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A CONTRIBUTION TO THE

Discussion on the Sewage Question,

AT THE

MANCHESTER AND SALFORD

SANITARY ASSOCIATION,

BY

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What shall we do with our Refuse?

A CONTRIBUTION TO THE DISCUSSION ON THE SEWAGE QUESTION, AT THE MANCHESTER AND SALFORD SANITARY ASSOCIATION.

THREE papers have been read before this Committee on the subject of water-closets, and other modes of dealing with human excreta. Mr. Newton entitles his paper Water-Closets *v.* Privies, clearly showing which side of the question he espouses. Mr. Holland is just as purely one-sided, while Dr. Syson attempts to deal impartially, with the various methods discussed, and not to be biased in any direction.

There is nothing to be deprecated in espousing one side or other, provided that the opposing views are fairly and sufficiently put; but I think that the two first-named gentlemen have unconsciously omitted to do this.

The question of Water-Closets *v.* Privies resolves itself practically into that of the removal of excreta by water carriage, and the various dry methods, and it ought not in fairness to be held that the present middens of Manchester and Salford represent the latter.

Few will dissent from Mr. Newton's opinion "that they are an evil, and one of the greatest magnitude." But I hope few will accept the conclusion at which he seems to arrive, that they are the inevitable alternative of water-closets.

Dr. Syson has named some of the evils and difficulties connected with the water-closet system, as it did not occur apparently to Messrs. Newton and Holland to mention them. Perhaps I may be allowed briefly to allude to the subject again.

Take a town of any size you please. The system involves a complex arrangement of drains, commencing at the closets themselves, and terminating usually at the bank or bed of a river, or somewhere about low water mark on the shore of the sea, or of a tidal estuary,—and to terminate in time future—in enormous tanks, almost lakes, of diluted excrement. The small drains from the houses have theoretically a fall to the street-drains, and these again to the larger ones to which they converge, and so on till they reach the place of exit, which is the lowest point. Provided that the engineering skill, practical and scientific, brought to bear on their construction has been perfect, so that this gradual and continuous fall has been maintained,—provided that the walls of the drains and the joints are everywhere, as they should be, impervious to air and moisture, you have an admirable arrangement for carrying away soft aud soluble matters,—assuming that sufficient water is used to sweep them along. These drains commence in the houses,—form an almost endless ramification under our towns; our houses, our streets, and our public buildings, are undermined by the tributaries of our "sewer rivers." But, perfect as this arrangement of tubes may be for the conveyance downwards of liquid and suspended solids, just as perfectly is it adapted for the ascent of the noxious gases rising from the decomposing mixture slowly flowing along them. These gases, unable to pass downwards, take advantage of every chink or cranny, of every imperfect trap, of every street grid, to escape into the air, and at every raising of the water-closet handle, our dwelling-houses are invaded by sewer air.

So then, granting that a system of drains may almost approach theoretical perfection, you only deal with the liquid and solid, and leave the noxious gases—subtle promoters of disease—struggling for and gaining access to your houses.

But we have heard from those whose authority is un-

questionable—just what we expected to hear—that in Manchester the drainage is not perfect; that drains have sometimes a fall, sometimes none, (at least in the right direction,) but go up hill instead, and, in short, that the irregularities in their level convert them, in many places, into enormous underground cesspools, from which tons of matter, chiefly decomposing human ordure, have to be removed. Then, too, by practical experience we know that they are not air and water-tight, that joints will give, and that rat-holes form an important means of sewer ventilation, too often unfortunately into dwelling-houses.

Dr. Hawkesley says that "about fifty-six years ago, a clever and eminent man invented water-closets, by which he hoped to wash away, and consign to oblivion, the material he was only anxious to put out of sight." But we *cannot* consign matter to oblivion, and it was never intended that we should do. A constant cycle of change is going on, or ought to be, by which matter taken from the soil and the air is formed into the tissues of the plant; afterwards into those of the animal; and, when its purpose in the animal organism is served, it is thrown back again to its original inorganic condition, ready once more to pass through the same series of changes. In the early days of water-closets, these familiar facts were unknown or ignored, and the land was believed to be inexhaustible. It seems as if, even now, there were scarcely a belief in the importance of obeying what is so clearly nature's method. We are engaged in a constant effort to remove from our midst—and to destroy if we can—matter that is of the utmost value as manure, and at the same time are importing manure at great cost to take the place of that we wilfully throw away. In Dr. Hawkesley's pamphlet you will find calculations showing the enormous amount, and the great money value, of what we now waste, but with which I will not weary you. But he instances

China, with its dense population, where "the soil has for upwards of three thousand years *never decreased in fertility;*" where they have no meadow culture or fodder-plants, or farm-yard manure, and yet "their fields yield a crop twice a year and never lie fallow." But "they return to the soil the elements taken from it." He quotes also from a report to the Minister of Agriculture at Berlin, by Dr. H. Maron, a statement to the same effect respecting Japan. That it is better cultivated than England,—has a greater population than Great Britain and Ireland,—and maintains them without any supply of food from other parts. "The only manure producer is man." Now, although we do not wish to follow them in all their arrangements, there is no reason why we should not get a hint or two from China and Japan. Much more might be said respecting the waste which the present water-closet system entails; a waste by no means compensated for by any system of irrigation of sewage yet adopted.

For the advocates of irrigation of sewage must admit that, by the time the land receives it, the greatest part of its value has been dissipated. The mixture of excrementitious matter with water already charged with decomposing matter, and its exposure to the action of the sewer air, leads of course to its speedy decomposition and the evolution of various gases to be inhaled at every visit to the water-closet. If these gases could be fixed, and the material, still containing them, be applied to the land, it would be a sanitary advantage and a national gain. Irrigation deals with the sewage when many of its most important constituents are lost, and when it is but the shadow of its former self.

After writing this sentence, an article in *The Times*, copied into the *Manchester Examiner* of the 25th inst., came under my notice, describing the successful results of irrigation with the sewage from the camp at Aldershott, where fifty acres of flinty

ferruginous sand were fit for sowing with Italian rye-grass at the end of a year, after the daily application of 170,000 gallons of sewage. But it is said that "one of Mr. Blackburn's great secrets is to get the liquid manure on to the land as soon as possible. Sewage very rapidly decomposes when exposed to the air, and with its decomposition and evaporation of its gases half its fertilizing elements are lost. A decomposed liquid manure he considers as almost injurious to the land."

This bears out my statement. The farm at Aldershott, distant only two miles from the camp, is of course much more favourably situated than the neighbourhood of Manchester, or indeed most large towns, for the reception of sewage, and there are but few lands so "dry and thirsty" as this is described as being.

Granting therefore, most willingly, that the application of liquid sewage to the land is much better than poisoning our rivers with it, or pouring it into the sea, I maintain that it is disposing of it in a wasteful and costly manner, inapplicable to the country at large.

But the water-carriage method not only entails the poisoning of the air in our houses as well as in our streets, but for a long time to come the poisoning and pollution of our streams and rivers. If *ever* they will be kept free from sewage admixture remains to be seen.

The advocates of the water-closet system are all willing to allow the reality of the mischief caused by the percolation of sewage into wells and water-courses from badly constructed cesspools, but they are unwilling to grant the force of the well-known examples of the outbreaks of cholera, as for instance that in Golden Square, that at Theydon Bois, near Epping, and others that could be cited, that have arisen in connection with water-closet drains. They must, however, acknowledge that the water-carriage system offers the greatest possible facilities

for the distribution of specific poisons discharged from the alimentary canal, and for the pollution of drinking-water—owing to the imperfections *always* actually present, even if not necessarily so, in an extensive system of sewers.

I have said nothing as yet of any other modes of dealing with excrementitious matters.

Most of us will admit that the present system of uncovered middens, so graphically described by Mr. Newton, is an evil and a disgrace, the effects of which can scarcely be exaggerated; and that the proposed plans of the Manchester and Salford corporations, although they have some good points, will provide an imperfect remedy. I may safely leave them, however, in the hands of Dr. Syson. But I demur to Mr. Newton's statement that "by the water-closet system the evil is removed from the midst of dwellings, and conveyed miles away before decomposition sets in." According to evidence brought before us at this committee, in the correctness of which, if I mistake not, Mr. Newton agreed, this is impossible in Manchester from the faulty construction of the drains.* And I demur, also, to the inference which I think may be drawn from his paper,—that the only alternative is the Manchester and Salford plan of storing up putrid soil in the ashpits.

Although at the Congress held at Leamington in 1866, to discuss the question of the sewage of towns, the advocates of the water method had a numerical triumph, I think they sustained an argumentative defeat; and that, to say the least, a case was made out for the dry method, which gave it a claim for a fair trial.

No adverse opinions can ever lessen the force of ascertained

* Bearing on this point I may mention a remark made to me the other day by Dr. Syson, "that he had never heard any of the advocates for water closets account for the fact that no paper is ever seen after the closet handle is once raised. In the course of a few yards does this paper get reduced to pulp and dissolved?"

facts, and evidence was then given, which no one could contradict, as to the success of the dry method at Halton, and at Lancaster, in the gaol and other places, where it has been tried by Mr. Garnett. This was in 1866. If it had been a failure it would have been given up; but yesterday morning I received a note from Mr. Langshaw, a well-known surgeon of Lancaster, referring to the gaol, in which he says that "it answers admirably. A little dried earth is always put into the commode, immediately after it is used, and the pan is emptied as soon as it is full enough. All disagreeable smell is done away with, and the manure which results is, I am told, *very rich,—a small quantity going a great way!* The plan is also carried out in our Royal Grammar School and at Ripley's Hospital, and I have been told that it is perfectly satisfactory in both establishments."

In the *Lancet* for February 20th there is an account of the success of the dry-earth closets at Broadmoor, in the State Criminal Asylum, where they have been in use for many months. They were used experimentally at first,—and for what reason? I will quote the answer. "As originally constructed, water-closets were everywhere provided throughout the wards, attendants' houses, &c.; but it appears that the constant tendency of the water-closets to get out of order, coupled perhaps with the prevalence during 1866 and 1867 of continued fever, of a mild type, yet showing marked tenacity of hold on the establishment, led to the experimental adoption last year of the earth closet, the result of that experiment being so satisfactory as to determine the government upon substituting the dry earth for the water-closet system altogether." There are now sixty-six in use, and "the further conversions are to be made when the necessary money shall be available."

I will not go into the details given, further than to say that there was "the strongest testimony from those most interested in the matter that the dry-earth system, in its sanitary aspects,

is, so far as Broadmoor is concerned, unassailable. The best proof, indeed, of this is that water-closets are being gradually abolished, and all their expensive paraphernalia of pipes, cisterns, cocks, &c., fixed at so great a first cost, and maintained at a considerable yearly outlay, are being removed."

More evidence of a similar character might be brought forward, and a paper which has been kindly sent to me from Lancaster, by Mr. Garnett, of Quernmore Park, gives a list of places where this method is in successful operation, from which it appears that it is gradually gaining ground. In this paper some plain directions are given as to the construction of common privies on the dry system.

But you will remember that this is not the storing up of *putrid soil* in the ashpits. This epithet, so familiar apparently to the water-closet school, I suppose from the continued contemplation of the result of their own ingenious apparatus, is not correctly applied to the product of the dry system when properly carried out. One distinctive character of this scheme is, that by it you avoid putrescence, and you preserve the excreta in a state the most valuable for manure, and the least offensive to the senses. It is no longer a question as to whether dry earth will accomplish this. This point has been proved and is acknowledged by the advocates of the water-carriage system. But as there are still some who may wish that this statement should be supported by authority, I will quote the words of Dr. Angus Smith, as given in his work on Disinfectants, just published:—"One may very correctly look on the soil as the greatest agent for purifying and disinfecting." But he says there is a limit to its powers, and that it "will not compare with metals or tar acids, if we look at bulk." He quotes Mr. Moule, and then says—"No one can doubt the disinfecting power of the soil, and certainly Mr. Moule has found a mode of applying it in very many cases." But, as all who know him

will anticipate, Dr. Smith sees both sides of a question, and cannot be held as a partisan by one or the other. You see, however, the power of the soil as a deodorizer is granted. He gives full credit to the "beauty" of the water-closet, but says, "its mechanism must be very excellent, and with the best a little chemical assistance from disinfectants is often needful to ensure comfort at home and avoid loss of property abroad." He says, however, a little further—"We live over a mass of putrescent matter in sewers; the water increases its activity.... The liquid matter, when neither removed rapidly nor disinfected, is our old enemy the cesspool, with a territory extending miles long instead of feet only, as in old times. The midden is better than the bad sewer. We find it not easy to obtain the theoretically good sewer of the Board of Health, which allows of no accumulation;" and further he says, "I believe we shall never see the extinction of either middens or water-closets."

I must apologize for making so many quotations, but you will, I am sure, willingly allow that one from Dr. Angus Smith is always worthy of careful attention.

I had now intended to give the view of Professor Rolleston, of Oxford, who is adverse to the use of the earth-closets. He was kind enough to promise me the proof of a paper to appear in to-morrow's *Lancet*, but unfortunately I have not yet received it; I may, however, say that he believes that the earth-closet "will fail as regards the spread of infection," as he "is more than equally certain that it will in other particulars." As the reasons for this belief cannot as yet be given, I abstain from more than mentioning Professor Rolleston's opinion until his paper is published.*

We may now, I think, consider the point of practicability as it regards the dry method. Dr. Syson dismisses Moule's earth-

* See Appendix.

closet in a somewhat summary manner. First, he says, it is not dry, as he has heard of unpleasant splashing. This, I think, is a mistake. In an institution I am acquainted with where a few are in use for the infirm and feeble, and found to be a great comfort, the "persons" he names have rather complained of the dryness causing the ascent of dust than of the opposite fault. But this is a trifling matter easily dealt with. Next, the quotation from Krepp, advertising Lienur's system, is of course intended "to make the boldest pause." When you speak of *millions* you are dealing with numbers of which we can form no estimate whatever, of which we have no definite idea, and in order to grasp their full meaning they must be subdivided into more manageable quantities. When you classify and systematize, and work out into a proper organization, these monstrous numbers lose their terror-exciting and bewildering vastness. Dr. Hawksley calculates that 3,000,000 inhabitants will occupy 500,000 houses, and divides these into 500 sections of 1,000 houses each. Each section he divides into ten sub-sections, each requiring a man and a boy with a waggon and pair of horses. A town of 100,000 inhabitants, according to this calculation, will occupy 16,666 houses and a fraction; but say 17,000 houses; *i.e.*, 17 sections—each divided again into 10 sub-sections—so that you would require 170 waggons,—no great number after all. If we take the population of Manchester and Salford as 500,000 it would give 83,330 houses in round numbers, but say 85,000 houses. This would be broken up into 85 districts requiring 850 waggons, &c., and if these were distributed over the vast area occupied by these towns I venture to say that the streets would not be blocked up, nor the traffic interrupted, more especially as this work would be over by nine in the morning.

But in this rough calculation I have proceeded on the supposition that the earth would have to be brought into the town,

as well as carried out. We are, however, not confined to the use of earth. In both the Manchester and Salford privies, ashes, in the former case sifted, are intended to be used; and they are also to be used in Mr. Morrell's closet. Now, if sifted ashes will serve the purpose of a disinfectant and deodorizer, a great part of the bugbear in the shape of the carriage into and out of a town of mountains of earth, that the opponents of the dry method make much of, will vanish. But will they do this? It is acknowledged that earth if used in sufficient quantity will do so. I will give one experiment made by the late Dr. Herbert Barker of Bedford—a man too early lost to his profession and his country—which is recorded in the Hastings Prize Essay for 1865. He went through a most extensive and laborious series of experiments, or rather through several series, and tested various substances as to their action on sewer gases, putrefying liquids and solids, &c. The one I quote consisted in burying completely 2 lbs. weight of intestines of the ox in 2 lbs. of wood and coal ashes, on the 15th of May. "On the 17th no change; 19th, fresh and sweet; 21st, very slightly offensive; 23rd, slightly offensive; 27th, yields no odour externally, but very slight odour internally; 29th, slightly offensive internally and somewhat softened; 31st, rather offensive; June 2nd, offensive—thrown away."

The same substance, treated with the same quantity of earth and placed in the same conditions became putrid much sooner.*

* Dr. Barker's experiments with 2 lbs. weight of intestines from an ox, completely buried in 2 lbs. weight of charcoal and earth, commencing May 15th, are as follows:—

Ex. 27.—Fresh-burned vegetable charcoal. May 17th, no change; 19th, a putrid odour emitted through the charcoal as well as from the substance; 21st, offensive; 23rd, slightly offensive, interior of good colour; 25th, rather offensive, but of fresh colour; 27th, yields a strong odour internally, but is of good colour; 25th and 31st, offensive, but still has fresh colour; June 2nd, very offensive and entirely decomposed—thrown away.

Ex. 28.—Earth-mould. May 17th, no change; 19th, putrid odour emitted through the mould; 21st, offensive; 23rd, very offensive, and contains maggots 25th, extremely offensive and full of maggots; 27th, entirely decomposed—thrown away.

He says that "wood-ashes possess a very decided deodorizing property; being in fact little inferior to carbolic acid." In his summary he says:—"For the deodorization of vegetable matter or offal that cannot be immediately disposed of, the zinc [meaning a salt of zinc] and sawdust mixture would answer perfectly. In its absence, or in the absence of carbolic acid... wood-ashes afford by far the best substitute. Wood-ashes act far better than pure charcoal, and after them, coal-ashes well pounded, stand next in efficiency."

Ashes we have in abundance, and have to pay for their removal. Separate them from the cinders, which should be burned, though they are now too often wasted, in spite of Professor Jevons telling us we shall soon be short of coal; then apply them either alone or mixed with earth to the excreta, and you will render them a valuable commodity, instead of useless refuse.

And in this way the difficulty of the dry-method becomes immensely lessened.

Of the various plans that we have had before us that of Mr. Morrell approaches the requirements of the case more nearly than any other. If it could be simplified in some points, as the action of the cinder-sifter, it would no doubt be improved, particularly for very low-class property. For middle-class houses and those occupied by the better-paid artizans I should be quite willing to abide by Mr. Morrell's judgment as to its keeping in order, even though Dr. Syson says it will not work. Mr. Morrell, as an engineer who knows the strength of materials and the strain they are equal to, will be allowed by Dr. Syson, I am sure, to be a competent judge of a question of this kind; and as an attempt to render the dry method available as a substitute for water-closets in our houses his scheme, I think, promises more of success than anything of the kind I have yet seen, especially if a little disinfecting powder is used with the dry-ash.

But we are told that dry methods will not work, that in the low parts of the town the people are so incorrigibly bad—so dirty—that no dry method will answer. That they steal the wood-work of the privies for fire-wood, that they are idle, so filthy and altogether so much below the brutes, that they cannot be expected to serve as anything but as instruments of destruction for any apparatus that can be devised. Now I beg to doubt a good deal of this, more especially when it is to apply with so much more force to the dry method than to any other. I believe that a little patience and some judgment, will in a short time do much to alter the habits of the people; and I do not suppose that this marvellously vicious and untamed class constitutes a large proportion of the population, nor do I see why it should be taken as the standard. But this unfortunate "residuum," occupying the cellar-dwellings, the back-to-back-houses, the undrained and filthy courts the disgrace of our authorities, where the people breathe the Manchester air (perhaps I ought not to call it the corporation compound of smoke and fœtor), instead of the air of heaven, would, if placed in somewhat more favourable circumstances, be gradually brought to appreciate the simpler decencies of civilized life. With our abundant supply of water we have none too much distributed in the "low parts" of the town. The *difficulties* of cleanliness and decency for these poor people must not be lost sight of. Baths and wash-houses for the poor should be more abundant and easy of access, and there should be a constant supply of water. The patient and persevering kindliness of the well-to-do and comfortable, should, as it could, wear away the crust of suspicion and shame with which the poor too often surround themselves, and which causes them to see enemies, till they prove to be friends, in all who are higher in the social scale than themselves.

With the use of the dry method the water supply to the

low parts of the town might be much more abundant than at present; and the cleanliness which is next to godliness—and without which the latter must rarely exist—would be more possible than at present.

We must not look at this question of middens as the only blot in our social condition, or the only cause for the high death rate for which we are too well known. It is difficult to separate the causes of the latter one from the other, and to assign to each its proper value; but we know that they go hand in hand, that food and drink, occupation and habits, the condition of the dwelling-house, and many other things, all combine to produce the result. The diminution of the infant mortality during the cotton famine, when the mothers could stay at home and nurse their children, illustrates this,* and points out one way in which our wealthy manufacturers could do much to increase the happiness of the mothers in their employ, as well as to lessen the number of those cut off before their time.

I hope it will not be thought that because I have said what I think as to the various methods of the disposal of sewage, I am insensible to the good points of the water-carriage system, and blind to the difficulties of the dry method. My object is to aid, in however small a degree, in inducing our authorities to give the latter a trial, and, when this is done, that it shall be tried thoroughly in all its completeness, so that it shall fail or succeed on its merits. If it succeed it will be an invaluable boon; and if it fail, which I do not expect, we can only hope to attain the minimum of the inconvenience, the danger and the loss incident to the water-closet system, by gradually approaching that perfection in construction from which we are now so far distant.

* My friend, Dr. Noble, took exception to the above statement, considering that the diminution of infant mortality was due to the mild winters during the cotton famine. But we know that the want of their natural food, and improper feeding, in lieu of it, is a cause of much of the loss of infant life, and I allow the passage to stand unaltered.

Appendix.

In the paper referred to, which appeared in the *Lancet*, of March 6th, Professor Rolleston draws attention to Von Pettenkofer's opinion which is adverse to "disinfection with earth and peat." Indeed he "fears the greatest danger from it, especially as regards cholera," from impregnation of the soil with excreta. Now without entering on the arguments for or against Von Pettenkofer's theory, we may be quite assured that the soil in the immediate vicinity of the earth-closets runs no more risk of impregnation than where water-closets are used, provided that we have, as we have a right to expect, the earth-closets and their appurtenances properly constructed. Of course some impregnation of the soil of the open country is a necessary condition of successful agriculture.

Professor Rolleston very properly applies this reasoning to "the localisation and diffusion of typhoid fever," and expresses the opinion that "of the two recognised foci for infection—the bespattered privy and the contaminated well,—the former may be the one which is more commonly at work." He then says, "for though it is said that the larger proportion of women—and children—sufferers points to the water, of which they are said to drink more, being the cause at work, the facts are, not that the women and children drink more water in tea, &c., than the men, but that they get less beer; whilst many of the men in our semi-savage villages never use a privy at all, or at least not habitually. This last is the true differentiating condition." Now I apprehend that it makes all the difference in the world as to whether the water is boiled or unboiled. If the men only drink water in tea, after boiling, they are much less likely to be attacked by typhoid fever than the women and children, who at their mid-day meal, or at other times, drink it fresh from the well; and in this way the beer may be a negative protection, by preventing the men from drinking unboiled water.

"What applies, however, to the wood-work and contents of a privy applies to the like elements in the constitution of the earth-closet, so far as disinfection or the want of disinfection is concerned." This of course applies to the "like elements" in the water-closet, and the inspection of a few public water-closets will show that they like privies may be bespattered. He says further, "If I am told that the earth-closet is inoffensive and that the privy is fœtid, I answer that a rattle-snake is none the less dangerous because its rattle is removed; and that, for anything shown or known to the contrary, odour is to infection, deodorization to disinfection, what the noise of the serpent is to its bite."

It is now believed by many authorities on what they consider good evidence, and the experience of most medical men goes to sustain the position, that "disinfectants" do truly render innocuous discharges from the body of a patient with fever. Professor Rolleston mentions with approval, as every one must who touches the subject of typhoid fever, the writings of Dr. Wm. Budd. But in this week's *British Medical Journal* (March 27th) Dr. Budd says of the disinfection of the discharges from the bowels, "this may be perfectly done by the use of disinfectants;" and he mentions green copperas, chloride of lime, Mc.Dougall's powder, and carbolic acid. Now it happens that these and other disinfectants also deodorize, and it seems, to say the least, not altogether improbable that what will deodorize will also disinfect.

Professor Rolleston has performed some interesting experiments, showing the power of retention of ammonia displayed by distilled water, wet and dry earth, and coal ashes respectively, which yielded it up in the order above given. Its retention by dry earth, and especially coal ashes, is remarkable, but is very much weakened when they are moistened, though still much more marked than when distilled water alone is used. "The precipitate produced [by Nessler's reagent] was much less dense and abundant than that produced in experiment No. 1 [with distilled water], and took a much longer aspiration before it was formed. It was formed much more rapidly from the wetted earth than by that from the wetted ashes."

This confirms the results of investigations by Professor Way and others. One would naturally conclude, if any inference is to be drawn from these experiments, that it would be favourable to the use of dry earth and ashes, but Professor Rolleston thinks not. After performing them many times, with great care, he throws the ammonia overboard altogether, and says that—"it is not certain that ammonia is the cause, or a necessary co-efficient of the cause, of miasma;" in which no doubt many will agree with him. But he goes on to say that "there is much reason to believe that it is precisely when the earth receives choleraic and typhoid evacuations, and should, ex hypothesi, disinfect them, that they become most deadly." He gives references to several German periodicals, to which just now I unfortunately have not access, and to Dr. Parkes on Hygiene, in support of this opinion. Now in the latter work, at the places cited, I can find nothing to favour this idea. A priori, one would not expect this to be the case, quite apart from any disinfecting power the soil may be supposed to have. For any chemical changes would be into simpler and less noxious forms, and if we believe that disease is conveyed by organic germs, although their vitality may be preserved, it is not probable that they will be rendered more active; and of course all this applies with equal force to water similarly impregnated. His third inference that "wetting seriously impairs the power which earth and ashes have of retaining gases in their pores" every one admits, although one may think that the probability of making long aspirations over the contents of the earth-closet is likely to be small. Ashes however, even wet, show considerable retentive power.

Professor Rolleston argues as if the contents of the earth-closets were to remain for an indefinite period, but the system when properly worked out would provide for their removal from the town at short intervals. Liquids would have, generally speaking, to go down the drains, which would of course be required to carry off rain-water; but it is a question whether or not it would be practicable to pour the urine from the house on to the earth or ashes. If these were abundant it is probable that it might be done

safely, and without reproducing "the horrid Manchester middens;" for the composition of these middens is generally very complex.

The fourth objection to earth-closets is the double journey into and out of town which the earth would have to make. This seems at first sight a great difficulty, but I believe that it would become much less of one if the scheme were thoroughly systematized. Such a scheme for any large town could not be perfected all at once; time and thought would be required, but this cannot be considered as remarkable in a new and extensive undertaking. This difficulty Professor Rolleston thinks may tempt us to advocate the employment of ashes (which are better than earth), and he fears the supply would be insufficient. If this should prove to be so in the cottages of the poor, why not utilize the vast quantities produced at the various works in most large towns? If this source were made use of I do *not* think with Professor Rolleston that "quantitative considerations" would prove the stumbling-block he anticipates. Contrary to his opinion, moreover, there is good evidence of the success of the dry method at Lancaster and other places, where it is tried on a considerable scale. And we must remember that it is only quite recently that any attempts have been made in this direction with scientific method; while the water-carriage system has long been and still is a favourite subject of engineering skill, and the construction of a *cloaca maxima* which shall rob the soil of its due, throw away the agricultural wealth of a country, and cost magnificent sums of money, is still an object of engineering ambition.