four years previous to the last visitation from cholera, a resolution passed the Board of Street Commissioners, to allow persons to remove the gratings from their underground drains, with the conditions that the city water should be laid on in making water-closet drains. That was in fact, leave to turn water-closet drains into the public sewers; and it *was about this time, and in consequence of this regulation, that the street drains were trapped.* Now previous to these changes respecting the sewers, the higher parts of Oxford were singularly free from cholera, as within that portion of the district (included in the *highest contour line* shown in Dr. Acland's map), which extends from the Town Hall to St. Michael's Church, and including Ship Street and the Turl, the cases of cholera in 1832 were only two; in 1849 there was none; but in 1854 there were 15. From this last number, three cases may be deducted as owing to an assignable cause, leaving the numbers as two, nought, and twelve for the three years of the visitations.

That the prevalence of cholera in 1854 in the district I have named, was the effect of sewage gases, will be more apparent if we carefully consider the locality of the various cases.

Now, taking all the cases of cholera which occurred in 1854, within the district from Magdalen Bridge—or rather from Long Wall and King Street—on the east, to St. Aldate's Street and the Corn-Market on the west; and between St. Alban Hall, Merton, Corpus, and Christ Church on the south, and Broad Street and Holywell on the north; it will be seen that most of the cases were in the principal streets, in the highest part of the district, and that they especially prevailed in corner houses, with little or no outlet; or in houses so blocked up at the back as to render ventilation very imperfect. In such houses, the water-closets must be within the limits of the building, and connected with the sewers or a private cesspool. And there must also be communications with the sewers by pump or other waste water-drains.

On the contrary, it will be seen, that within the same district hardly a case occurred in back lanes or courts—

where open cesspools are more generally used, and where the pumps and drains are usually exterior to the house—except in places where a fairly assignable cause may be advanced for cholera prevailing.

A case of cholera occurred in Long Wall in 1859: there was also one in 1832. Of these cases, I know nothing; but as the houses are just without the fortification walls, and near or upon the site of the old city ditch, it is probable that the quality of the water may have been the inductive cause of cholera in these cases.

There was a death from cholera in 1854, in a yard in the lower part of the High Street. This yard is near the site of the old East-gate, and from inquiries I made at the time, I understood that the water was so bad, that the woman who died was the only one in the yard who would drink it. The bad water may therefore be assigned as a cause of this case.

There were two deaths from cholera in 1854, in a front house at the corner of King Street, and two other cases in that street. There was no case of cholera in this street either in 1832 or 1849, and these cases may have resulted from the wells having been rendered useless, from the culvert being laid along the street a short time previously. I have already alluded to the effects in St. Peter-le-Bailey, from the wells being drained during the prevalence of cholera in 1849. The cases in this street may therefore be passed over.

No case of cholera occurred in Merton Street, Grove Street, Alfred Street, Bear Lane, or Blue Boar Lane: that is, from King Street to Saint Aldate's.

In the High Street there was no case in any of the courts, or the street, from the yard already mentioned to Oriel Street, where a case occurred in a *corner* house.

The next case in the High Street was at the *corner* of the Turl; but there was no case in Swan Court, Amsterdam Court, or Payne's Yard.

There were three deaths from cholera in a yard opposite the Market. It was stated at the time that some of the clothing of a deceased cholera patient had been taken into this yard, and washed there; and if so, the introduction of cholera may here be accounted for.

There was no other case in the High Street, from the

Turl to St. Aldate's, where a case occurred in a *front* house near Carfax, which had no *back door or window*.

A death occurred from cholera in a *front* house in St. Aldate's, at the *corner* of Blue Boar Lane. And there was a death, and two cases of cholera in a *front* house in St. Aldate's, near the Butter-Bench.

A case of cholera occurred in Corn-Market Street, and within a few doors from Carfax Church. This case was not in a front house; but from the respectability of the proprietor who then lived in it, and from the crowded state of the buildings about that spot, I have no doubt that these premises had drains in connection with the public sewers.

Similar remarks would probably apply to the next case, which was in a *front* house nearly opposite to Messrs. Grimby and Hughes' new building.

There was a death from cholera in a *front* house in Market Street: in reference to which Dr. Acland makes this note: "Reduced by previous illness and distress. House offensive from bad drainage." This may therefore be set down as a case of sewage gases.

A case also occurred in a *front* house nearly opposite the last-named.

The next case in the Corn-Market was in a *front* house, with no outlet, and enclosed on each side and the back. And a death occurred at an Inn in the Corn-Market, within a few yards of the street, but of this case I know nothing.

There was no case of cholera either in Ship Street or New-Inn-Hall Street, and the next we come to was in a *front* and *corner* house in Magdalen Street, and which had not a foot of outlet.

No case of cholera occurred in any of the houses in Broad Street, from the Corn-Market to Turl Street, or in the yards at the back of them. But there were two deaths in *front* houses in Turl Street. There was a case of cholera in one of the *front* houses in Broad Street, nearly opposite to the Clarendon; but no case occurred in the small cottages in the yard at the back of these houses, or in those in a narrow passage opposite to the Ashmolean Museum, in which the houses are small and form one row. They are quite blocked up at the back, and have a rather

high wall in front of them; they are therefore very badly ventilated: but the cesspool, and the pump and waste-water drains are exterior to the houses, and no case of cholera occurred here during either of the visitations. The description of these houses would fairly apply to many of those in the yards and courts to which I have already alluded, or have yet to notice.

A man was taken with cholera in New College Lane, while carrying round milk; but that case has no bearing on the question under consideration.

There was no case of cholera in Holywell, or in St. Helen's, or any other of the courts and passages on either side of the street.

I have thus gone over every case of cholera which occurred in 1854, within the limits stated. Now, if we exclude the case in Long Wall, and that in the yard near the East-gate, the four cases in King Street (two of which were in a corner house), and also exclude those that occurred in the yard opposite the market, in all of which cases there seems to be a fairly assignable cause for cholera prevailing—there were sixteen cases, *all in the more elevated parts of Oxford; all in principal streets; all, with the exception of two in the Corn Market, in front houses; and all in houses within which* (there can be no doubt) *there were some communications with the public sewers, either by water-closet or by waste water drains.* But, during the same period, not one case occurred in any of the lanes, courts, or passages to which I have alluded, and where, in general, the closets, pumps, and drains are exterior, and the houses therefore uncontaminated from communications with the sewers.

I believe I have now shown that the sewers, under present circumstances, are productive of much evil, and that houses connected with them by drains are liable to contamination to a fearful extent; and especially so in the higher parts of Oxford, where the sewers, being trapped, are receptacles for all the lighter gases generated or collected in the sewers at lower levels, and connected in the same system of sewerage. Few persons are aware of the degree to which water-closet pipes may become charged with gas. I know of one case where an explosion took place, while the owner was looking for the defect in the pipe by the aid of a lighted candle.

If I am right in my views thus far, it is obvious that some efficient mode for ventilating the sewers must be adopted, to prevent the evils at present arising from them; and certainly before the system of sewerage can with safety be extended, or more water-closet drains be turned into them than at present. There are many persons who contend that these evils may be prevented by proper attention to the trapping and machinery of closets and drains. I believe that no house containing a water-closet, or hardly a drain, in connection with the sewers in their present state, can be altogether free from sewage gases. Servants may be careless in such matters; in the construction of closets, &c., we must depend on workmen who may be neglectful, or on materials that may fail; and at all times be liable to accidents, which, if not discovered at the time, might lead to serious consequences. I have known several cases in which rats had gnawed through lead work connected with closets. One in which the lead pipe had been fractured, from the shrinking of the wood on which it rested. And in one case an iron pipe was cracked from a settling in the foundation of the house. In fact, hundreds of accidents of a similar kind might happen, which human foresight could hardly prevent.*

* It is a curious fact that almost every one will defend his own water-closet as being almost perfection. This may be owing to the sense of smell being deadened by the repetition of a like effluvium—as in smelling a musk plant; or perhaps the smell, if not in excess, may be passed over as a matter of no consequence. For, as the public sewers are receptacles for all kinds of matter, the gases from them may be of any and every kind; and, although less offensive to smell, may be far more pernicious than those of an ordinary cesspool. At Washington, previous to the outbreak of the epidemic, nothing offensive was noticed in the Hotel, otherwise than that of a “closeness” of the air in the passages.

Since the reading of my paper, I was conversing with a gentleman on these subjects, when he spoke of his own closet as a very superior one, and as being entirely free from an unpleasant smell. I was prevailed on to go with him to inspect it; but he had not gone half-way up the stairs, when he exclaimed, “Bless me! (*sniff, sniff*) why, what? (*sniff, sniff*) I can’t understand this!” By this time we had got to the closet, when we found the pan empty of water and the window closed. Now, from a disarrangement of the machinery, or from the carelessness of servants or others, such a case might occur in any house; and if during peculiar seasons or conditions of its inmates, very serious consequences result from it.

A gentleman, residing in Park Crescent, informed me that for a

As I have only a superficial knowledge of the nature of sewage gases, it is more than probable that I may be in error respecting their action when in contact with common air; but as I am in the presence of those who can set me right on such matters, I shall, in reference to the ventilation of the sewers, not only express my own views on the subject, but also state the opinions of others with whom I have spoken upon it, as I shall thus give a wider scope for remark upon what I advance.

Most of those with whom I have conversed as to the means of ventilating the sewers, have at once spoken of shafts as all-sufficient for the purpose; but, generally, on being pressed for further information as to their plan, they have seemed to be all abroad upon the subject. Some have spoken of a ventilation shaft on or about Carfax, and of forty or fifty feet in height; and, on objections being made to this plan, they have proposed carrying up a shaft somewhere in St. Giles's fields, or even at Summertown, so as to be above the elevation of Carfax; seemingly under the idea that gases will flow to the highest level as water to the lowest. On this head, the fact seems to be overlooked that gases, to rise from the sewers in volume, must be buoyed up by heavier gases, or by the expansive force of the gases within the sewers being sufficient to overcome the pressure of the external air. For my own part, I believe that lofty ventilation shafts could not be adopted; for if the sewage gases did rise in them in any quantity, it would only be when the barometer stood very low; and then, as the gases generated over a large area would be discharged about one spot, this concentration of the gases would be an intolerable nuisance wherever the shaft or

time an unpleasant smell was observable in his kitchen; and that, on taking up the floor, it was found that the drain-pipe was broken across, the gases thus escaping into the house. Probably, from the sewerage system of the Crescent not being very extensive, no harm arose from this case; but it may be well to consider what might have been the consequences of such an accident in the basement of any house with a drainage in connection with the more extensive system of trapped sewers in Oxford: especially if during severe cold weather, when the warmth of the house would promote the escape of gas into it from the over-charged culverts in proximity to the broken pipe. Such an accident, if not at once discovered, or if carelessly overlooked, might, in one night, lead to serious consequences.

shafts might be placed.* But I believe that lofty shafts would not sufficiently ventilate the sewers, and that with whatever discharge of gas there might be from them, there must still be such a quantity of gas left in the sewers as would render it dangerous for a dwelling-house to be in communication with them by any kind of drain; for it is only from the expansive force of the gases within the sewers that any gas is driven out of them, and I believe the more lofty the shaft the less effective it would be. Gases do not rise from ordinary drains in any perceptible quantity in fine weather, but with a diminution of atmospheric pressure they rise more freely, *i. e.* the expansive force of the gas has less resistance: I therefore consider that in severe fine frosty weather, and just at the time when houses in connection with the public sewers are most liable to contamination from them—these lofty shafts would be almost or quite useless. As to a ventilating shaft at a mile distance from Oxford, I believe it would be almost useless, and insufficient for the purpose.

It has been proposed to ventilate the sewers by means of the stack water-pipes on the fronts of the houses; this plan seems feasible, as, if effectual for the purpose, the gases would be dispersed over a large area, and not concentrated on one district as with a single shaft. But from

* I have been surprised by finding that a very general opinion prevails, that gases discharged from a shaft would at once ascend into the atmosphere, to a height according with their density as compared with that of common air: just as bubbles of gas will rise through water. It is only from this that I consider it necessary to observe (and I apologize for so doing) that gases do not arrange themselves in layers, but that every gas will diffuse itself and form an atmosphere independent of every other gas: thus even carbonic acid gas is found in the air at the greatest height reached by man. Therefore gases discharged from a shaft would diffuse themselves both upward and downward; and an accumulation thus diffused from a centre shaft would become a nuisance to the neighbourhood, more or less in accordance with the direction of the wind, and especially so during dull, heavy, windless weather, with a low barometer. A chimney on fire may afford an illustration; as it is evident to the smell much sooner than can be accounted for from the mere descent of the fine particles of soot from gravity alone. If a large quantity of coal gas were discharged into the air, at a considerable height, it would soon become obvious to the smell of persons at a much lower level, although such gas if confined in a balloon would rise in the air.

the reasons I have already given, I doubt whether the sewers could be sufficiently ventilated at any time by means of such lofty shafts, even if in ever so great a number. And during frosty weather, the coldness of the metal pipes would condense the sewage gases within them and prevent them rising: and this at a season when the houses, from their internal warmth, would be like air pumps sucking the gases from the drains connected with the sewers; and when the external air would also be as much as possible excluded from dwelling-houses on account of the temperature.

Another objection to this plan is, that as these water-pipes only reach to the level of the roof gutters, the attics and upper rooms would be liable to contamination from the gases whenever they did rise in the pipes. And the higher houses would be subject to gases given off from the top of less elevated houses in the neighbourhood.

Another method I have heard spoken of: that is, to clean the culverts daily, or oftener, by flushing them. That occasionally flushing them would be beneficial, there can be no doubt, if under proper arrangement: but I believe it would be hardly possible to do so to the extent some persons propose. Excessive flushing would increase one difficulty: that is, how to get rid of the sewage matter: and after all might do harm more than good, as the dash of a large volume of water along a *trapped* culvert, would probably so condense the gas in the lateral drains, as to force it through the traps which might otherwise have prevented its passing.

The ventilation of the Oxford sewers by means of shafts with fires in them to create a draught, is, I believe, impracticable, if not impossible. Sewage gases are not all combustible, and we have yet to learn whether or not their deleterious qualities would be much lessened by passing through heated tubes or even fire itself: and it would be an expensive and dangerous experiment to concentrate and discharge the sewage gases in such a manner into the heart of Oxford. But, independent of this objection, I believe the scheme impracticable. It is very well to get rid of vitiated air or injurious gases from any place where the air can press in below and thus force an upward current into the rarefied space produced by the fire; but

gases could not be sufficiently drawn from the sewers unless openings were made at the other end of the sewer to admit air to produce a draught. I doubt the practicability of producing a draught through a culvert of a mile in length; or, even if this could be effected, I cannot conceive how the sewers of Oxford, with their present ramifications, could be ventilated by such a draught, which would almost entirely be confined to the most direct course from the open mouth to the shaft, and even this would be nullified by the failure of the trapping of any one drain throughout its whole course.

My own opinion is, that the only effectual means for ventilating the sewers would be by open shafts, with flat iron gratings, from the culverts along the middle of the streets. This would bring the open air into the nearest connection with the sewage to be ventilated. The sewage gases would be freely diffused, and not injuriously accumulated in any one district; and from reasons already given, I believe gases so diffused could do no harm. With such a system of ventilation other means might be adopted which would render water-closet and house drainings into the sewers free from danger: ~~or~~ ^{as} where practicable, a ventilating pipe might be inserted, exterior to the house, into all drains connected with the public sewers, and carried horizontally or otherwise to any out of the way spot. I also believe that much benefit would arise from the insertion of a ventilation pipe into water-closet pipes, *below the trap*, so as to allow any gas to escape into the open air at the top of the house or where most convenient.

But the street ventilation is the chief point for consideration; for if with the improvements in the formation of culverts and also drain-pipes, and with the constant flowing of water along them the sewers should still be in any degree offensive, it would only prove that a necessary precaution had been taken in leaving them open to ventilation. Or if free from smell, their being open would do no harm, and be a safe-guard from the effects of wind or water on the mouth of the culvert.

However, I have no fear that the ventilation of the sewers on the plan I propose would be in any degree offensive; as the trapping of the street drains in 1850 was

not owing to their being offensive, but in anticipation of unpleasant effects from the discharge of water-closet drains into the sewers. But, from the increased supply of water since that period, I understand there is much less deposit in the sewers than previous to that time. I am aware that under the present system an imperfectly trapped drain may at times be very offensive; but then it is an accumulation of gas which is escaping, and this, too, close to the foot pavement; but I have often noticed that when a culvert has been opened in the middle of a street, no offensive smell has been observable, and that hundreds of persons might have passed without being in the least annoyed by it. Now, as at such times an accumulation of gases, from a considerable extent of sewage drains, must be discharged from a single opening, I cannot conceive that any unpleasant or injurious effects could arise from ventilation shafts along the middle of the streets, which from their number would prevent an accumulation of gas in any part of the sewers.* In arranging the shafts care might be taken to avoid proximity to street crossings, and, if necessary, means might be provided for closing the shafts on special occasions. Thus they might be closed on market days in the upper part of the High Street, in the Corn-Market, Market Street, and the Turl; or in Broad Street during the parade of Rifle Corps, &c., and in fact whenever and wherever it may be desirable to do so. Even if it should be found necessary to close the whole by day and have them open only during the night, I believe the ventilation by such means would be more effectual than could result from more lofty shafts.

* The use of charcoal as a deodorizer would, I believe, be unnecessary with numerous shafts, and both troublesome and expensive in its application; while if only a few shafts were used, with charcoal, however effectively the gases escaping from them might be deodorized, still there would be the objection that the sewers must be in a great degree overcharged with gases to cause any great escape of it from such shafts, and consequently houses not in the immediate neighbourhood of them would still be liable to contamination if connected with the sewers, although perhaps in a less degree than at present.