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THE PRINCE'S ILLNESS: ITS LESSONS.

A LECTURE ON THE PREVENTION OF DISEASE.

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1872.

This Lecture was delivered to a popular audience in December last, in the School Room of St. Clement's, Nechells, under the auspices of the Bloomsbury and Nechells Christian Association. It is now published in the hope of inducing the public to consider how greatly Zymotic Diseases may be diminished by simple sanitary precautions.

16, Temple Row, Birmingham.
January 2, 1872.

THE PRINCE'S ILLNESS:

ITS LESSONS.

For some days we have all been more or less anxious about the health of a man who may some day come to be our King, and we have all felt a profound sympathy for the mother and the wife who have watched at his bedside. After this period of anxiety and concern, it is pleasant to be able to speak more cheerfully, and to know that the calamity which we so much feared is gradually growing less and less threatening. From the moment the true character of the Prince's illness was known, the public mind was disturbed by the memory of the sad loss which typhoid fever inflicted on the country ten years since, in the death of the Prince Consort. We feared for the son the same fate that had befallen the father, and consequently throughout the country the thoughts of even the least loyal have travelled to Sandringham, and have watched the silent struggle between disease and its victim, with an all-absorbing interest. It is a peculiarity of Royalty, placed as it is at the summit of our social system, that its sorrows and its pleasures, its faults and its virtues, should attract every eye; and thus, in this present time of sorrow, the bearing of all classes has shown a watchful sympathy for the ebb and flow of the Royal life.

This feeling becomes so strong at times that we are almost tempted to think that there is something special in a Prince's illness, and that somehow or other it must differ from that of others. We know that it is not so. The same struggle that has been going on in the Royal Family is going on even now in many families in this town, and in thousands of families in this kingdom. Of these cases we do not hear, but in each and every case there is the same great enemy to contend with—an enemy, too, who attacks us with the weapons we have ourselves forged for him. Putting aside for a moment his Royalty, and regarding the Prince simply as a young man of thirty, placed in deadly peril from illness entirely due to ignorance of sanitary precautions, is not this circumstance alone enough to rouse us to a determination to prevent such evils for the future?

There was a time when every malady was a mystery in its origin—when Pestilence walked in darkness; but this is so no longer. We have arrived at a knowledge of the causes which produce these diseases, and we particularly well know the causes which produce such attacks as that from which the Prince is still suffering. Having gained a knowledge of the conditions which can develop the disease, we have the power, if we use our knowledge aright, of preventing it. Why, then, do we suffer this evil to exist? It is difficult to say. We know that the disease is propagated mainly by sewage-polluted air and sewage-polluted water. But, notwithstanding such knowledge, we allow, all over England, water to be polluted and the air of houses to be poisoned. The result is that we have 120,000 people laid up with typhoid fever every year, and some 20,000 persons killed.

This awful sacrifice of life is due to the almost universal neglect of the ordinary laws of health—a neglect which is

about equally distributed among all classes, and which will continue to sacrifice its annual thousands, until the people at large are roused to a sense of the enormous magnitude of the evils they suffer from. It is with a view of creating some interest in these questions, which are of such great importance to all, that this evening I wish to call your attention to the way in which typhoid fever and other preventable diseases are allowed to flourish in the midst of us, and to point out the precautions by which we may individually save ourselves from their attacks. I shall simply use the Prince's case as an illustration of the neglect of the commonest laws of health which everywhere prevails.

We all recognise in a kind of hazy way that death must come to each of us some day; but we have got so used to the idea that we take little trouble about it. Every week in the papers there is published a statement of how our great enemy, death, is carrying on his campaign. These returns of the killed and wounded published by the Registrar-General ought to excite some little interest in measures calculated to obstruct the progress of the enemy. We ought to study the returns, to learn with what weapons we are likely to be attacked, where the carnage is thickest, and how we are most likely to escape the shafts of the foe.

For example, the returns for the week just ended show that we have been dying in Birmingham at the yearly rate of 30 per 1,000 of the inhabitants; while in Wolverhampton the death rate has been more than double ours, because there the most preventable of all diseases—small-pox—has been slaying its dozens, as a testimony against neglect of vaccination.

By means of the following Table (No. 1) you can compare at a glance the rates of mortality in the healthiest districts with the rate for the whole of England and Wales;

and, further, you can see how much faster we inhabitants of large towns die than our neighbours in the country. The table shows also how much more these great town districts are ravaged by preventable disease. In successive columns the mortality per 1,000 from typhoid fever, choleraic disorders, and other zymotic diseases is given, and lastly the percentage which deaths from these causes form of the total deaths.

No. 1.

ANNUAL DEATH RATE TO 1,000 PERSONS LIVING (1851-60.)

District.	All Causes, per 1,000.	Typhoid and Typhus, per 1,000.*	Cholera, Diarrhœa, &c.	Other Zymotic Diseases.	Total from Zymotic Diseases.	Percentage of Deaths from Zymotic Diseases.
Healthiest Rural Districts ...	15·	·51	·27	1·7	2·48	16·5
Mean of Twelve Rural Districts	17·1	·6	·4	1·9	2·9	17·
England & Wales	22·	·9	1·0	2·95	4·85	22·
Birmingham (Parish) ...	26·5	1·0	2·2	3·95	7·15	27·
Aston	21·0	·75	1·7	3·2	5·65	26·9
Sheffield	28·4	1·3	2·2	4·4	7·9	27·8
Wolverhampton...	27·5	1·4	1·8	4·15	7·35	26·7
Manchester..	31·5	1·25	2·4	4·4	8·05	25·5
Leeds	27·7	1·1	2·25	3·45	6·80	24·5
Liverpool	33·3	1·35	2·9	5·15	9·40	28·2
London	23·7	·85	1·5	3·7	6·05	25·5
Bristol.....	26·9	·95	1·3	3·5	5·75	21·3

* In Birmingham Typhus is so rare that the death rate in this column virtually represents the death rate of Typhoid. This is true also of the Rural Districts. Typhus, which is the fever of *over-crowding*, is a disease distinct from typhoid.

The low general death rate of the healthy districts is the standard we should aim at. I do not say that we can hope to make towns as healthy as the country, but we certainly may hope to greatly diminish the number of deaths which annually occur from the prevalence of such diseases as typhoid fever.

Birmingham has long been regarded as comparatively healthy for a large town. It is so. Taking the borough, which includes part of Aston, and Edgbaston where the death rate is as low as 14, we find that the death rate, calculated for a period of twenty years ('51 to '70) is only 25 per 1,000.

If we take the parish of Birmingham, however, we find that the death rate was for the ten years ('51 to '60) 26·5 per 1,000 ; but, what is most worthy of note, the deaths from preventable diseases amount to 27 per cent. of all deaths—a higher percentage than in any other large town except Sheffield, where it is slightly higher, and Liverpool (with its frequent typhus), where the percentage reaches 28·2 of all deaths. Taking the typhoid fever alone, we have some 2,000 cases every year, and lose some 300 lives. In the third column, the death rate from choleraic disorders is seen to be as great here in Birmingham, where we have been visited by no Asiatic cholera epidemic, as in most other places, and more than double the rate of England and Wales generally. When we recall the fact that these choleraic diseases are produced by the same conditions that favour the development of typhoid, the position of Birmingham is, I think, far from satisfactory.

I have said that these diseases are mostly preventable, *i.e.*, are materially lessened by proper sanitary precautions. This is especially true of typhoid fever, the disease of which I wish more particularly to speak. We have seen that this fever slays its hundreds annually in Birmingham, its

myriads in the kingdom; and yet there is good reason for believing that proper sanitary measures would save a large proportion of its victims.

Typhoid fever has had many names given to it, and is often spoken of as enteric fever, gastric fever; but no names are more expressive than the old ones—cesspool fever and nightsoil fever, which, like the more modern one, pythogenic fever, point directly to its origin.

The poison of typhoid fever reaches us in two ways: 1, by means of water poisoned by sewage matter; 2, by air poisoned by sewage gases.

I. *Poisoned Water.*—The contamination of water by sewage matter occurs through the leakage of liquid sewage into wells. The large towns generally have their water supplied by companies, and as this water is conveyed in impenetrable channels, there is in towns less danger of contamination. The *poor*, however, both in towns and country, are still, for the most part, compelled to drink well water, and are therefore still exposed to this source of fever poison. Either from appalling ignorance, or strangely misdirected ingenuity, builders nearly always contrive to put the cesspool close to the well or pump; even when they remove the cesspool to a distance, they contrive to conduct the drain leading to it close by the well, and so arrange for the production of sewage fever whenever the drain leaks.

Two cases will suffice to illustrate this mode of production of typhoid: one which occurred at Bedford in 1859, and the other which happened at Islington quite recently.

BEDFORD.

The story of the Bedford fever is this:—For years before the great outbreak, it was the habit of the town to have every autumn an attack of fever. The fever could not be traced to sewer gases or the foul air of cesspools. It did not correspond in its distribution with the ramifications of the sewers, and it was shown at the time that the cesspools did not

give off foul gases into the houses. The water supply next fell under suspicion, and, on examination, the water was found to be largely contaminated with decaying animal matter. The cesspools in Bedford, some 3,000 in number, were so constructed as to let liquid sewage soak away from them into the surrounding soil. The wells were in very many cases close to such cesspools. The porous subsoil of gravel in which these cesspools were placed was everywhere percolated by sewage liquids, and so the water supply drawn from the same source grew worse and worse till the great epidemic of sewage-generated fever burst out. In one case a very good instance of how far through a porous subsoil foul matter will travel was detected. "The water from some wells situated 500 feet from the gasworks was so affected with the soakage of gas tar refuse as to be most offensive, and quite unusable for any purpose."—*Third Report of the Medical Officer of the Privy Council.*

ISLINGTON.

The outbreak of typhoid fever at Islington occurred in the months of July, August, and September, 1870, and was propagated through the medium of milk contaminated by water poisoned with sewage matter. The whole outbreak was studied by Dr. Ballard, now Medical Inspector of the Privy Council, and the facts which he made out are shortly these :—"Typhoid is, as is now agreed, propagated by sewer poison. Now, there was on the premises of a certain respectable milkdealer at Islington an underground wooden tank, supplied from the mains of the New River Company. This had not been opened or inspected for years. When opened at Dr. Ballard's desire, some inches of one side were found decayed or destroyed by rats. This allowed the water to flow over into a hole in the ground, evidently scooped out by rats, and leading to certain underground rat-burrows, by which, when the tank was filling, the water flowed into some old brick drains and water-closet drains, close by. Through these underground channels there was free communication between the tank and the sewers; not only could water run away from the tank into the drains, but foul gases from the drains were sure to pass back into the tank; and in June last an alteration was made in the drains, during which they were obstructed, so that there would be a reflux of the overflow water from these drains and rat-burrows back into the tank. It is a significant proof that this did happen, that at least two families shortly afterwards complained that the milk "had a bad taste," and that the milk, when kept, became "not merely sour, but stinking." It is certain that the milk-cans were washed out with water from this tank, and a shrewd suspicion may exist that some of it was mixed with the milk; but, if so, it must have been done by the men without the master's knowledge; because, if ever water were used for this purpose it was taken from another cistern, which also supplied the house, and the tank water was intended only for washing and stable use. Given, then, milk poisoned with a small dose of sewage, we find that the milkman, his family and servants and customers, were very shortly afterwards affected with a peculiarly fatal typhoid fever; and the connection between the milk as cause, and the fever as effect, is shown by the fact that the fever was confined virtually to those who drank this milk. The medical practitioners of the neighbourhood soon became aware of the existence of an

extensive and fatal epidemic in a limited district in the healthiest part of Islington. Of course, all the obvious and usual causes were first suggested, inquired into, and dismissed as untenable. The exposure of new ground in widening the railway, the nuisance of a huge dung-shoot, and the existence of foul drains in houses, were all accused in turn ; but it was the milk distribution alone which was proved to be co-extensive with the fever. Dr. Ballard ascertained that 142 families, including the milkman's own, formed the "milk walk" or *clientèle* of this dairy. Of these 142, it is known that 70 families were invaded by typhoid in the ten weeks during which the outbreak lasted. In these 70 families were 175 patients, of whom 30 died—a mortality of more than 17 per cent. It was remarkable to see how the typhoid picked out the families supplied from this one dairy, and avoided all the rest. Wherever the fever appeared, it did not attack one, but several members of the household. In certain families, where particular members took no milk, they escaped, whilst others suffered. The women and children, who take most milk, suffered in greatest proportion. A young lady who had a tumbler of this milk daily, whilst the house was supplied from another source, was the only victim in the house. The dairyman himself, and his workman, who, of course, took the milk freely, were amongst the earliest victims—for this, like other outbreaks, became milder as time went on, and ceased when the business was given up and the cows sold, some time after the death of the proprietor. Meanwhile, the disease was mainly confined to a circle with a quarter of a mile radius from the dairy, whilst the rest of the extensive parish of Islington was virtually free."—*Medical Times and Gazette*, vol. 2, 1870, p. 620.

II. *Poisoned Air.*—Next we have to consider air polluted by sewage gases, as a medium for the propagation of typhoid fever. It is the misfortune of our present system of drainage that all the sewers are huge manufactories for the production of poisonous gases. In these underground channels we carry away our refuse by means of water carriage, which we have adopted, not because it is the healthiest, but because it is the cheapest. Now, the moment the refuse and excreta are mixed with water, we have the conditions for a decomposition, which goes on continuously, and this decomposition generates vast quantities of poisonous gases, which, if they cannot find an outlet elsewhere, must force the traps and enter our houses. These gases being specifically lighter than air, do not pass out at the mouth of the main sewer, but, on the contrary, tend steadily to rise to its highest

ramifications. Whenever the sewers are over-full, after heavy rainfalls or from any other causes, the gaseous contents of the sewers, compressed by the liquid contents, bubble through traps and force their way wherever an outlet can be made. At sea-side places, such as Scarborough, the conditions are even worse, for there twice in about twenty-four hours the rising tide stops the outflow, and forces up into the town and into the houses all the abominable gases which the sewers contain. This is one of the most common causes of typhoid fever. At nearly all our sea-side watering places, the sewage arrangements favour the pollution of the houses. A season never passes in which I do not come across instances of typhoid fever in Birmingham, which have been contracted during the annual pilgrimage to the sea-side in search of health. In Birmingham we have no tides to cause the reflux of sewer gases, but, judging from my own observations and those of others, there is, I believe, in the drains leading to the main sewers, always a very much stronger up-draught when the wind blows so as to exert its pressure on the mouth of the main outfall of our sewer system. The influence of these noxious gases from sewers in propagating typhoid fever is well illustrated by the Windsor epidemic of 1858.

WINDSOR.

The history of this epidemic is as follows :—It occurred in the autumn, after a very dry summer. It affected rich and poor indiscriminately in those parts of the town which were attacked, and a remarkable fact was that the *poorest* part of the town, which had been most severely affected by cholera, escaped almost entirely. The two parts of the town attacked were composed of two distinct populations, and placed on a higher and a lower level. There were thus in Windsor three distinct districts, all drawing their water from wells or the Thames, two of which were affected with typhoid, and one, the poorest and worst housed and most affected with cholera, which escaped. All these districts got rid of their impurities through town sewers which discharged into the Thames, and near the outfall the cases of fever were very numerous. But the great point of interest in the case was this : in the two districts to which the epidemic of typhoid was almost exclusively confined the private drains communicating with the main drains *were inside the houses*

themselves, while in the poorer district which escaped the private drains *were almost all outside the houses*; there were no sinks or other openings from the drains inside the houses. Next, as to Windsor Castle, which escaped in 1858: the sewers were well ventilated, and were quite distinct from the town sewers. In the Royal mews, a few houses in one part were drained into the Castle sewers, and these escaped also. On the other hand, the greater part of the Royal mews, separated only by a road from the other part, was severely visited by typhoid, and the houses so attacked were in direct communication with the town sewers.—*Vide* "Public Health in relation to Air and Water." By Dr. GAIRDNER.

Turning back to the Prince's case, to which of these sources are we to refer his illness—sewage-poisoned water or sewage-poisoned air? We may at once acquit the water. The history of his attack points to his visit to Scarborough as the time when the poison entered his system. The water he used at Scarborough was the "Bristol" water, which is singularly pure, and free from all possible contamination. There remains only the air as the medium of infection. The Prince, it appears, was exposed to foul air from a manure yard, which he passed several times on his shooting excursions. This spot—which from all accounts would be a disgrace to the neighbourhood of any town, is doubly so to a fashionable health-resort like Scarborough—is near the outfall of a main sewer. Some have supposed that the effluvia from this spot may have caused the fever. Such a supposition is far-fetched, for sewage exhalations in the open air are generally harmless, and while other more probable sources of infection exist this source may be entirely dismissed. Londesborough Lodge, the house in which the Prince stayed, however, presents several sanitary defects, which would amply account for the production of the illness. The house is situated about 150 feet above the sea level, and is thus placed at the upper end of a considerable length of sewer—a position most favourable to the escape of sewer gas. The main drain runs down the centre of the house, the smaller drains running from the circumference to the

main drain beneath the floors. The drains thus placed in a position in which they could not be easily examined, represent a most faulty system, and one calculated, on the occurrence of a small flaw, to produce great mischief. At each end of the corridor, under which the main drain runs, a water-closet is placed. All the drains were, at the time of the visit, carefully trapped, but every time the tide rose these traps would be forced, and as the soil-pipes of the closets were not run up to the roof and opened at the top, every time they were used the gases from the sewer beneath would find an easy entrance to the house. One of these closets, ill-ventilated itself, communicated directly with the Prince's bedroom, and thus formed a perfect ventilating shaft by which the fever-producing gases could escape. When it is added that the rooms are stated to be small and close, and the house much overcrowded, we have a set of conditions quite sufficient to indicate the source of the fever poison. It has been shown that the back-draught up the sewers to Londesborough Lodge was very great, and that there must have been constantly going on a struggle between the expanding gases and the traps, which could have but one result—the forcing of the traps and the pollution of the air of the Lodge with the poisonous emanations of the sewer. The fact that three persons visiting Londesborough Lodge at the same time caught typhoid fever, and that others suffered from indisposition, such as is constantly observed to follow exposure to sewage poison, forms a strong case as to the origin of the Prince's illness. From these remarks I would not have anyone infer that Londesborough Lodge was worse than many other houses. On the contrary, the noble owner, with whom we must all feel the deepest sympathy, was most anxious to make the sanitary condition of his house as perfect as its original defective arrangements would allow. The Lodge was like thousands of other country and sea-side

houses, and scarcely worse than thousands of the villa residences which surround our large towns. Truly, ignorance of sanitary science is not confined to the poor, but flourishes even in the highest places.

The intimate relation which exists between the pollution of air and of water, and the prevalence of typhoid fever, has been shown most thoroughly in the great diminution of deaths from this cause in those towns in which sanitary works have been thoroughly carried out. In the "Ninth Report of the Medical Officer of the Privy Council," there is an inquiry on this subject by Dr. Buchanan, from which the following table is taken :—

No. 2.

	Town.	Change in Typhoid Death-rate per 10,000 annually.	Degree of Change.
Reduction exceeding half.	Salisbury	From 7½ to 1¾	− 75 per cent.
	Stratford	" 12½ " 4	− 67 "
	Croydon	" 15 " 5½	− 63 "
	Merthyr	" 21⅓ " 8⅔	− 60 "
	Ely	" 10⅔ " 4½	− 56 "
	Ashby	" 13⅓ " 5¾	− 56 "
	Brynmawr.....	" 23½ " 10¼	− 56 "
	Penrith	" 10 " 4½	− 55 "
	Warwick	" 19 " 9	− 52 "
Reduction between one-third and one-half.	Leicester	" 14⅔ " 7¾	− 48 "
	Macclesfield ...	" 14¼ " 8½	− 48 "
	Banbury	" 16 " 8½	− 48 "
	Morpeth	" 16½ " 10	− 40 "
	Cardiff	" 17½ " 10½	− 40 "
	Cheltenham ...	" 7⅓ " 4⅔	− 37 "
	Newport	" 16⅓ " 10⅓	− 36 "
	Dover	" 14 " 9	− 36 "
	Alnwick	" 13½ " 8⅔	− 36 "
	Bristol	" 9⅔ " 6½	− 33 "
Trivial reduction.	Rugby	" 10 " 9	− 10 "
	Carlisle	" 10 " 9¾	− 2 "
More or less increase.	Chelmsford ...	" 12 " 12⅔	+ 5 "
	Penzance	" 7½ " 8	+ 6 "
	Worthing	" 7½ " 9¼	+ 23 "

"Many of the public improvements have coincided with reduction of typhoid. Though not with absolute constancy, drying of the soil of a town, and reduction in the crowding of houses, have been followed by the reduction of fever. Much more important appears to be the substitution of an ample supply of good water for a scanty and impure supply: other things being equal, the towns in which this substitution has been completed have made most improvement. Merthyr is a conspicuous instance of a town where before any other important change had been made, typhoid fell to a notable extent as soon as inspection and cleansing were adopted.

"It is, however, the purification of atmosphere from decomposing organic matters that has been most uniformly followed by a fall in the prevalence of typhoid. And this has occurred equally, whether the purification has been brought about by the abolition of cesspools or by draining or drying 'middens.' Apparent exceptions, indeed, are found in certain towns at the bottom of the foregoing list (disregarding Penzance, where the drainage works have just got into operation) viz.:—Rugby and Carlisle, where the reduction has been of slight amount; and Chelmsford and Worthing, where there has been more or less increase of fever. But in these four towns, and in no others (for Leicester need not be considered) sewage is received into pumping works at the outfall in such a way that sewer gases are necessarily much confined in the pipes. In the case of Worthing the defect of the outfall arrangement was most serious, and in the absence of other exits, sewer gases had demonstrably been forced into houses and outbreaks of typhoid had occurred as the demonstrable result thereof. In the other towns, though to an inferior degree, there were facilities for the same accident occurring. So that it appears that the four towns where fever has not been greatly reduced are so far from constituting an exception of the rule, that removal of organic impurity from the air has been followed by reduction of typhoid—that they even add strongly to the presumption that the rule is absolute and universal."

Such evidence needs no comment: its figures speak more forcibly than any words. But notwithstanding the clear, unmistakeable character of its teaching, the country at large has turned a deaf ear to it, and scores of towns still breed typhoid fever by their neglect of sanitary works, and sacrifice their inhabitants in scores to the Demon of Filth.

If we only turn to our own town, we can find evidence of this. Our water supply in Birmingham is deplorably defective. The quality of the water used in our town as compared with good drinking water is shown by the following table (No. 3), kindly supplied to me by my friend, Professor Alfred Hill, M.D., Borough Analyst:—

No. 3.

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

Description.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total combined Nitrogen.	Previous Sewage or Animal Contamination.	Chlorine.	Hardness.			Remarks.
									Temporary	Permanent	Total.	
1. Bala Lake	2·79	·227	·001	·001	·000	·002	0	0·73	0°·1	0°·3	0°·4	...
2. Glasgow, from Loch Katrine ...	3·28	·256	·008	·002	·031	·041	0	0·47	...	...	·3	...
3. Manchester, from Derbyshire Hills	6·80	·242	·026	·001	·001	·028	0	..	...	...	2°·7	...
4. Alison St. Well, Birmingham	15·00	·059	·012	·003	·000	·014	0	1·06	4°·57	10°·28	14°·85	Perfectly clear.
5. Aston Bore Hole ...	15·00	·019	·012	·0025	·370	·384	3,403	1·83	2°·36	7°·10	9°·46	Ditto.
6. Waterworks Supply, March, 1871	24·30	·191	·020	·001	·277	·298	2,463	1·59	6°·14	12°·71	18°·85	Slightly turbid.
7. Waterworks Supply, June, 1871	23·21	·459	·046	·003	·208	·256	1,789	1·42	3°·14	11°·00	14°·14	Turbid.
8. Waterworks Supply, Dec., 1871	22·10	·163	·023	·000	·172	·195	1,405	1·72	5°·40	10°·00	15°·40	Pretty clear.
9. Edgbaston (Well at)	37·20	...	...	·003	2·503	...	24,730	4·80	0°·57	18°·28	18°·85	Slightly turbid.
10. A Public Town Well	76·52	·301	·038	·007	3·505	3·548	34,730	6·03	0°·0	36°·85	36°·85	Clear.
11. Town Well	196·90	...	...	0·400	·828	...	11,260	16·84	0°·0	88°·57	88°.57	Turbid.
12. Birmingham Sewage	121·00	7·40	2·54	3·20	0·0	5·17	...	15·60	...	...	...	After partial subsidence.

The columns Organic Nitrogen, Ammonia, and Nitrogen as Nitrates, indicate contamination by animal matters, probably excrementitious. Organic Nitrogen represents such matters undecomposed; Ammonia represents them partially decomposed, and Nitric Acid perfectly decomposed. The presence of these substances, however, suggests the probable simultaneous presence of matters not decomposed nor easily decomposable, but retaining their vitality and capable of producing disease, such as typhoid, cholera, diphtheria, etc.

Much Chlorine has the same significance, being derived from urine. These facts are at once evident on inspecting the above table, which shows that waters obtained from sources remote from the habitations of men, such as those from Loch Katrine, Bala Lake, and the Derbyshire Hills, contain no sewage contamination; while in waters derived from surface wells, such as Nos. 9, 10, and 11, Nitrogen abounds in some form, and indicates a most dangerous degree of contamination. The same remark applies to Chlorine; in samples 1—7 the quantity of Chlorine is very small; but in the Town Well, No. 11, it is greater than in raw Birmingham sewage.

Three years ago, referring to the sanitary condition of Birmingham, and the necessity of appointing a Medical Officer of Health, I wrote—

"We have but one Inspector and six Sub-Inspectors for a population of 350,000. The fact that London and Bristol, the two healthiest of our large towns, are the towns possessing the most perfect system for the removal of all rubbish and refuse, and also the most thorough inspection, should stimulate the people of Birmingham to insist on adequate inspection and frequent scavenging. The second great step (and second only because it requires time for its accomplishment), the improvement of the water supply, is also much discussed. The purchase of the Water Company's Works by the Corporation is considered by some inexpedient, inasmuch as it would deprive us of an independent critical body. Be this as it may, there can be no manner of doubt that measures should be taken early to close the noisome wells and pumps which are now sowing the seeds of disease so widely. Nor would this be so costly an undertaking as many

suppose. Some two-fifths of the population use these well waters; these 140,000 people occupy at the most some 28,000 houses, the average in the parish of Birmingham, the worst part of the borough, being 5·01 persons per house. A large number of these houses are built in courts, and eight or ten houses are generally supplied by the same pump; in some instances many more. The cost of laying on the Company's water to these courts would not exceed £2 for each court, and, consequently, for some £5,000 to £7,000 the whole of the present contaminated well waters might be got rid of. As the water-rate, which would vary from 1½d. to 2d. per week per house, would fall chiefly, if not wholly, on the owners of the property, the expense of laying on the water should be borne by the rate-payers. A penny rate for two years, a halfpenny rate for four, would more than cover the whole expenditure. At the present moment, it is true, the Company could not supply the water necessary for the whole town, but the supply is being increased, and the suppression of the pumps must be gradual, and might easily be regulated by the increase in the supply of the tap water. Surely there should be no hesitation in spending so small a sum to secure pure water for our poor in place of their present impure supply. Can we wonder at the recent large mortality from diarrhœa, and the present prevalence of typhoid fever, when we know that two-fifths of our population are drinking water containing in very many cases from eight to fifty grains of organic matter per gallon?"

How long, I again ask, are we to go on suffering from such evils? To save our hundreds annually from these diseases we must pour into all our courts an ample supply of pure water. This is one great lesson which the prevalence of typhoid and diarrhœa in our town teaches us. The difficulties may be great, the expense may be large, but we ought never to rest till this work is accomplished for the poor.

If we now turn to the richer classes—how do they fare? No better. They escape the sewage-polluted water, but they fall victims to sewage-polluted air. Only recently the prevalence of typhoid fever in certain villa residences, near London, was carefully inquired into, with this result:—

"The degree of sickness of different parts of the locality, and particularly of prevalence of enteric fever, has corresponded very closely with degrees of defective sewerage arrangement. Where houses are connected with the public sewers, there sickness and the prevalence of enteric fever have been at a

minimum; where they are connected with estate sewers which communicate with the public sewers, but are of inferior construction, there sickness has been greater and enteric fever more common ; where the houses have cesspools attached to them, or they are connected with sewers which do not form part of any proper system of sewerage, and which are of radically faulty construction and form—in fact, elongated cesspools—there sickness and enteric fever have been at a *maximum.*

"There is good reason for the belief that the well-to-do or wealthy population in the suburban districts, which occupies villa residences unconnected with the public sewers, suffers, not uncommonly, to a much larger extent from certain forms of preventable disease, and particularly from enteric fever, than the labouring population living in cottages similarly circumstanced. This was remarkably the case in the peculiar localisation and prevalence of the disease at Forest Hill which has formed the subject of inquiry. And the reason is not difficult of detection, for in the villas *the inlets of drains, often numerous, are brought within the house, while in cottages they are, as a rule, kept outside and the chance of mischief from defective sewerage is in direct proportion of the liability of the residence to be permeated by sewer gas.* I have been very greatly impressed, during the present inquiry, with certain cardinal defects (which have come under my observation) in the construction of cesspools, the connection of house sewers therewith, and of all local sewers in the localities inspected. *In no instance have I found any proper provision for the ventilation of the cesspools, or to prevent regurgitation of gas into the houses ; and I do not understand, notwithstanding that such provision is essential to prevent mischief from the inflow of sewer gas into dwellings, that it is required from builders by the local authorities.*"

House Drainage.—This brings us to the great question of *House Drainage.* House drains, as they are constructed, have two actions : they allow house refuse to run down them, and the sewer gases to escape up them.

The common answer is, "But all our drains are trapped."

Now, these traps are so insufficient, that though of some use, they engender a false sense of security. Traps cannot act contrary to the laws of nature, and if traps of the present construction prevented the entrance of sewer gases, the action of each trap would be a miracle.

If there be an unbroken connection between the sewers and the drains, and waste and soil pipes of a house, you may trap them all ; but, nevertheless, up each sewer, drain, and pipe the sewer gases will ascend, as through a flue, to escape

into the house, quickly or slowly, according to the nature of the trap. There is no trap in existence which can, under such circumstances, prevent the frequent entrance of foul gases. A flap trap cannot be closed at all times, and water traps only absorb gas on the under surface to evaporate it on the upper surface of the water, and, moreover, are never stronger than the weight of a column of water one and a half inch high, and rarely stronger in the bell traps than the weight of a column of water one quarter of an inch high—a strength totally insufficient to meet the expanding force of the gases generated in a sewer.* What ought we to learn from this? This lesson—taught by the Windsor fever—that *there should be no drains whatever inside the house.*

This can be easily effected, with reference to all sink and waste pipes, by having them cut across. Outside the walls let the pipe terminate one or two feet above a trapped grating, and on this grating let all the refuse of sinks and waste-pipes be discharged.

By this simple arrangement, gases which escape from the drains will no longer rise directly into the inside of the house, but escape into the open air to be rendered harmless by dilution.

With reference to water-closets—1st, I would say, in *new houses* let all water-closets be built outside the four walls of the dwelling-house, and connect them, if you like, by an open corridor. Inside the dwelling-house, and close to bedrooms, they should never be. In houses where closets exist, and communicate either with town sewers or drains leading to cesspools, the remedy consists in thorough venti-

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* See some excellent letters in the *Times*, by Mr. R. Rawlinson, C.B., and Mr. B. Latham. The latter calculates that the expansive force of gases in a sewer sometimes exceeds the weight of a column of water 30 inches high.

lation. The soil-pipe should be continued high up to the roof, and kept open at the top, to act as a flue, and conduct all sewer gases, not into the house, but out at the top into the open air, where they can do no harm. The under surface of the closet-pan should also be ventilated into such an upshaft, in order that any gases which may happen to collect above the the syphon trap of the soil-pipe may pass away freely, and not be discharged into the house, whenever the closet is used. The upshaft from each closet-pipe should be conducted to the highest part of the roof, and placed as far as possible away from all windows and chimneys. Finally, every householder should have all his house-drains flushed thoroughly twice a week.

Next as to Town Sewers. Every main sewer should be ventilated into the open air, once in about every hundred yards. People object to these ventilators in the streets: the smell is disagreeable. For my own part, I am rather more sensitive to such smells than most folks; but whenever I perceive them in the road, I rejoice that the houses are probably free: what is only a disagreeable odour in the street or roadway would breed illness in a house.

But there is no reason that even the most sensitive should be offended. We could easily build ventilating shafts, opening into the roadway, for our sewers, and deodorise the gases by means of charcoal, as is done in the City of London. If these shafts were not allowed to open in the roadway, they might be raised above the level of the houses. Ugly they might be; but while we can tolerate ugly chimneys belching forth black smoke for money's sake, surely we might tolerate ventilating shafts for our sewers for health's sake. Or, lastly, we might utilise the ugly chimneys as they do elsewhere, and ventilate our sewers into them, so that the fever gases might go up to heaven with our smoke.

To sum up: the most important lesson is — (1) to

have no sewers, or drains, or pipes running into drains, within the four walls of a dwelling-house. (2) When this cannot be done, to take care that all sink-pipes and waste-water pipes are broken off at least one foot above the trapped grating on which they discharge; and in case of any soil-pipe running from the inside of the house into a drain or sewer, to have it continued up to the roof, and open at the highest point, and furthest from the windows, to discharge freely the sewer gases above the roof, rather than inside the house.

With regard to cesspools, they should never be placed within the walls of any dwelling house. Have them, if you must have them, as far as possible from the house; and never have them, as is the custom, carefully covered over—on the contrary, open at the top, so as to permit free and constant ventilation; and whatever drains run into a cesspool, let them be so ventilated or broken at the upper surface that they do not form a continuous flue through which the gases may rise from the cesspool directly into the dwelling. In the country, where cesspools are most common, they should be replaced by earth-closets, which afford at once an economical and safe method for the treatment of the excreta.

Ventilation.—There is one point more to which I must allude—*Ventilation.* It is the escape of sewer gases into the stagnant air of bedrooms that works evil most surely. Open windows are the best and cheapest ventilators. Windows open at the top, chimneys open also, and a good healthy current of air passing under the doors, not only of sitting-rooms but of bedrooms, form the secret of pure air. There is no superstition that has killed its thousands more surely than the popular one that night air is bad. Impressed by this fatal fancy, the Englishman makes his bedroom a kind of Black Hole of Calcutta. This neglect of the purity

of the sleeping room—a room, remember, in which we spend more of our time than in any other single room—is bad in the case of the rich, terrible in the case of the poor. When I remind you that a man consumes every twelve hours some 200 cubic feet of air, taking from it the oxygen, and breathing out poisonous carbonic acid gas, you will recognise the importance of fresh air. Shut a man up in an air-tight room eight feet in all directions, and in twenty-four hours he would be dead or dying. Fresh air is as much food to us as bread and meat—nay, more; we can live for months on a very scanty fare of bread and meat, but cut off our supply of air and we quickly die. It is in our bedrooms, however, that we sin most in respect to the neglect of fresh air. In the cold of winter our great object is, no doubt, to keep warm. An open window is, therefore, impossible? Not so. By means of extra clothes, or a fire, we can keep warm and still have a window open for fresh air to enter. Fires in bedrooms are too commonly considered injurious; they are so only when every crack and cranny by which air can enter is obstructed. When the door has list round it, and mats thick and woolly placed against it—when the windows are made double, or carefully covered over with sand-bags and curtains—then it is the fire grows dull, consuming the scanty air the sleeper ought to breathe; but open the window an inch or two, and fresh air will come in fast enough to make the fire burn bright and the sleeper rise refreshed. In the stagnant, impure air of an ill-ventilated bedroom, sewage-polluted air works its deadliest injury. A dose that might possibly be inhaled with impunity in the open air is, in such bedrooms, the beginning of disease, because there we have no current of fresh air to dilute it, and for six or eight hours the poison breathed and rebreathed over and over again exercises its greatest influence when the vital powers are at their lowest point. There are, moreover, physiological experiments on

record, which afford some ground for believing that our power of absorbing gases from the atmosphere is greater during sleep than at any other period of the twenty-four hours. Whoever has kept fish in a glass globe has tried an experiment which we are unwittingly ever trying on ourselves. The fish breathe the water as we breathe the air. The stagnant water of the globe soon becomes impure, and, therefore, day by day, we replace it by a fresh supply; but even then, unless the globe is very large, the little prisoners soon die. Every day when the fresh water is poured in the fish become more lively and energetic, just as we townspeople feel new life within us when we get into the country, or inspire the pure air of the sea-side or the hill-top. As it is with fish so it is with ourselves, with this difference, that we try to observe the laws of health for the fish we keep; in our own cases we systematically ignore them. What our children do for fish surely we ought to do for ourselves and our children—our lives are worth many fishes.

To prevent disease fresh air is essential, and nowadays, when we all live in houses into which sewage-polluted air finds an easy entrance, the thorough ventilation of our rooms is a double necessity.

Such are some of the defects which we ought to remedy. Individual effort can do much to diminish disease, but there is need of more than we can do ourselves to finally overcome great scourges like typhoid fever. Private effort must be supported and enforced by State action. As the *Times* recently pointed out, the sanitary arrangements of houses have hitherto been neglected by the law, which has been framed upon the principle that improvement is to be effected by acting from the general to the particular, and not as in ordinary human fashion, by reforming the particular evil first and then attacking the more general.

"Until this defect is in some way remedied, it is hopeless to expect that architects and builders will carry out recognised principles in the construction of dwelling-houses, especially as public opinion is not yet sufficiently advanced to enforce the suggestion made long ago by one of the soberest sanitary workers in the kingdom, that it would be well to hang one architect and one builder annually, each selected for the purpose by his own fraternity, until the survivors had learnt the necessity of fulfilling in a proper manner the duties of their respective callings.

"If we regard the subject from a practical point of view, it must be confessed that any legal supervision of the construction and maintenance of dwelling-houses would be, if not impossible, at least very difficult, and thoroughly alien from the spirit of English institutions. But an effectual remedy for the evils complained of might probably be found by the application of the familiar principle that wrong-doers, or persons responsible for the wrong-doing of others, are liable to pay pecuniary damages to those whom their acts or defaults have injured. We know that nearly all, if not all, cases of typhoid arise from the contamination of drinking water by sewage, or from the permeation of dwellings by sewer gas. In order that such contamination or permeation may occur, somebody must be in fault—either the local authority, responsible for the public works; the owner of the premises, responsible for the original construction of the private works; or the occupier, responsible for their maintenance in a state of efficiency. There is scarcely a single case of typhoid in which there would be any serious difficulty in at once placing the hand upon the cause of its origin, or in pointing out the person or corporation to whom the presence of that cause was to be attributed. A short Act of Parliament, providing that, after the lapse of one year from its enactment, any corporation or person who was found by a jury to be responsible for having caused typhoid fever should be liable to pay pecuniary damages to any who suffered from the disease, or to the representatives of any who fell victims to it, and providing also a simple mechanism for holding the necessary inquiries, would suffice, during the year of grace accorded, to revolutionise the sanitary state of England. That which is now everybody's business, and therefore nobody's, would at once be made the urgent concern of every owner or occupier of a dwelling-house, and of every ratepayer in the kingdom."—*Times, December* 12, 1871.

The new Local Government Board should endeavour to carry some such Act. We now have in this Board a central authority to appeal to in matters of public health, and sanitary legislation which might save thousands of lives annually ought no longer to be postponed to the exigencies of political party. Sanitary legislation has hitherto been unpopular in the House of Commons; it has had no influence on the position of a Ministry, and has afforded no promise of office to the greedy place-seeker. Our legis-

lators will troop down to Westminster in crowds to vote on the Game Laws or the Deceased Wife's Sister's Marriage Bill. Earnest politicians will stump the kingdom from end to end to disestablish a church or introduce a ballot box, but the sanitary condition of the country, which slays its tens of thousands annually, is a subject our Parliament men do not care for. Even by voluntary association we support two or three expensive organisations (one of which proposes to spend some hundred thousand pounds in its work) to look after the working man's interests as far as his beer is concerned, but we have no societies eager to prevent our poorer classes being slain daily by the pollution of the water which should replace the beer. Surely this state of things cannot last long. It rests with the people who are the first sufferers to alter it, and when the people take up this question in their might, reform will not be far distant. Even on the lowest ground, of what it costs—

"It is worth while to consider for a moment the magnitude of the stake at issue. Typhoid fever is not contagious, and is believed to spread only by means of excremental pollution. It destroys about 20,000 people every year in England, and it proves fatal to about one in six of those whom it attacks. It may, with high probability, be assumed to be absolutely and entirely preventable and unnecessary. Since the death of the Prince Consort it has sacrificed, we may say, 200,000 lives, and a million of persons have struggled through and survived it; many of them more or less crippled in body or in mind. We have seen that it falls upon the higher and middle classes of society rather than upon the labourer or the artisan. But if we suppose that its victims during ten years were persons earning on an average only £1 weekly, that six weeks was the average duration of each illness, that each patient was maintained by others at an expense of a pound a week until death or recovery, and that each lost life was worth £100 to the community, we arrive by a simple calculation, at the sum of £34,400,000 sterling as the barren cost in money of typhoid fever for that brief period in our history. Its cost in values which money cannot measure, in misery to survivors, and in the destruction of mental power, it would, of course be impossible to estimate."—*Times, Dec.* 12, 1871.

Such are some of the simple lessons which we may learn from a recent event. They are all embraced in the

word, Cleanliness, which is well said to be next to Godliness. Nay, more, I would say where Cleanliness is not, Godliness cannot be; for Godliness cannot exist knowing evil and not trying to overcome it; and dirt is evil, whether it be actual dirt in our houses, or dirt on our bodies, or dirt in the air we breathe, or the water we drink. Wherever it may be, it means impaired health, less capacity for work, less capacity for pleasure, less capacity for doing good, and, therefore, less capacity for trying to improve the world that is round about us, which is the work God intended us to do.

The highest motives, then, as well as the lowest motives, combine to tell us how important it is to determine on improving the evils I have indicated. Let us, in our gratitude for the survival of our Prince, resolve to stamp out this Filth-fever. Throughout the land we have raised memorials to express our admiration for the blameless career of the Father; now, wiser by ten years' experience, let us signalise the recovery of the Son by the destruction of the pest from which both have suffered.

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