ADDRESS IN PUBLIC MEDICINE

BY

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in Ireland; M.O.H. Dublin.*At the Annual Meeting of the British Medical Association
at Bristol, August, 1894.*SANITARY SCIENCE AND THE PREVENTION OF
ZYMOTIC DISEASE.

It has been said humorously, yet not without a touch of sarcasm, that the physicians desire for their patients great longevity and frequent illness. Some years ago a writer in the *Scotsman* objected to the appointment as medical officers of health of medical men engaged in practice on the ground that "no sane body of men can bring themselves to believe that medical practitioners, whose livelihood depends upon sickness, are likely to exert themselves in exterminating it." To such an audience as that which I have the honour of addressing, no arguments or proofs are necessary to refute this writer's assertion. Those of us who devote ourselves solely to curative medicine are as anxious as those who practise only preventive medicine to prolong human life and avert disease. The desire to discover and eradicate the causes of disease, so as to convert man almost into a race of terrestrial immortals, has for centuries been characteristic of the professors of medicine. Even in our own time we witness the revival of the old idea of the *elixir vite* in the testicular juice of Brown-Séquard, and in Maliniano's search for the bacillus of senility.¹ Are there not enthusiasts amongst us who, grasping the conception of Weismann,² that there are somatic unicellular organisms endowed with the potentiality of everlasting life, believe in the possibility of conferring upon the multicellular organism, man, the immortality of the unicellular organisms which form portions of every living being?

But leaving this region of speculation, and dealing only with solid facts, we may claim that medical men stand pre-eminent amongst those who devise means for prolonging life and lessening sickness. They were the first to show that pure water was indispensable to health, that the efficient drainage of houses and of towns was a prime requisite to the maintenance of the health of communities, that overcrowding spread disease if it did not develop it, that the high mortality associated with many industrial occupations might be lessened by the adoption of certain precautions. The lives saved by the adoption of Jenner's sublime discovery of vaccination amount to millions. Why is bacteriology so eagerly cultivated by thousands of medical men, and by many of them with no view to pecuniary reward? Partly, no doubt, for the desire of enlarging the boundaries of the science of biology, but chiefly as a means of counteracting disease. Prophylaxis wholly, and etiology chiefly, are studied for the purposes of preventing disease, and consequently of diminishing the employment of the medical practitioner. No doubt some work for medical men is afforded by the appointment, in recent times, of officers of health; but this kind of work engages the time of but a very limited number of the profession.

So important do medical men regard preventive medicine that they have constituted special diplomas for proficiency in that department, and many who hold them have no intention of becoming medical officers of health. Plato, in his *Republic*, shows a high appreciation of public hygiene and State medicine. The government of a community was, in his opinion, incomplete unless a State physician took an active part in it.

In the government of modern communities the medical man plays, even from a public health point of view, a very subordinate part in these countries at least. When they are

appointed on public boards—which is rarely the case—they usually occupy the lower positions. No medical man has a place in the Treasury, the Home Office, the Colonial Office, the Council for India, the Board of Trade, or the Charity Commission. He is never made even a Master in Lunacy. The only medical man who occupies a position which gives him a direct share in the government of any great department of the State is Sir Walter Foster, Parliamentary Secretary to the Local Government Board. There are upwards of 250 Privy Councillors in Great Britain and Ireland, but only one of them has a medical qualification, namely, Professor Huxley. In Germany medical men are constantly created Privy Councillors, and the government of that empire is largely in the hands of those who possess the highly prized titles of professor and doctor. The Prime Minister of Hungary is Dr. Alexander Wekerle. In Ireland medical men seem to have a better chance of attaining to the higher posts in the public departments. One of the five members of the Local Government Board must be a medical man. Two of the Commissioners of Control of Lunatic Asylums are physicians, and they constitute the inspectors of those institutions. The Registrar-General was once a practising physician.

As the present tendency in the social world is the upheaval of the lower strata of society towards its "upper crust," as the working man has become a senator and mechanics are being metamorphosed into justices of the peace, we may hope soon to find some of the members of our profession following in the wake of Sir Walter Foster and taking high places in the Executive Government of the country. Hitherto we have only been permitted to suggest measures for the promotion of the public health; it is time that we should have a more direct influence in sanitary legislation and in the administration of the sanitary laws. There are many medical men eminently fitted by their culture, experience, and ability to hold the office of Minister of Public Health—aye, even with a seat in the Cabinet!

WHY IS LIFE IN TOWNS SHORTER THAN IN THE COUNTRY?

In 1893 the death-rate in England and Wales was 19.17 per 1,000 persons living. In the thirty-three largest towns the rate was 21.57. In England and Wales, less the thirty-three towns, the rate was 17.9. The ages of the people in the towns are more favourable as regards mean expectation of life, and the proportion of females—who have in the country at large a lower death-rate than males—is greater in the towns. Corrected for age and sex distribution, the death-rate in the thirty-three towns was 23.32, and in the rest of the country 17.62. Thus, the mortality rate in the towns was 5.7 per 1,000 in excess of that in the rest of the country. The difference between the rural rate and that in some of the towns was appalling. For example, the difference as regards Liverpool amounted to no less than 13.17 per 1,000. In that city there died, in 1893, two persons for every death in equal population in many parts of England. For example, in the outer ring of London, population 1,543,296, the death-rate in 1893 was only 15.4.

Why has one British town twice as high a mortality as another, and why is the average duration of life so much greater in rural districts than in the towns? These are problems of momentous import, the solution of which should be the aim of the sanitarian. The causes are, no doubt, highly complex, and many of them are local. Some of them are easily discoverable—such as overcrowded tenements, ill-ventilated houses, defective sanitary accommodation and drainage, accumulations of filth, ill-kept slaughter-houses and dairy-yards, noxious effluvia from factories and workshops, and imperfect combustion of fuel. The close approximation of persons to each other in towns favours the spread of infective diseases. But with all our knowledge of these causes of high death-rates, we still are at a loss to account for great differences between towns which appear to be placed under almost identical conditions as regards their salubrity.

Amongst the poor in all towns birth and death-rates stand highest. Their greater fecundity and high marriage-rates compensate for their enormous mortality. The poorer a man is the more likely is he to marry. It is a remarkable but

¹ Trattato sulla Possibilità della Prolongazione illimitata della Vita Umana.

² Weismann's *Essays*. Translated by E. B. Poulton, S. Schönland, and C. E. Shipley. Clarendon Press, Oxford, 1889.

undeniable fact that a man's desire for matrimony is in the inverse proportion to his ability to maintain a family.

In the city of Dublin the birth-rate in 1893 was 32 per 1,000 of the population, and the death-rate was 29.1. In the townships which surround the city, and in which the proportion of the poorer classes is small, the birth-rate was 18.7, and the death-rate 21.

In Dublin, in 1893, 15,579 persons were, together with their families, classified as "professional and independent." Their general death-rate was 21.6; their zymotic death-rate 1.3; 81,469 persons belong to the middle class; their death-rate was 20.3, and their zymotic death-rate 2.7. There are 83,472 labourers, hawkers, porters, etc., and their families; their death-rate was 32.1, and their zymotic death-rate 4.4.

The death-rate of children under 5 years old in those classes was as follows: Independent and professional, 19.5 per 1,000; middle class 43.4; hawkers, porters, labourers, etc., 104.

These figures show the appalling mortality of the children of the poor. It is the high mortality of infants which chiefly raises the urban death-rates. If the deaths of children under 5 years old were excluded, there would only be a difference of about 2 per 1,000 between the town and country death-rates.

A large proportion of the lower classes in the towns is underfed, insufficiently clothed, and badly lodged. These unfavourable conditions tell most severely upon the very young, amongst whom I have shown death's harvests to be so abundant. It is not so much the infective diseases which thin the ranks of the toilers of the great towns—it is constitutional maladies which mow them down. The means for lessening the excessive mortality of the very poor do not lie altogether in the domain of public medicine. They must also be worked out by the political economist, aided by those philanthropists whose pecuniary resources enable them to gratify their benevolent instincts. Just in proportion as the people are well fed, clad, and lodged, will they, by reason of their consequent higher vitality, be able to resist the assaults of both constitutional and infective diseases.

COMPARATIVE POVERTY OF TOWNS IN RELATION TO DEATH-RATES.

As higher death-rates prevail amongst the poor than obtain in the case of the well-to-do classes, an undue proportion of very poor people in a town must necessarily cause a higher death-rate than where the poor are comparatively few. This will be the case even where the general hygienic conditions of both towns are much alike.

Mr. Sergeant, in a paper published in the *Journal of the Statistical Society* for June, 1864, argues that in estimating the death-rate of Birmingham, as compared with that of London, an allowance of 1.5 per 1,000 should be made in favour of the former city, on account of the comparatively small proportion of the affluent classes which inhabit it.

The recorded death-rates of towns are corrected for age and sex distribution. The death-rates of persons arranged in groups according to ages in England and Wales are determined. It is known that females enjoy a longer period of life than males. If the proportion of persons whose mean expectation of life is greatest in a town exceeds that in the county at large, a correction is made for this condition of things. So, also, if females are, relatively to males, more numerous in a town than in all England and Wales, a correction is also made for that state of the population. The recorded deaths for the English towns are, with few exceptions, below the rates when corrected for age and sex distribution. If a similar correction could be made in cases where the poor classes (amongst whom everywhere the death-rate is highest) are in excess it would be most desirable. I have endeavoured to find in the Census Reports of 1891 materials for such a correction, but the results are disappointing. It may be considered that the comparative poverty of towns might be to some extent determined by ascertaining the proportion of the population who were domestic servants. On the whole, we find that in the towns where the domestic servants are very numerous the death-rates are low. Croydon, for example, had the lowest death-rate of the great towns in 1893—namely, 16.99 (corrected), and the highest proportion of domestics—namely, 8.8 per cent. of the population, or in the ratio of 44

per cent. to the heads of families. Bath and Hastings³ are the only two of the 62 largest towns which exceed Croydon as regards proportion of domestics. In Bath the domestic servants constitute 11.4 per cent. of the population, and 49 to every 100 heads of families; in Hastings, 11.11 per cent. of the population and 59 to every 100 heads of families. As a rule, in the towns where but a small proportion of the population are domestic servants, death-rates are high, and *vice versa*; but there are some exceptions. In the 62 largest towns the average percentage of domestic servants is 4.6. The 10 great towns which had the highest death-rates in 1893 have a mean percentage of 2.86, whilst in the 10 great towns with lowest death-rates the percentage is 4.81.

Towns.	Percentage of Domestic Servants.		Towns.	Percentage of Domestic Servants.	
	To Heads of Families.	To Total Population.		To Heads of Families.	To Total Population.
Aston Manor...	11	2.2	Newcastle-on-Tyne...	23	4.7
Barrow-in-Furness...	22	4.0	Newport ...	23	4.4
Bath ...	49	11.4	Northampton ...	19	3.8
Birkenhead ...	30	6.0	Norwich ...	20	4.5
Birmingham ...	14	2.9	Nottingham ...	16	3.4
Blackburn ...	10	2.0	Oldham ...	9	1.8
Bolton ...	10	2.0	Plymouth ...	22	5.1
Bradford ...	12	2.6	Portsmouth ...	21	4.5
Brighton ...	41	9.0	Preston ...	12	2.4
Bristol ...	26	5.7	Reading ...	28	5.6
Burnley ...	11	2.2	Rochdale ...	10	2.2
Bury ...	11	2.3	St. Helens ...	16	2.8
Cardiff ...	20	3.9	Salford ...	14	2.8
Coventry ...	14	3.0	Sheffield ...	17	3.6
Croydon ...	44	8.8	South Shields ...	17	3.5
Derby ...	19	3.9	Southampton ...	23	5.2
Devonport ...	15	3.4	Stockport ...	11	2.5
Gateshead ...	14	2.8	Sunderland ...	17	3.7
Grimsby ...	19	4.0	Swansea ...	21	4.3
Halifax ...	11	2.4	Tottenham ...	16	3.3
Hanley ...	14	2.7	Walsall ...	17	3.2
Hastings ...	59	11.7	Warrington ...	14	2.6
Huddersfield ...	14	3.1	West Bromwich ...	13	2.5
Ipswich ...	29	6.5	West Ham ...	14	2.8
Kingston-upon-Hull ...	18	4.0	Wigan ...	14	2.6
Leeds ...	13	2.8	Willesden ...	31	6.5
Leyton ...	18	3.7	Wolverhampton ...	20	3.8
Leicester ...	14	3.0	York ...	29	5.9
Liverpool ...	19	3.9	Ystradfydwg ...	16	2.9
London ...	27	6.1			
Manchester ...	15	3.1	62 Towns (including London)	21	4.6
Merthyr Tydvil ...	19	3.7	61 provincial towns	18	3.7
Middlesbrough ...	17	3.1			

The percentage of tenements which consist each of a single room might, one would suppose, offer an indication of the poverty of a town. I find, however, the most extraordinary differences in towns, salubrious and otherwise, as regards one-room tenements. In Plymouth, which is a fairly healthy town, 24.4 per cent. of the tenements consist of one room each, and 27 per cent. of two rooms. In Preston, which has nearly the highest death-rate in England, there are only 5 per cent. of the tenements consisting of a single apartment. Devonport, a moderately healthy town, has the largest percentage of one-room tenements—namely, 25.2; Hanley has only 0.1 per cent. of these tenements. Thus, one-room dwellings are 252 times more numerous in Devonport than in Hanley. In London 18.4 per cent. of the dwellings are one-room tenements. Here I may mention that in the sixty-two largest towns there are, on the average, 12.5 per cent. of one-room tenements, or excluding London, 3.8. In the provincial towns, with the exception of Liverpool (7.7 per cent.), all the high death-rate towns have very few one-room dwellings.

In Hanley the local authorities will not permit the erection of one room dwellings. Although a manufacturing town—the principal in the potteries districts—and its industrial occupations admittedly unhealthy, its death-rate in 1893 was only 20.2.

In the Scotch towns one-room houses, as they are termed

³ Birth rate in Bath, in 1893, 19.5; death-rate, 18.5. Birth-rate in Hastings, in 1893, 19.3; death-rate, 14.27.

there, are even more common than in England. In 1873 Dr. Russell found that they constituted 32.8 per cent. of the total houses; but the proportion has been steadily diminishing since that year.

In Dublin I have estimated that one-third of the families live in single rooms.

Towns.	Of each 1,000 Tenements the Number consisting of				Of 100 Tenements of 4 Rooms, or under, the Number consisting of			
	1 Rm.	2 Rms.	3 Rms.	4 Rms.	1 Rm.	2 Rms.	3 Rms.	4 Rms.
Aston Manor ...	12	20	231	166	3	5	53	39
Barrow-in-Furness ...	15	123	95	100	4	39	28	29
Bath ...	94	147	119	136	19	30	24	27
Birkenhead ...	53	77	60	198	14	20	15	51
Birmingham ...	14	43	369	156	2	7	64	27
Blackburn ...	3	24	16	596	1	4	3	92
Bolton ...	2	87	40	563	0.3	13	6	81
Bradford ...	25	185	308	196	3	26	44	27
Brighton ...	95	114	81	108	24	28	21	27
Bristol ...	89	153	130	123	18	31	26	25
Burnley ...	24	90	66	534	3	13	9	75
Bury ...	9	79	114	569	1	10	15	74
Cardiff ...	22	141	77	119	6	40	21	33
Coventry ...	8	123	135	214	2	26	28	44
Croydon ...	36	50	50	110	15	20	20	45
Derby ...	4	38	40	170	2	15	16	67
Devonport ...	252	295	167	90	31	27	21	11
Gateshead ...	102	370	231	153	12	43	27	18
Grimsby ...	8	33	27	248	3	10	9	78
Halifax ...	54	272	191	171	8	39	28	25
Hanley ...	1	34	34	263	0.3	10	10	80
Hastings ...	51	99	75	71	17	34	25	24
Huddersfield ...	50	206	269	185	7	29	38	26
Ipswich ...	18	53	28	156	7	21	11	61
Kingston-upon-Hull ...	24	87	120	341	4	15	21	60
Leeds ...	14	176	218	259	2	26	33	39
Leyton ...	27	39	103	154	8	12	32	48
Leicester ...	3	66	31	150	1	26	12	60
Liverpool ...	77	108	126	177	16	22	26	36
London ...	184	262	163	123	27	31	24	18
Manchester ...	15	97	52	390	3	18	9	70
Merthyr Tydvil ...	7	130	133	331	1	21	23	55
Middlesboro' ...	26	102	146	432	4	14	21	61
Newcastle-on-Tyne ...	132	304	208	146	17	38	26	19
Newport ...	21	143	89	99	6	41	25	28
Northampton ...	19	64	71	139	6	22	24	48
Norwich ...	21	79	85	155	6	23	25	46
Nottingham ...	9	35	130	146	3	11	40	46
Oldham ...	7	83	24	650	1	11	3	85
Plymouth ...	244	270	137	81	33	37	19	11
Portsmouth ...	40	75	60	102	14	27	22	37
Preston ...	5	27	53	374	1	6	12	81
Reading ...	11	33	42	103	6	18	22	54
Rochdale ...	18	213	102	397	3	29	14	54
St. Helen's ...	9	87	72	427	2	15	12	71
Salford ...	23	104	39	390	4	19	7	70
Sheffield ...	6	67	239	248	1	12	43	44
South Shields... ..	104	414	211	115	12	49	25	14
Southampton ...	62	91	67	125	18	26	19	37
Stockport ...	10	119	37	505	2	18	6	74
Sunderland ...	91	292	261	123	12	36	36	16
Swansea ...	27	131	73	262	5	27	15	53
Tottenham ...	53	76	117	132	14	20	31	35
Walsall ...	5	63	80	361	1	12	16	71
Warrington ...	7	81	32	316	2	19	7	72
West Bromwich ...	5	101	194	388	1	15	28	58
West Ham ...	53	97	193	211	10	17	35	38
Wigan ...	6	174	112	400	1	25	16	58
Willesden ...	108	165	184	117	19	29	32	20
Wolverhampton ...	3	89	86	341	1	17	17	65
York ...	28	98	69	258	6	22	15	57
Ystradyfodwg... ..	9	142	134	122	2	35	33	30
62 Towns (including London) ...	125	201	200	267	16	25	25	34
61 Provincial Towns ...	38	117	139	242	7	22	26	45

Although I have shown that in many salubrious towns the one-room dwellings preponderate, very bad accounts of this kind of dwelling have been given by competent observers. Carnelly and Anderson have shown that the death-rate from diarrhoea per 10,000 of the population was 19.6 in four or more room dwellings, 27.6 in three rooms, 39 in two rooms, and 59.8 in one-room dwellings. Körösi, of Buda-Pesth, has, in an elaborate memoir, demonstrated the bad influence on health produced by living in one or two-room tenements. Dr. Russell, of Glasgow, stated that in 1885, whilst the general death-rate of that city was 25, the rate amongst the

occupants of one-room houses was 27, of two rooms, 26, of three rooms, 20, and of four rooms, 18.

It is stated that in 1885 there were only 75,000 out of 1,315,000 of the population of Berlin living in single rooms, yet that they contributed nearly one half of the deaths in that city.

The high death-rate which characterises the denizens of single-room dwellings is largely the result of the miserable conditions of the people themselves, apart from the state of their dwellings. If they exchanged their one-room dwellings for four-room tenements, they would still have a high death-rate by reason of their poverty and its concomitant evils, and, alas! I fear, from their intemperance.

Wherever one-room dwellings can be obtained the poorest, idlest, and most intemperate classes of the population will secure them; but no matter where they live their residences, unless under strict supervision, will be filthy, and suffer from insanitary evils. In towns, at least, the vitality of the people will, in a general way, be directly proportional to their means of procuring the necessaries and comforts of life.

BACK-TO-BACK HOUSES.

Dr. Tatham, lately Medical Officer of Health for Manchester, published some statistics which seemed to prove the insanitary character of houses which were built back-to-back without any intervening space. Dr. Bell, of Bradford, has also published statistics in reference to that town, which appeared to show that the people who lived in those kind of houses enjoyed better health than those whose dwellings had through ventilation. I think the recent interesting investigations of Dr. Herbert Jones has decided this question in favour of Dr. Tatham's view. He has compared the two classes of houses in Ripley and Saltaire, where the social status and other conditions of the inmates were identical. In Saltaire the annual general death-rate in a period of six years was 16.6, and the zymotic death-rate 1.08 in the through houses, whilst in the back-to-back houses the two rates were 21.1 and 1.7 respectively. The deaths from phthisis were in the ratio of 2.3 per 1,000 of the population of the through houses and 3.4 in the back-to-back houses. As these statistics apply to a population of more than 20,000 we may accept them as clearly proving the insanitary state of houses which have not a through ventilation. It is to be regretted that the local authorities still allow such houses to be built. In Dublin they could not be erected, there being a by-law directly prohibiting their construction.

THE HOUSING OF THE WORKING CLASSES ACT, 1890.

This important statute has greatly stimulated the local authorities in reference to the clearing of unhealthy areas and the erection of dwellings for artisans and labourers. As such operations entail great expense on the ratepayers, the money devoted to them should be judiciously expended. The demolition of insanitary dwellings under the provisions of this Act is a costly proceeding, for undoubtedly more than their market value has to be given in compensation for them. It seems to me that houses unfit for human habitation might be more frequently dealt with under the provisions of the Public Health Act, and consequently without cost to the public. In Dublin 2,700 houses have been tenanted and closed—about 1,000 of them never to be reopened—without any compensation to the owners. If a man has a house unfit for a human dwelling, why should he be compensated for its disuse? We prevent a butcher from disposing of the carcass of an animal unfit for the food of man, but we do not compensate him for his loss.

If a municipality be wealthy they could do no better work than the providing of good dwellings for artisans and labourers; but if their means are limited they should look only to the wants of the labouring and still poorer classes. In all towns there is a by no means inconsiderable proportion of the population who live from hand to mouth—who are often even in a state of semi-starvation. These unfortunates include old men and women, still capable of doing a little work if they can get it; hawkers, the lowest class of porters, street vendors, widows with or without children, messengers, "sandwich men," and other strugglers for existence. Then the mendicants, prostitutes of the lowest order, and the criminal classes must live somewhere, and we can easily

imagine what their abodes must be! It is in the dwellings of the very lowest classes that the seeds of infective disease are nursed as if in a hotbed. These places are pest spots, and any amelioration of their condition must be a gain to society at large. With, perhaps, the exception of the utterly disreputable persons, it is for these people that healthful dwellings should be provided at very moderate rents. It has been alleged that the providing of model tenements at rents of 3s. 6d. per week, and upwards, causes the vacation of tenements which must then be let at reduced rents to people poorer than the previous occupants. This may be the case, but certainly only to a limited extent. Artisans are a fairly independent class, and are well able to provide good dwellings for themselves; but the most dependent portion of the community ought to have the first claim on local authorities, and certainly upon the sympathy of men of the Lord Iveagh and Peabody type. The Corporation of Dublin have been able to provide two-room tenements, with separate sanitary accommodation of the most modern style, at 2s. per week, and without loss to the City Treasury.

I can present no more striking description of the deplorable state of the houses of the lower classes than that given by Dr. Hope, Medical Officer of Health for Liverpool, in the July number of *Public Health*. He says that 578 houses are about to be demolished. They consist each of three rooms, one over another, and without any intermediate landing, so that the same atmosphere pervades the entire house. They are back to back and side to side, and their sanitary accommodation is outside and for common use. They have bulging walls, broken window sills, crumbling mortar, rotten woodwork, walls and ceiling stained by saturation with vapours of breath, and foul smelling. The death-rate in the three streets of insanitary houses was 63.1, 67, and 71 respectively.

WATER IN RELATION TO DISEASE.

The disuse of town wells and the filtration of public water supplies have done much to lessen the urban mortality. The filtration of water practically commenced only close to the middle of this century, and it is within this period that the great reduction in the death-rates of towns has taken place—a reduction not altogether due to improved water supplies, but, I believe, largely from that cause. The value of filtration through mere sand has until recently been underestimated, but the researches of chemists and bacteriologists, more especially those of Dr. Percy Frankland, have shown that filtration through sand and gravel can be made almost as perfect as through charcoal. It has been demonstrated that a fresh sand filter acts merely mechanically, and prevents the passage of the grosser particles; but a filter some time in use has its superficial layers permeated with a jelly-like mass of microbes which acts as the real filter. These microbes convert the nitrogen of the organic matter into nitrates, and they arrest the passage through the filter of other microbes. I believe that there are many persons in charge of filter beds who are not aware of these facts, who do not know that new filters let microbes pass freely through them, that the sand layer should not be more than 30 centimetres in thickness, and that the rate of flow of water through the sand should be uniformly four inches per hour. The medical officers of health are not usually consulted about filtering beds, but it would be desirable that they should ascertain whether or not the new views with regard to them are known to the water-works officials.

Wolffhügel found that the 3,000 colonies per cubic centimetre in unfiltered Berlin water were reduced by filtration to 107, which, however, are 57 in excess of the number assigned by Koch to good water. In the Dublin pipewater the number does not exceed 25.

Dr. Percy Frankland states that sand particles, averaging 0.06 inch in diameter, allowed from 26 to 40 per cent. of bacteria to pass through; whilst sand grains, averaging 0.006 inch permitted 14 per cent. to pass through. When very fine sand (silver silt) 5 feet in depth was used 95 per cent. were retained. Garden soil and peat are perfectly efficacious filtering materials, but the water passes too slowly through them. I cannot avoid here passing a eulogium upon the magnificent treatise of Dr. and Mrs. Percy Frankland on the micro-organisms in water which has just been published. Beside being a record of the admirable researches of the

authors, it is a valuable epitome of the literature of this subject.

Professor Koch has expressed very strong views as regards the inferiority of surface drainage to subsoil water for potable purposes. He considers natural filtration through layers of soil as more efficacious in removing organisms than any system of sand filtration. The process in the former case is slow, and the amount of filtering material considerable. There is no doubt that the water of deep wells, though often excessively hard, and therefore not suitable for domestic purposes, generally contains the merest trace of organic matter, and is practically free from microbes.

The great importance of water filtration was painfully demonstrated during the last epidemic of cholera at Hamburg. This city, Altona, which is close to it, and Wandsbeck, virtually a suburb of Hamburg, derive their water supplies from the Elbe and a lake. F. Reiche, Resident Physician to the General Hospital, who has published a very elaborate account of the epidemic, states that there were 17,972 cases and 7,610 deaths. In Altona and Wandsbeck there were few cases. Hamburg derived its water from the Elbe, above the town, and it was not filtered. Altona used filtered water taken from the river below Hamburg, and Wandsbeck's supply was taken from a lake and filtered. Analysis proved the pollution of the Hamburg water and the purity of the supplies to the two other towns. Here, surely, we have a strong proof of what Dr. Ernest Hart terms water-borne cholera. It is, however, remarkable that Koch was unable to detect a single cholera bacillus in this highly-polluted water. Another remarkable point in connection with this epidemic is that the water used by Altona contained the sewage of Hamburg, the second largest town in Germany. Can there be a more wonderful proof of the purifying power of proper filtration?

At the same time one cannot help asking, Is there anything to be gained by tracing what has been termed the "pedigree" of water? It is stated that a better opinion as to the purity of water can be formed by knowledge of its sources than by the results of its analysis. It seems inconceivable that any amount of filtration could make river water pure that contained the sewage of an enormous town.

It must, however, be observed that Altona is situated on much higher ground than Hamburg, that it is not, like the latter, permeated with stagnant canals, and that it is a healthier town. It seems not unlikely that the deplorable insanitary condition of Hamburg was the principal cause of the ravages of cholera. The correspondent of the *Lancet* in the number of that journal for July 7th, 1894, describes the condition of the purlieus as almost indescribably bad. Official statistics showed that the deaths in the population were influenced by their incomes. The upper classes, though they drank the polluted water, suffered but little.

The fitness of a water for potable purposes is generally determined by its chemical, and rarely by its biological, examination. The chemists, as a rule, believe that their method is the surer one, whilst the bacteriologist considers his process as the only really reliable one. The chemical analysis is much more cheaply obtained than the bacteriological one, if the latter be thoroughly carried out; therefore the general public will continue to have water chemically, rather than biologically, examined. It is, however, clear that both methods are desirable, and I have no doubt that at no distant date the water analyst will be able to carry out both processes, as, indeed, a few of them now do.

We have not yet determined, in relation to chemical analysis, the line which divides a bad from a good water, nor do I believe that such a line can be drawn. One that contains very little organic matter may be dangerous to drink, whilst, on the contrary, water with a large amount of organic matter has been drunk with impunity for years. In the eleventh annual report of the Local Government Board an account is given of the failure to detect pollution in water. 0.05 gramme of typhoid dejection was added to a litre of pipe water, and half that quantity of the dejection to another litre of water. Both, together with unpolluted water, were analysed by distinguished chemists, who were aware of the nature of the articles submitted to them. In the unpolluted water the free ammonia was 0.0021, and the albuminoid ammonia 0.0075 grain per gallon, which quantities

were raised to 0.0025 grain of free and 0.0095 grain of albuminoid ammonia in the least polluted water, and to 0.0027 grain of free and 0.0123 grain albuminoid ammonia in the more polluted water; thus the addition of 0.5 gramme of typhoid dejection to a litre of water, or 1.7 grain per gallon, had almost no appreciable influence upon the composition of the water, which before and after pollution would be passed by the chemist as a good one. As only about 8 per cent. of typhoid dejection is solid matter, of which about 6 per cent. is soluble, the addition of 1 grain of typhoid excreta to a gallon of water would add only 0.06 grain of soluble matter to the liquid. It may be said, then, of what utility is water analysis if it passes as good a water to a gallon of which 1.7 grain of typhoid stool had been added? It is unfortunate that there is no accurate chemical method for determining the precise nature of the organic matter found. As a rule, the larger the percentage of nitrogen contained in the organic matter the more likely is it to have been derived from an animal source. Analysis certainly shows the amount of organic matter present, and although such matter is usually innocuous it is sometimes the reverse. The greater the amount of organic matter, or rather of albuminoid matter, the greater the chance that it may include infective substance. When we have a water with a very small amount of nitrogenous organic matter, there is no likelihood that typhoid dejections will be present. Under the ordinary conditions affecting our water supplies, it is improbable that typhoid stools would be mixed with them, as was done in the experiments just quoted. They are thrown into waterclosets, privies, ashpits, manure heaps, the soil, ditches, rivers, etc. From all these media they may find their way into rivers or wells, furnishing potable water, but with rare exceptions there must, under such circumstances, be large quantities of other kinds of organic matter associated with the typhoid excreta and carried with it into the water. In short the passage of unmixd excreta into potable water must be a circumstance of rare occurrence. In the ordinary cases of pollution by typhoid or other dejecta, the analysis of water proves its unfitness for use.

Dr. R. Bruce Low, in a report to the Local Government Board, states that Penrith has a water supply which chemical analysis shows to be pure, but which, he is satisfied, is liable to excremental pollution, likely to produce enteric fever and other maladies.

The number of micro-organisms in water is regarded by most bacteriologists as a measure of its purity, regardless of its chemical composition. For example, Professor Leeds, of the United States, condemned a water which, in every chemical respect, was much superior to another which he passed as good, because the former contained a very much larger number of organisms than the latter.

As minute doses of virulent poisons have had no bad effect upon the animal economy, it is likely that very small numbers of pathogenic microbes or very small quantities of toxins and microzymes may also be impotent for evil. In the great centres of population it is not unlikely that the inhalation and swallowing of disease-producing micro-organisms is a common occurrence.⁴ That they do not always produce disease is because the organism which takes in the micro-organism is strong enough to master the latter, or because a few individual microbes are unable to do much, if any, harm. Professor Ray Lankester says: "One typhoid bacillus passing into or even reaching the intestines would not be able to hold its ground."

The epidemic of enteric fever in the Tees Valley in 1890 and 1891, investigated by Dr. Barry, of the Local Government Board, has been held to prove conclusively that this disease is propagated by water. On an area of 1,103 square miles, with a population of about half a million, 1,463 cases of the disease were reported. It was ascertained that 219,181 persons were supplied with the Tees water, whilst the remaining portion of the population drank water derived from other sources. Amongst the former, attacks of enteric fever were fifteen times more numerous than amongst the

latter. Dr. Barry shows that the Tees is liable to extensive pollution, one town and about twenty villages discharging their sewage into it.

Dr. Barry's conclusions have, of course, been questioned by the water companies, for the water had been subjected to sand filtration; and Dr. Mitchell, of Castle Barnard, and Dr. Creighton, of Cambridge, have controverted them. Dr. G. H. Ganett, in a pamphlet on the water of the Severn, says of the Tees outbreak that it may have been caused by some accidental fouling of the water; but that the whole of the water of the Tees was infected by typhoid bacilli, derived from a very small amount of possible pollution at a point nearly twenty miles above where the water was removed for drinking, as suggested, is an idea that cannot be entertained.

The question as to the Tees Valley outbreak being really due to polluted river water came before the Commission appointed in January, 1892, to inquire into the quality and quantity of the water supplied to London. Mr. Wilson, who was examined as a witness, appeared to represent the Stockton and Middlesbrough Water Board. He pointed out that in a village of 162 houses no case of enteric fever had occurred during the outbreak, though the Tees water was used in all the houses; and further, that before this village got a supply from the Tees it used to suffer greatly from the ravages of typhoid fever. Mr. Wilson challenged the accuracy of the statistics, which, he said, were got by three different methods—compulsory notification, voluntary notification, and by replies to Dr. Barry's question. Mr. Wilson attributed the prevalence of typhoid in the district to general insanitary conditions.

This Water Commission sat a large number of times from May 16th, 1892, to June 30th, 1893. It comprised Lord Balfour of Burleigh (chairman), a geologist, a chemist, three engineers, and a medical man devoted to statistics—all eminent in their respective professions. They examined 92 witnesses. In their report the Commission state that the evidence produced before them proved that the pollutions to which the rivers Thames and Lee are subjected are very numerous, and that filth is illegally and unnecessarily discharged into these rivers. They also state that the methods of filtration in use by the different water companies "differ enormously," and that some of them are quite inadequate.

With admitted extensive pollution and defective filtration, the surprising thing is that the Commission report that the water as supplied to the consumer "is of a very high standard of excellence and purity." They do not believe that any danger exists of the spread of disease, provided, however, that the water is properly filtered.

The medical and statistical evidence submitted to the Commission proved that London had a comparatively low typhoid fever death-rate, and that outbreaks of this disease, or even solitary cases, were not clearly attributable to the use of the London pipewater. So far as my observation of the London tenement houses goes, it seems extraordinary how their inmates escape enteric fever if water be the usual vehicle of its poison. An intermittent water supply, with storage cisterns placed on the roofs of waterclosets in small close yards, is a common state of things in thousands of tenement and, indeed, in other kinds of houses. There seems to be no evidence that the bacilli of typhoid fever find their way into these cisterns, notwithstanding that they are exposed to foul emanations and are often uncovered; there may be other diseases caused by the water in some of those exposed cisterns.

In many towns supplied with well-filtered water, complaints are made that it is occasionally impure. Dr. Victor Despeignes states that the water at Lyons, though filtered under good conditions, when it arrives at the taps contains so many bacilli as to constitute it a danger to health. Cisterns are the cause of much pollution of water, and therefore, if possible, they should not be used.

THE ORGANISMS IN SEWER AIR.

The results of recent investigations in reference to the composition of sewer air seem to show that it is superior, bacteriologically at least, to ordinary air. Some of the accounts of its purity are so roseate that one might naturally conclude that a sewer outfall would be an excellent health resort. Dr. John Billings, of the United States army, goes so far as to

⁴ Dr. W. D. Miller, of Berlin, discovered thirty-one different pathogenic organisms in the mouth, and Professor Leeds found per cubic centimetre of his own saliva six hours after taking food 10,775 colonies of bacteria. Peroxide of hydrogen and solution of saccharin are excellent disinfective washes for the mouth.

doubt whether there is conclusive evidence to prove that sewer gases have ever produced disease. Professor Koch found only 3 to 4 micro-organisms in 100 litres of the air of a Berlin sewer, whilst the atmosphere above the sewer teemed with them. Haldane detected only 20 microbes per 100 litres of air in a Bristol unventilated sewer. In a school in Dundee Carnelly and Haldane found 1.510 bacteria and 10 moulds per 10 litres; whilst in a sewer in that town the number was less than 100 micro-organisms.

Mr. L. Parry Laws has recently made two investigations as to the number and kind of the organisms in the air of the London sewers. He finds that they do not differ in nature from those in the atmosphere; they consist of moulds and micrococci only, whilst the sewage itself contains mostly bacilli.

As sewage when quite recent rarely has a bad odour, we can easily understand that in the case of well-constructed and constantly flushed sewers the air in them would not differ from ordinary atmospheric air. It is the emanations from stagnant sewage in ill-kept sewers that are to be dreaded. In any case, be sewers well kept or badly kept, it seems the safer plan to prevent their gaseous contents from entering our houses. It is an old story that the persons who work in the sewers enjoy as good health as other workmen of the same class, but recent and accurate statistics show that this is not the case. The medical department of the Paris Bureau of Public Works has shown that there is an abnormally large amount of sickness amongst the workers in sewers, and that great precautions have to be observed in order to preserve their health.

In curious contrast to Koch, Carnelly, Haldane, and Laws' observations, we have quite a sensational account of an evolution of pathogenic bacilli from New York sewers, given to us by Dr. Fischer of that city. He examined bacteriologically sewer air which had passed into private and tenement houses where cases of diphtheria had occurred, and detected virulent organisms in it. In forty examinations of moist sewer air he detected, in twelve instances, pathogenic bacilli, of which some were Klebs-Loeffler's diphtheria microbe, and one was the bacillus typhosus.

Dr. J. Bruce Low considers that he has proved to demonstration that sewer air caused a great mortality from typhoid fever in the districts of Sheldon and East Thickley. During an epidemic of that disease in 1893 there were 224 cases and 41 deaths in a population of 10,000. Although some of the cases were caused by infected milk and exhalations from middens, the greater number were due to the entry of sewer gases into houses.

Dr. Davies, medical officer of health for Plumstead, is disposed to blame the street sewer ventilators for the recent increase of diphtheria in London.

Alessi has shown that the gases of putrefaction rendered animals peculiarly liable to infection from doses of typhoid cultures, which had no effect upon the great majority of animals not exposed to those gases.⁵ Sewer air might have a similar action.

THE VENTILATION OF SEWERS.

No sanitary subject has been so much debated of late as that relating to the ventilation of sewers and drains. The present system allows communication between the sewers and the atmosphere, for the purpose of preventing the air in the former from acquiring a greater tension than that of the latter, and also for the dilution of the sewer gases by fresh air. This system converts what were formerly sealed conduits of sewage into open sewers, but with this difference, that the emanations from the sewers are evolved through openings 100 yards or so apart, and are, therefore, concentrated at a limited number of points. From a health point of view we may regard a perfectly open sewer as obviously less objectionable than one which is open at a limited number of points. It is contended that in unventilated sewers the gases generated by decomposition of organic matter force the weak traps on house drains and pass into the houses. From my own experiments on air pressure in the Dublin sewers, I have come to the conclusion that it is extremely slight when the weather is calm; if there is a strong breeze then the pressure increases because large volumes of air are blown into the sewers through the ventilating openings.

⁵ *Centralblatt für Bacteriologie*, B xv, No. 7.

Mr. Baldwin Latham—a great authority on sanitary engineering—and Professor Attfeld say that large quantities of air entering a sewer displace equivalent amounts of foul air, which must escape somewhere.⁶ Latham considers that too much stress is laid upon the subject of ventilation of sewers, and believes that it is only necessary to give the air sufficient vent to prevent pressure upon the traps of the houses.

The ventilating openings in the streets are generally objected to by those who live opposite to them, and undoubtedly from some of them malodorous effluvia are noticed and often complained of. The trite remark that it is better to have the sewer effluvia in the street than the house is, of course, quite true; but the traps on drains ought to be strong enough to prevent the sewer air from entering the house. In every town there ought to be registered plumbers as sanitary officers, whose duty should be to see that the connections between the drains and sewers are properly made, and that the traps are sufficient and efficient. I have no doubt but that in most towns much soil pollution is the result of faulty house drains leaking their contents.

Bristol is, perhaps, the only one of the large towns in which the sewers remain unventilated. As they discharge their contents into a tidal river, and, therefore, are sealed for some hours daily, it might be supposed that the backing up of the sewage would cause pressure upon the air in the sewers. The medical officer and city surveyor are, however, quite satisfied to allow them to remain as they are, and deprecate every proposal to ventilate them into the street. As typhoid fever is the disease which is, as asserted, the most likely to be produced by sewer emanations, Bristol ought to have more than an average amount of the disease if the sewer ventilation theorists are correct. In 1892 I collected statistics which showed that the mean death-rate from enteric fever in the period 1887-91, in fifty large British and Irish towns, was 21.3 per 100,000. In Bristol the rate was 12.6. The highest rate was in Belfast, namely, 53.6; the lowest in Plumstead, 7.3. Five towns had smaller rates than Bristol, and 44 had higher rates. If Bristol has made a mistake in not ventilating its sewers, it has not paid apparently any penalty, for in the period 1881-90 only one of the large towns had a lower zymotic death-rate. I should feel disposed to adopt the Bristol plan were it not that there might be difficulty, in some towns at least, in cleansing the sewers. In Dublin, before they were ventilated, great care had to be taken in allowing the men to enter them, as the air was sometimes found to be mephitic. The proposal to ventilate sewers by causing pipes from them to pass up the front of the adjacent houses is not likely to meet with much favour. The plan has been tried in Sydney, Australia, and it is stated that the sewer organisms showered down from ventilating outlets on the windows and other parts of the house. Mr. J. M'Garvie Smith, who has made those observations, recommends that sewer air should be cremated and the open grids in the streets closed. Dr. Arthur has a very unfavourable opinion of sewer air, and suggests the exit end of drains might be made to act as efficient traps by causing them to dip below the sewage level in the sewers. In narrow streets and other close places I certainly am in favour of abolishing the open grids. In cases where there are no ventilators great care should be taken to keep the sewers free by thorough flushing, and disinfectants should be occasionally put into them, especially in warm weather. Ventilating shafts and pipes are slowly superseding the grids. In wide streets shafts of considerable height should be erected, and a few of them would suffice to, at least, prevent pressure in the sewers, though it would not ventilate them much. Dr. Kenwood's system of cremating the gases is a good one, but, I fear, too expensive for general use. The ventilation of house drains is considered to be of even more importance than that of sewers. A trap prevents the entrance of sewer gases through the drain into the house, but on the house side of the drain it is usual to have two free openings. One of these is placed just inside the trap, the other is at the end of a pipe which passes from the drain to a point higher than the house. The idea is that pure air always enters the lower opening and passes out through the upper one, thereby ventilating the drain. It often happens that the fresh air inlet becomes a foul air outlet, for if the air in the ventilating pipe be warmer than

⁶ *Transactions of the Seventh International Congress of Hygiene*, 1891.

the air in the drain the latter will not pass up to the higher opening. Very often, too, especially in the case of 4 inch bore drains, the flush from a watercloset may force foul air out through the so-called fresh air aperture. In my experience I often find these air inlets, when situated in deep areas and other confined places, a great nuisance. If the inlets cannot be placed in proper places it is better to do without them. The ventilating pipes will certainly prevent pressure being put upon the traps, and the drains can be kept free from foul air by thorough flushing.

It has occurred to me that instead of an opening for air ingress, a porous, unglazed earthenware chamber might be used. We know that gases diffuse readily through plaster-of-paris and biscuit porcelain. A vessel of this kind placed on the drain would allow air to go through it, but would not allow the passage of microbes or solid particles. It would sterilise the foul gases of the drain. I attached to a large vessel, containing wort in rapid fermentation, a porous earthenware vessel. No pressure, or a trifling one, took place in the air in the vessel unless the connection between it and the porous vessel was cut off; then the pressure became considerable.

PERSISTENCE OF TYPHOID FEVER AND ITS CAUSE.

Typhoid fever is not so prevalent in these countries or on the Continent as it formerly was; but it has not decreased in the same ratio as typhus fever, small-pox, and almost every other zymotic disease, except diphtheria. The general improvement in the sanitary condition of all our great towns has reduced the zymotic death-rate to nearly one half of what it was at no distant date; but in some towns typhoid fever has not declined, and in a few it has increased. The etiology of this disease is of great interest to the sanitarian; and it has been said, perhaps not on good grounds, that the general sanitary state of a town is directly as its typhoid fever death-rate.

There is a very general belief that this disease is almost wholly propagated through the media of water, food, and sewer air. Whenever a case of typhoid fever occurs, the condition of the sanitary accommodation and drains is the first thing to be called in question. If nothing wrong is detected in those directions, then the water is accused. If the water is found to be pure, the blame is laid upon the milk. I have no doubt that localised epidemics of this disease are frequently caused by infected water or milk; but I believe that the greater number of cases arises from the *materies morbi* of the disease being absorbed from the air.

Up to the present pathogenic micro-organisms have not been frequently detected in the atmosphere, but neither have they been found, except rarely, in water or milk, suspected to have produced disease. There are, however, some clear cases of detection of poisonous microbes in the air. Dr. R. Wurtz and Dr. S. Lodge proved the existence of the bacillus anthracis in air. According to Klein, the bacillus of swine fever is transmitted through the atmosphere. The bacillus of tuberculosis has repeatedly been detected in the dust of rooms, and therefore must have been in the air.

Vailland relates a case in which typhoid fever was apparently propagated through the air.⁷ Russian soldiers quartered in certain barracks were found to suffer much from enteric fever. A bacteriological examination of the dust in the barrack rooms resulted in the discovery of immense numbers of the bacillus typhosus.

Justyn Karlinski, an authority on typhoid fever, relates that the prevalence of enteric fever in Stolac, a town in Bosnia, was due, not to polluted water, but to exhalations from a filthy soil.

The recent epidemics of typhoid fever in Havre have formed the subject of much discussion in the French Academy of Medicine. Brouardel considers that they were mainly caused by polluted water. On the contrary, Dr. Gilbert asserts that they were chiefly due to a polluted condition of the soil. He says that in Havre the soil is not purified, the houses are not drained, and but two elements of salubrity exist—namely, pure water and undoubtedly pure milk.

The effects of soil pollution on the health of a community are strikingly proved in the case of the City of Ahmedabad, Bombay Presidency. When the excreta of the population

were deposited in the soil of the city, and kept there for an indefinite period, the death-rate averaged in 1874 80.54.75. Then the night soil was systematically removed to points just outside the city, and in the next six years the death-rate fell to 44.74. Lastly, the excreta were removed to points some miles from the city, upon which the death-rate fell to an average of 40.43.

Dr. Bertin, of Nantes, whilst believing in the transmission of typhoid fever through the medium of water, points out (giving an example) that it may be caused by infected dust from filthy soils.⁸

In my annual report on the health of Dublin for 1891, I gave a map showing the distribution of 1,988 cases of typhoid fever in Dublin. I pointed out that on the gravels the ratio of cases to the population was 1 in 92.8, and on the clays 1 in 145.3. This proved that the clays were safer to live on as far as typhoid fever was concerned. I expressed my belief that these facts appeared to show that the organisms that produce typhoid fever escape into the air more readily from the gravels than from the stiff and usually moist clays.

I have just prepared a map showing the distribution of 3,461 cases. The difference between the gravel and the clays, though not so great as previously pointed out, is shown very decidedly. This is probably due to the exceptionally hot and dry year of 1893, in which the superficial layers of the clays dried to a greater extent than usual, and permitted of the escape of the typhoid organism.

—	Population of the City of Dublin by 1891 Census.	Per Cent.	Number of Persons affected by Typhoid Fever in 12 years ended 1893.	Per Cent. of Total Number of Cases.	Ratio of Cases to Population.
Living upon gravel soils ...	75,488	30.8	1,292	37.3	1 in 58.4
Living upon the clay ...	169,615	69.2	2,169	62.7	1 in 78.2
Total	245,104		3,461	100	1 in 70.8

I believe that typhoid fever is a disease of the miasmatic class, and that it becomes endemic in certain localities in which the conditions of the soil are favourable to the development of the micro-organisms which cause the disease. That the typhoid bacillus can exist apart from man for an indefinite period is shown by the prolonged cultivation of this deadly organism in nutrient materials. If it can live and multiply on broth and potatoes it can, for a season at least, exist in soils containing organic matter. Uffelmann's very recent experiments show that the typhoid bacilli can resist drying for a considerable time. After eighty-two days in white sand, they were still capable of culture. In house sweepings they continued intact for a month. They can be blown about in dust, and in this way get into milk or water, and be directly swallowed or inhaled.⁹

Karlinski found typhoid bacilli alive after five months' retention in earth. He says that the part which the soil plays in epidemics should not be underestimated. He noticed a fact of great etiological interest, namely, that when the soil was saturated with rain water the bacilli perished. I think it will be found that, however salubrious the gravels and sands may be in a general way, there are some diseases which prevail more upon them than on the stiff and cold clays. This, at least, is the case in Dublin, where typhoid is more prevalent on the gravels than on the clays.

The gravels in Dublin lie low, and are nearest to the river Liffey, which flows through the city into a bay. The clays, which occupy the higher parts, rise to a height of 70 feet above low water in the river, whilst the gravels are only about 24 feet above low water. I caused three wells to be sunk in the gravels and four in the clays, and noted the height of the ground water in them. In the low-lying gravels, generally believed in Dublin to be water-logged,

⁸ *Journal d'Hygiène*, July 12th, 1894.

⁹ *Centralblatt für Bakteriologie und Parasitenkunde*, 1894, xx, 133.

⁷ *Revue Scientifique*, January 25th, 1890

the water remained low, whilst in the clays it came much nearer to the surface of the ground. The condition of the tide has only a trifling influence on the height of the ground water, although the bottoms of all the wells in the gravels and of one in the clays are below high water.

OBSERVATIONS ON THE HEIGHT OF GROUND WATER IN SEVEN DUBLIN WELLS, 1893-4.

Wells in the Clays.

Marroubone Lane (height of ground above low water, 10 68 feet).—Greatest depth of water surface from ground surface, 7 feet 7½ inches, April 17th, 1894; extreme of fluctuation, 2 feet 1½ inch.

Stanley Street (height of ground above low water, 52 feet).—Greatest depth of water surface from ground surface, 6½ feet, July 7th, 1894; greatest depth from surface, 5 feet, April 17th, 1894; extreme fluctuation, 1½ foot.

Mansion House (height of ground above low water, 43 feet).—Greatest depth of water surface from ground surface, 9½ feet, September 23rd, 1893; least depth, 7½ feet, July 11th, 1894; extreme of fluctuation, 2 feet.

Fishamble Street (height of ground above low water, 30 feet).—Greatest depth of water surface from ground surface, 7 feet 4 inches, November 29th and 30th, and December 4th, 1893; least depth, 6 feet, May 21st, 1894; nearly the same up to July 17th, 1894; extreme of fluctuation, 1½ foot.

Wells in the Gravels.

Portland Row (height of ground over low water, 23½ feet).—Greatest depth of water surface from ground surface, 12 feet; all winter, 1893; least depth, 8 feet 2 inches, October 5th, 1893;¹¹ extreme of fluctuation, 3 feet 10 inches.

Hanover Quay (height of ground above low water, 24 feet).—Greatest depth of water surface from ground surface, 16 feet 10 inches, July 17th, 1894; least depth, 15½ feet, April 16th, 1894; extreme of fluctuation, 1 foot 7 inches.

Essex Quay (height of ground above low water, 19½ feet).—Greatest depth of water surface from ground surface, 12¾ feet, July 7th, 1894; least depth, 8 feet 11½ inches, April 18th, 1894; extreme of fluctuation, 3 feet 9½ inches.

Mean of *maximal* depths from ground surface of water surface of wells in the clays ... 7 feet 7½ inches.

Ditto, *minimal* ... 6 " "

Difference ... 1 " 7½ "

Mean of *maximal* depths from ground surface of water surface in wells in the gravels ... 13 " 10½ "

Ditto, *minimal* ... 10 " 9½ "

Difference ... 3 " 0½ "

On the whole the ground water lies lowest when typhoid fever prevails most in Dublin.

Until lately the great majority of the houses of Dublin were provided with privies and ashpits, from which much filth percolated into the soil, and, although waterclosets have almost completely been substituted for privies, it will be long before the soil and subsoil become purified, and at present they are just the kind in which the typhoid bacilli would find a congenial habitat. It has been suggested that the waterlogged condition of Dublin is the cause of the prevalence of typhoid fever, and that the obvious remedy is subsoil drainage. It is, however, a fact that the low-lying portion of Dublin, where there is most typhoid fever, is not damp, and that the ground water lies low there, and that in the parts where the ground water comes much nearer to the surface there is least typhoid fever. The explanation of this is not difficult. The cold wet clays are unfavourable to the bacillus of the disease, whereas they have a better feeding ground in the loose and well aerated gravels. The greater movement of air in the gravels, and the action of strong winds upon them, favour the evolution of the microbes from the soil, the superficial layers of which dry more readily than those of the clay. In hot dry seasons Dublin suffers, like other towns, most from typhoid. The highest death-rate

from this cause occurred in 1893, a year phenomenally hot and dry.

Dr. David Hardie, in a pamphlet on the atmospheric pathology of typhoid fever in Queensland (Brisbane, 1893), shows a connection between this disease and the soil. High barometric pressure and temperature favour the development of typhoid fever. A heavy rainfall in summer lessens the amount of disease, not only in that season but in the following winter. This effect appears to be due to the rain interfering with the germination of the bacilli, and the rain also washes them out of the soil.

The Dublin pipe water is supplied continuously to the houses, and storage cisterns have fallen completely into disuse. The water is admittedly of a high degree of purity, and is collected in a mountainous region twenty-three miles distant from the city. London, on the contrary, derives its water from rivers into which the sewage of a considerable region is discharged, sometimes with but slight, if any, purification. The water is generally stored in exposed cisterns. Yet the typhoid fever death-rate is more than three times as great in Dublin as in London. The drainage of London is superior to that of Dublin, and its soils are not so polluted. It is in the highest degree improbable that faulty sanitary accommodation and house drainage is the cause of the high typhoid fever death-rate in Dublin. In this respect it is neither worse nor better than many large towns which have very little typhoid fever. The distribution of typhoid in this city shows that soil conditions have an influence upon it, and I believe that by far the greater number of cases owe their origin to emanations from a filthy soil. The reduction of the amount of typhoid fever in Dublin and Belfast (which is placed under somewhat similar conditions as to soil and drainage) can only be accomplished by keeping soil, air, food, and drink pure. The prompt and complete removal of filth, the continuous flow of sewage in the mains, the prevention of leakage from drains and sewers, are obvious measures for lessening the mortality caused, not only by typhoid fever, but by many other maladies.

It is perhaps worth remarking that since the introduction of stone pavement into the Dublin streets typhoid fever has increased. It is most prevalent amongst persons whose working hours are spent in offices and warehouses in the streets which are paved or asphalted. The bacilli of typhoid fever or their spores, which escape into streets that are macadamised, cannot get through the paved roadways, and are therefore more likely to be drawn into the interior of the houses through the basement floors, which are rarely concreted. The rain washes the soil beneath the macadamised roads, but the soil beneath the paved streets receives no purification of that kind. I believe there would be little or no typhoid fever in Dublin if the city rested on a stratum of asphalt.

During the 10 years ended in 1893, 1,699 deaths ascribed to typhoid fever were recorded in Dublin; of these, 24.2 per cent. were registered in the first quarters of the year, 16.8 per cent. in the second, 19.7 per cent. in the third, and 39.3 per cent. in the fourth.

The limits of this address do not permit of any discussion on the biology of the so-called typhoid bacillus, and whether or not it is capable of permanent independent existence apart from man. There is reason to believe that at least its spores can retain their vitality for lengthened periods outside man. The possibility of the evolution during successive generations of harmless bacilli of disease-giving properties is highly probable. The innocuous *coli communis* is the possible ancestor of the virulent typhoid organism, and both are almost indistinguishable. If this be so, there must be many transitional forms between the two bacilli, and consequently many forms of typhoid fever or diseases resembling it. Professor Von Babes has detected in the bodies of persons who had died from typhoid fever bacilli which, though morphologically resembling Eberth's organism, differed from it under cultivation and in other respects. Dr. M'Weney and myself have cultivated an organism exactly resembling the typhoid bacillus, and which we found in polluted water believed to have caused an outbreak of typhoid fever. This organism was precisely intermediate in its reactions between the typhoid bacillus and the *coli communis*,¹² and quite recently

¹⁰ Low water means the Ordnance datum line, which is 8.094 feet below mean sea level, and was the level of the low water in Dublin Bay on April 8th, 1837.

¹¹ This well was only 12 feet in depth, and it dried up in October, and remained dry all the winter.

¹² *Journal of State Medicine*, July, 1894.

Dr. M'Weeney¹³ found, in a similar kind of water, a bacillus which almost, but not quite, comported itself like the typhoid bacillus.

It is stated that typhoid prevails most among the upper classes. This is not the case in Dublin. During the years 1892 and 1893 the following were the mean death-rates from enteric fever amongst the different classes of society :

	Deaths per 1,000 of the Class.
Professional and independent class	25.7
Middle class	71.1
Artisan class...	57.3
General service class ...	51.3
Hawkers, porters, labourers, etc.	57.5

Clerks, commercial assistants, civil servants, traders, and business managers make up the great bulk of the middle class; and amongst persons following those occupations which keep them mainly within doors, enteric fever is most prevalent.

TREATMENT OF TYPHOID DEJECTA.

I am of opinion that typhoid stools are sometimes not completely disinfected before they are allowed to pass into the sewers. Phenol is generally mixed with them, but this body has not a very strong action upon them. Bacteriologists, dealing with mixtures of the typhoid and other bacilli, have killed the latter by phenol solutions, leaving the typhoid bacillus separate and alive. I have cultivated typhoid dejecta which had been treated with carbolic acid, and succeeded in developing the bacilli in large numbers. The small portions of excreta in the stools sometimes are not completely permeated by the disinfecting solution. A 5 per cent. solution of sulphuric acid, with a little permanganate of potash, is a good steriliser. It should be added in equal volume to the stool. Smooth porcelain vessels are the proper receptacles for the mixture, and they should not be emptied for one or two hours. To prevent the action of the acid upon drain and sewer, lime should be added to it before the mixture was thrown out. Dr. Day, Resident Physician Cork Street Fever Hospital, has adopted this treatment of typhoid dejecta, and considers it satisfactory.

Undoubtedly the best way to dispose of infected excreta is by burning it in a destructor, as was first, I think, done by Dr. Sergeant at the Bolton Fever Hospital. A destructor for this purpose costs about £100, and it should be attached to every hospital where fever patients are treated.

THE EXTINCTION OF INFECTIVE DISEASES.

The domain of public medicine is steadily enlarging in every direction. Investigations into the intimate nature of the infective maladies, the mystery of the immunity from some diseases shown by certain individuals, races, and countries, and the conditions affecting contagion, are going on wherever science is cultivated. Surely the time must come when the results of these researches will enable man to extirpate some or all of the diseases which even now we consider and term "preventable."

The slow growth of population in mediæval times was mainly due to plagues and pestilences the great majority of which have ceased to exist. In our own times we may probably witness the extinction of two diseases which in former days cost an enormous loss of life—I refer to typhus fever and small-pox. Leprosy and ague, once common diseases in Britain, have died out. The frightful mortality in our towns, lasting well into the eighteenth century, was mainly due to zymotic diseases. Public medicine and private hygiene have lessened the death-rates in our towns by 20 to 50 per cent. Let us contrast the England of to-day with the India of to-day, which, so far as relates to sanitation, resembles the England of the Middle Ages. In England from 2 to 3 persons per 1,000 of the population die every year from zymotic diseases; in India in 1891 the death-rate from all causes was 30.14, whilst the zymotic death-rate was 18.27, or equal to the death-rate from all causes in England. In the vast Province of Bengal the zymotic death-rate was 23.04.

England has been described by foreigners as the birthplace and home of sanitary science, and it surely deserves the compliment. Its general and fever death-rates are amongst the lowest in the world. This is the more remarkable when one considers the large proportion of the people who live in

towns—for towns everywhere are less salubrious than the open country.

Death-rates from the Principal Zymotic Diseases per 1,000 Persons living.

Year.	England and Wales.	Large English Towns.	Year.	England and Wales.	Large English Towns.
1870	4.52	5.63	1882	2.76	3.61
1871	4.61	6.48	1883	2.32	2.90
1872	4.03	4.83	1884	2.80	3.61
1873	3.07	3.90	1885	2.23	2.88
1874	3.77	4.46	1886	2.42	2.98
1875	3.47	4.32	1887	2.42	3.33
1876	3.14	4.05	1888	1.87	2.49
1877	2.73	3.52	1889	2.23	2.87
1878	3.43	4.40	1890	2.16	2.89
1879	2.47	3.20	1891	1.91	2.40
1880	3.36	4.04	1892	2.01	2.64
1881	2.33	3.38			

The mean zymotic death-rate in England and Wales in the decade ended in 1879 was 3.524, and in the great towns 4.479. In the decade ended in 1892 the rate in England and Wales was 2.037, and in the great towns 2.899.

Never before in the history of the world were 30 millions of people located on 50,000 square miles, as is the case with the England of to day. Of these millions two-thirds reside in the towns, which yearly have a quarter of a million added to their teeming population. In Germany 42 per cent. of the population live in towns containing 2,000 and upwards. Only every tenth Russian lives in a town. Notwithstanding the great and continuous increase in its urban population, Great Britain grows healthier and healthier from decade to decade. Amongst the various influences which have contributed to bring about this exaltation of the national health, the work of the British Medical Association has not been least effective. Judged by its past, we may surely expect that the voice of the largest and most powerful medical association in the world will continue, trumpet-tongued, to advocate the cause of sanitary progress.

AN ADDRESS

DELIVERED AT THE OPENING OF THE

SECTION OF PUBLIC MEDICINE.

At the Annual Meeting of the British Medical Association held in Bristol, August, 1894.

By W. H. CORFIELD, M.A., M.D.Oxon.,

Professor of Hygiene in University College; M.O.H. St. George's Hanover Square; President of the Section.

REMARKS ON THE VITAL STATISTICS OF 1893.

As an address on public health is to be delivered to the Association by Sir Charles Cameron, it is only necessary for me to address you very briefly in opening the work of this Section, and I would therefore merely say a few words to you about the lessons we can learn from the incidents of last year from a public health point of view. By noticing what diseases are diminishing in fatality and what are increasing we may always learn something.

The year 1893 was a very hot and very dry year; during it the death-rate of the thirty-three largest English towns was 21.6 per 1,000, a little higher than the average of the previous ten years, which was 21.3, instead of being lower, as it ought to have been; but the death-rate in London shows a still greater increase, namely, from an average of 20.4 to 21.3, or nearly 1 per 1,000 higher than in the last ten years, and 1.2 per 1,000 higher than in the last five years.

The zymotic death-rate in 1893 was for the thirty-three largest English towns 3.18, as against an average of 2.91 during the previous ten years, while in London it was 3.08 as against 2.82 during the previous ten years.

It seems at first sight surprising that with continual improvements in sanitary arrangements generally there should be not only an increase in the general death-rate in any

¹³ BRITISH MEDICAL JOURNAL, May 5th, 1894.