

Second report of the commissioners appointed to inquire whether any and what special means may be requisite for the improvement of the health of the metropolis : with minutes of evidence.

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London : Printed by W. Clowes for Her Majesty's Stationery Office, 1848.

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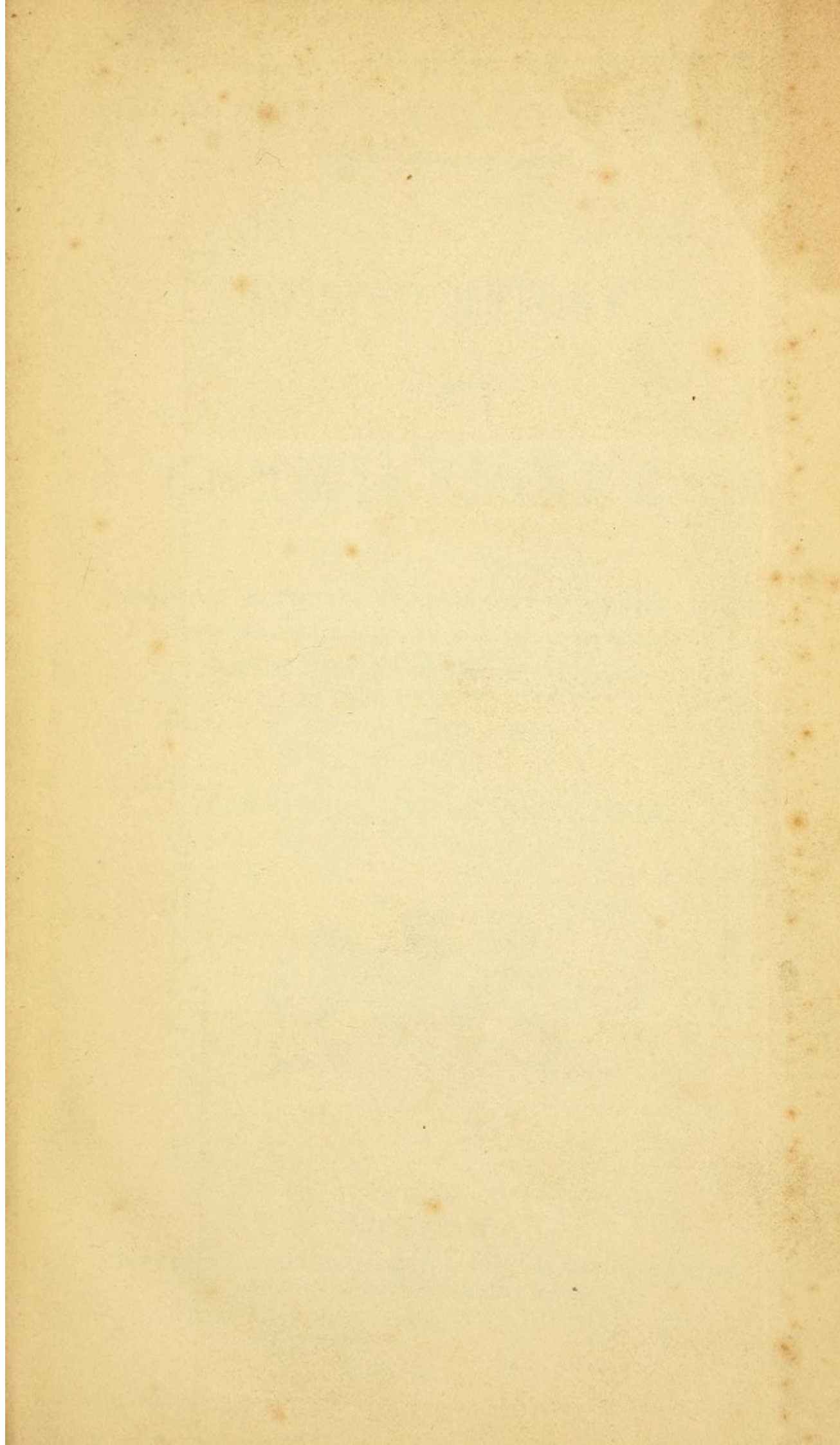
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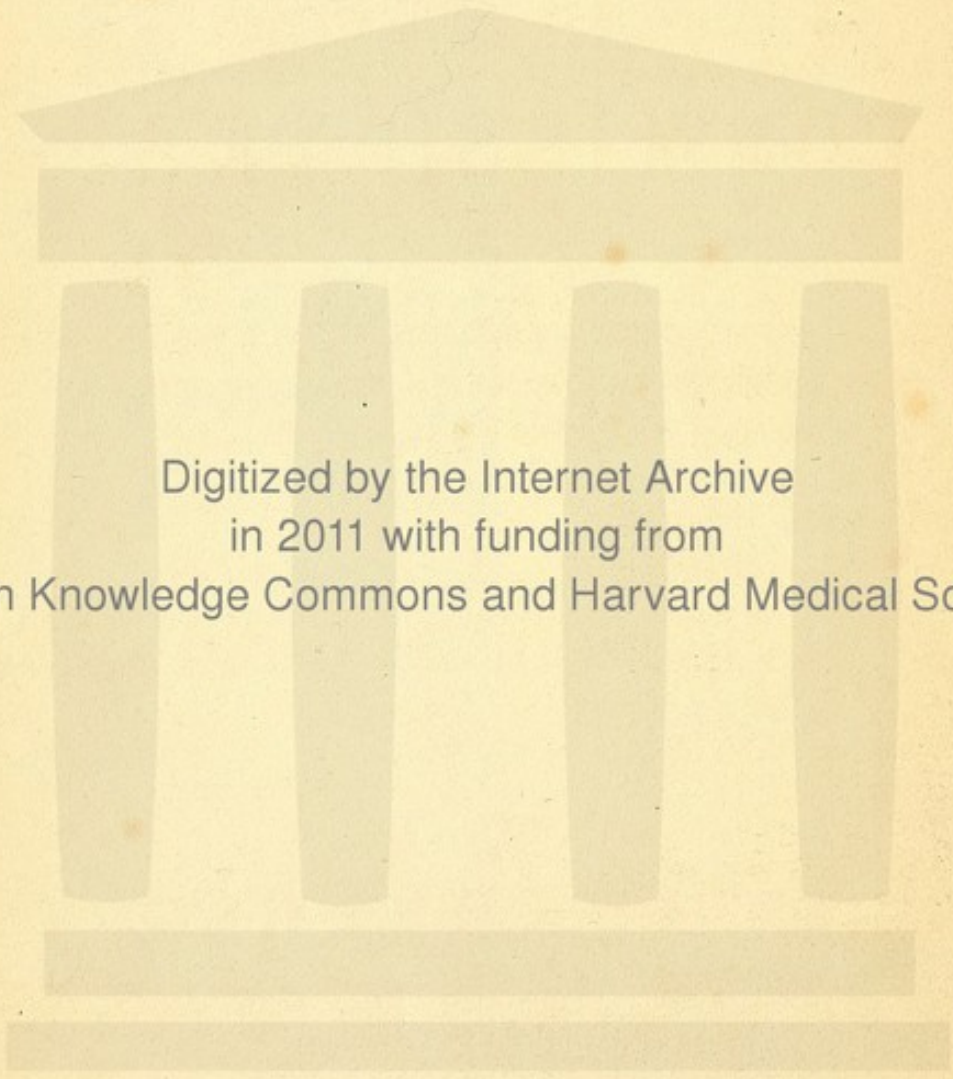
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METROPOLITAN SANITARY COMMISSION.

SECOND REPORT

OF THE

COMMISSIONERS

APPOINTED TO INQUIRE WHETHER ANY AND WHAT SPECIAL
MEANS MAY BE REQUISITE FOR THE IMPROVEMENT
OF THE HEALTH OF THE METROPOLIS,

MINUTES OF EVIDENCE.



LONDON:

PRINTED BY WILLIAM CLOWES & SONS, STAMFORD STREET,
FOR HER MAJESTY'S STATIONERY OFFICE.

1848.

METROPOLITAN SANITARY COMMISSION

SECOND REPORT

OF THE

COMMISSIONERS

APPOINTED TO INQUIRE INTO THE STATE OF THE METROPOLIS
WITH A VIEW TO THE IMPROVEMENT OF THE HEALTH OF THE METROPOLIS



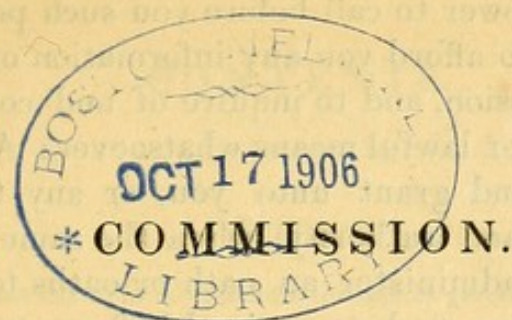
MINUTES OF EVIDENCE



LONDON:

PRINTED BY WILLIAM CLOWES & SONS, STATIONERS' STREET,
FOR THE METROPOLITAN SANITARY COMMISSION.

1862



VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith: To Our Right Trusty and Well-beloved Councillor ROBERT GROSVENOR (commonly called LORD ROBERT GROSVENOR), and our Trusty and Well-beloved EDWIN CHADWICK, Esquire, THOMAS SOUTHWOOD SMITH, Doctor of Medicine, RICHARD OWEN, Esquire, Hunterian Professor at the College of Surgeons, and RICHARD LAMBERT JONES, Esquire, Greeting: WHEREAS We have thought it expedient, for divers good causes and considerations, that a Commission should forthwith issue for inquiring whether any and what special means may be requisite for the improvement of the Health of the Metropolis, with reference more particularly to the better House, Street, and Land Drainage, Street Cleansing, and Paving; the collection and removal of Soil and Refuse, and the better supply of Water, for domestic use, for flushing Sewers and Drains, and cleansing Streets; and also to the best means of using existing Works, and of erecting new Works requisite, and of maintaining them in good action; and also to the most equitable provisions for regulating the Charges, or assessing, collecting, and paying the Monies requisite for such purposes, more especially in the Districts chiefly inhabited by the poorer classes of the population. NOW KNOW YE, that We, reposing great trust and confidence in your knowledge and ability, have authorized and appointed, and do by these presents authorize and appoint you, the said ROBERT GROSVENOR (commonly called LORD ROBERT GROSVENOR), EDWIN CHADWICK, THOMAS SOUTHWOOD SMITH, RICHARD OWEN, and RICHARD LAMBERT JONES, or any two or more of you, to be Our Commissioners for the purposes aforesaid; AND for the better enabling you to carry these Our Royal intentions into

effect, WE DO hereby give and grant to you, or any two or more of you, full power to call before you such persons as you shall judge likely to afford you any information on the subject of this Our Commission, and to inquire of and concerning the premises by all other lawful means whatsoever: AND WE do also hereby give and grant unto you, or any two or more of you, full power and authority, when the same shall appear to be requisite, to administer an oath or oaths to any person or persons whatsoever to be examined before you, touching or concerning the premises: AND WE do by these presents, Will and Ordain that this Our Commission shall continue in full force and virtue, and that you Our said Commissioners, or any two or more of you, may from time to time proceed in the execution thereof, and of every matter and thing therein contained, although the same be not continued from time to time by adjournment. AND Our further Will and Pleasure is that you Our said Commissioners, or any three or more of you, upon due inquiry into the premises, do report to us in writing, under your hands and seals, your several proceedings under and by virtue of this Commission, together with what you shall find touching or concerning the premises: AND WE further ordain that you, or any three or more of you, may have liberty to report to us your proceedings under this Commission from time to time, should you judge it expedient so to do. And for your assistance in the due execution of these presents, we have made choice of Our trusty and well-beloved HENRY AUSTIN, Esquire, to be Secretary to this Our Commission, and to attend you, whose services and assistance We require you to avail yourselves of from time to time as occasion may require. IN WITNESS whereof We have caused these Our Letters to be made Patent.

WITNESS Ourselves, at Westminster, the Twenty-fourth Day of September, in the Eleventh Year of Our Reign.

By Writ of Privy Seal,

EDMUNDS.

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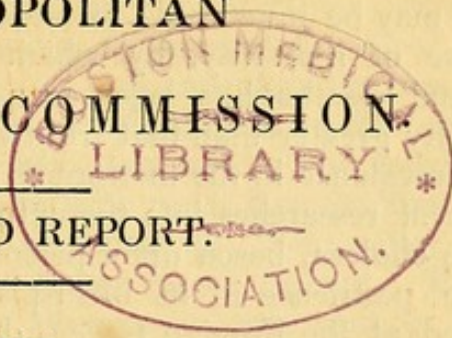
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METROPOLITAN
SANITARY COMMISSION.
SECOND REPORT.



MAY IT PLEASE YOUR MAJESTY

WE arrested our inquiries, to submit early the first clear practical conclusions which they presented for executive action, namely, the conclusions at which we had arrived in relation to the identity of the tracks of cholera and typhus, and to measures preventive of both, and the conclusions in relation to the state and progress of expensive and inefficient works under the direction of the several district Commissions of Sewers, and the necessity of their immediate re-organization.

When we submitted these conclusions in our First Report, we had received only a small proportion of the returns in answer to the inquiries we made of the medical officers of the Poor-law Unions in the Metropolis. Since that time we have examined these returns, and have ascertained the present condition of the localities, and the nature and extent of the diseases now prevailing, particularly in the several districts which suffered most severely from cholera during its former visitation. We have resumed the consideration of the special subject of the Asiatic cholera, because it has continued steadily to advance in Europe, and because the available measures of prevention are in principle the same as those which are most efficient against typhus and diarrhœa, the epidemics by which the population of the depressed districts has been lately, and we regret to state continues to be, most severely ravaged. The whole tenor of the evidence which has come before us shows, that epidemic cholera is to be regarded, in its essential circumstances, as an exemplar of epidemic disease in general, indicating only in a more striking and appalling manner a state of things which is always to be met with, more especially in the depressed districts : namely, the presence of some common and fatal epidemic, called common from the very circumstance that it is seldom if ever absent, together with a morbid susceptibility to the causes of any general and extraordinary epidemic that may arise.

As a still further exemplification of the circumstances and conditions, the chief of which appear to us to be removeable, that increase the intensity and favour the spread of epidemic disease ; we have also, since our First Report, investigated as closely as the time and means at our disposal would permit, the incidents of the

severe visitation of the metropolis by epidemic influenza. It appeared to us to be desirable to endeavour to ascertain how far it may be practicable to remove or mitigate the causes of an increase of mortality, by which an excess of upwards of six thousand deaths has been occasioned within eleven weeks, a mortality greater than that from cholera during the five months of its prevalence in the metropolis in 1832.

Recent researches into the nature and mode of propagation of Asiatic cholera, based upon personal experience and observation of the pestilence in its birth-place, and official Reports lately received at the Foreign Office, describing its progress in the different countries in which it has again broken out, contain much additional evidence corroborative of the opinions and recommendations which we submitted in our First Report. This is especially the case with reference to the conditions on which the progress of the disease appears to depend: the influence of moisture and fog in extending it; the inutility of cordons and quarantine regulations in arresting it; the non-extension of the disease through families, in which the seizure, in the great majority of instances, and except under peculiar circumstances, is confined to individual members; the inefficacy of isolation in preventing an attack; the general immunity of nurses and other attendants on the affected, however unrestrained the communication; and the greater benefit derived from making proper provision for the assistance of the sick in the ordinary hospitals or at their own homes, than by establishing special cholera hospitals for their reception.

After adverting to the attraction of the choleraic poison for moisture, and the remarkable predilection of cholera for all places where human beings are thickly crowded together, and where the effluvia from the excretions are consequently abundant, Dr. Parkes, late an army surgeon in India, describes the rise and progress of two epidemics, which he witnessed; one in 1842, at Moulmein, in the Tenasserim provinces, and the other at Madras, in 1845, both being, he says, fair types of the general manner in which cholera spreads in India.

“Some time in the early part of 1842,” he says, “cholera appeared in the northern parts of Burmah, and, passing in a southerly direction, committed great ravages, and caused great consternation at Ava and Ameerapoor. After traversing these cities, it passed down to Rangoon, pursuing the course of the Irrawaddy and its tributaries, and attacking chiefly the towns and villages situated on the banks of these rivers. Still pursuing a southerly course, in August it appeared in the Burmese town of Martaban, situated on the junction of three great rivers—the Salween, the Attaran, and the Gyne, and nearly opposite to the British settlement of Moulmein.

“In September it appeared in Moulmein, and continued to prevail with greater or less violence till July, 1843, when it disappeared, although an isolated case was occasionally seen during

the two following years. Soon after its entrance into Moulmein, it was reported to have appeared in the villages to the south, on the banks of the Salween, and on the sea side, and then still travelling due south, it reached in November the second principal Burman town, Tavoy. Tavoy is a place of considerable size, and is situated about 150 miles south of Moulmein, on the banks of a broad shallow stream, loaded with debris from the neighbouring mountains. Cholera raged here with great fury for three or four months, and then gradually disappeared. Soon after entering Tavoy, it was heard of in the villages round the city. Travelling south, it shewed itself shortly afterwards (some time in January, 1843) in Mergui, the third principal town in the provinces, situated on a small island, formed by two branches of the Tenassarim river, opening into the Bay of Bengal, 150 miles to the south of Tavoy.

“During this progress from the north towards the south, cholera attacked chiefly, or exclusively, the towns and villages stationed in low marshy places, on the banks of rivers, or on the shores of the sea. It did not extend inland, and the Burmans were accustomed to escape it by leaving their houses and travelling into the jungle. Directly the first death occurred in any village, the men deserted their fishing or their paddy fields, and betaking themselves to their endless forests, preferred the chances of famine and the dangers of the jungle to the risks of exposure to the attacks of cholera. They universally stated, that though they were left without food by this flight, and were exposed to the burning noon-day rays, and to the heavy tropical dews at night, that cholera universally left them after the third or second day's march inland.

“For many months the disease at Moulmein was confined almost entirely to the houses situated on or over the river, and chiefly to the south end of the town; one side of the main street runs close to the river, and the great majority of cases occurred on this side; comparatively few on the other.

“The only Europeans attacked at the commencement of the epidemic, were the sailors belonging to the ships in the river. The ships nearest the shore suffered most. Thus nine cases occurred on board Her Majesty's brig ‘Britemorte,’ lying close in shore; she was moored about a mile away, into the centre of the stream, and no more cases occurred. Three cases occurred on board Her Majesty's brig ‘Syren,’ also lying in shore; she was also moored into the centre of the river, and cholera immediately ceased. The 63rd regiment sailed in September and October, 1842, for Madras. One transport brig, accidentally detained three days in the river, had fourteen cases of cholera during the voyage; the other transports, four in number, got to sea at once, and had no cholera. A few cases occurred during this time among the Europeans on shore, but these consisted only of those who lived close to the river.

“No case occurred in the European and native regiments, whose barracks are situated half a mile or a mile from the river, although these men were in constant intercourse with the bazaar. After prevailing chiefly at the south end of the town, the cholera spread gradually over the whole town, which extends for four miles along the banks of the Salween.

“Cholera is not common at Madras. The hot, dry, and sandy soil of this station is so absorbent of water, that perhaps during the greater part of the year the climate is too dry for the disease, and during the remainder of the year the rains are generally heavy.

“The 84th regiment landed at Madras in excellent health, in April, 1845. On the 19th of June, the first case of cholera appeared, and from this time cases were admitted every two or three days for ten weeks. A hot land wind during the day, followed by a heavy shower in the evening, generally produced one or two cases of cholera in the next 24 or 36 hours.

“A few days before the cholera appeared in Fort St. George, it had attacked with some violence the 57th regiment, stationed at Harcourt, 80 miles to the westward. After it had appeared in the Fort, we heard of its prevalence in the bazaar and black town of Madras, where it was very fatal, and created great alarm among the Hindoos.

“In both these epidemics the main facts are similar to those deduced from the general observations of the majority of writers. Suddenly into either place a new agent enters. It finds its conditions of development, not in any unusual atmospheric vicissitudes, but in the ordinary local and customary conditions. At Moulmein it prevails in one part of the town months before it invades another. The only reason for this preference seems to be that this part is nearest the river, and is the lowest, dampest, and most thickly populated quarter. It does not attack the residents on the high grounds; and when it spreads from its original point of seizure, the conditions which allow of such spread, are to be recognised in the occurrence of meteorological phenomena previously wanting. So also at Madras; the disease is heard of at a station 90 miles off, a few days afterwards it appears at Madras itself. The atmospheric phenomena are not very different from those of years unmarked by its presence; but there is a certain degree of moisture in the atmosphere, and the wind blows directly from the station, in which the disease had shortly before been prevalent. It is very fatal in the black town, crowded with Hindoos, and in the quarter of the Mussulmans, collected round the palace of their Nuwaub, both places dense with a dirty and offensive population. It is less severe in the fort, quartered by English soldiers, and tolerably clean. It is not seen at all in the houses of English residents, scattered for miles along the chief roads and the shores of the sea. In both cases we have the usual evidence of a poison exhaled from

unknown sources, and existent in the atmosphere, entering the town, and propagating itself more or less rapidly, according as it meets with moisture, animal and vegetable effluvia, and perhaps other terrestrial exhalations, which form the conditions which it demands for its development and increase."

With reference to the circumstances connected with the progress of this disease towards Europe, it is stated in the *Journal de Petersburgh* of the ^{22 October}/_{3 November}, 1847, that—"At Piatigoosk, in the Caucasus, the fortress and faubourg of Kislovodk had been attacked by the epidemic for three weeks, whilst a battalion of infantry which had encamped in a space that lies there, had entirely escaped; but one day when a thick fog enveloped the whole town the cholera suddenly appeared in the camp."

The following statements extracted from the official Reports to which we have referred, exhibit the views at present entertained by those who have had the most recent opportunities of observing the character and mode of propagation of this pestilence in its progress towards Europe.

From a despatch received from Constantinople, containing a report made to Mr. Vice-Consul Stevens by Doctors Sapi and A. Borg (Italian physicians), respecting the invasion, progress and disappearance of the Asiatic cholera morbus at Trebizond in September, 1847, we learn that the Asiatic cholera having ceased its ravages in Georgia towards the latter end of August, 1847, broke out in Trebizond in the beginning of September. "During the month of August," says the Report, "among other prevailing diseases were particularly to be noticed bowel complaints, which yielded with some obstinacy to the ordinary remedies.

"Considering this pre-disposition to the cholera morbus, its proximity, and the conflicting opinions afloat respecting its mode of propagation, it was deemed advisable to prevent communication between the Russian ports which were infected and our coast, and to this effect vigorous measures were issued from the Sanitary Office.

"These precautionary measures proved as ineffectual in preserving us as those taken for the health of the place.

"On the 9th of September a mechanic died, whose body, on inspection, presented unequivocal signs of the cold plague. On the 10th. we visited several patients who presented all the symptoms of cholera. None of those persons were near each other, and their dwellings were situated in different quarters of the town. After that day, up to the 17th of the same month, the malady, as on all other occasions, seemed disposed to abate, considering the small number of new attacks. However, in the space of one week its victims amounted to nearly 100. From that date up to the 23rd of September, the disease raged with intensity, the town was thrown into consternation, and the mortality was computed at nearly 600.

6 *Isolation does not prevent its attacks. High situations exempt.*

“The epidemic continued by spreading itself into countries and villages along the coast, making more or less havoc.

“On the first invasion of cholera no house counted more than one patient; the families first affected were afterwards nearly all exempt. In the days of havoc, that is to say, from the 18th to the 23rd of September, there were few houses which had been free from it, and in almost every family they counted more than one person attacked in the space of a few hours. These houses were chiefly Turkish, which reckoned as many as five deaths or as many persons attacked. The violence of the symptoms kept pace with the virulence of the epidemic. The epidemic ceased in the same order which it followed after its invasion. The families which, after having had members of them attacked or dead, took refuge in the country, proceeded on their return to the purification of the bedding and clothes of the choleric, without catching the disease, although there were still remnants of the epidemic in the place. An individual who without having had any sick in his house, went for a few instants to see a person attacked, was generally exempt from having the cholera.

“Several families, who had isolated themselves in the town or in the villages, in spite of their precautions, were attacked. Those families which during the period of the epidemic have observed a rigorous system of diet, notwithstanding their direct or indirect communications with choleric, were exempt. Those who sought refuge in elevated places in the country likewise escaped.”

These representations are in accordance with the following statements which are extracted from a report dated Moscow, Nov. 4, 1847, from the Swedish physicians Liljevalch and Grähs, Commissioners appointed by the Swedish Government to investigate on the spot, the nature and progress of the pestilence which has been prevailing for several months past at Moscow.

“It has appeared to us highly advantageous to forward this Report at the earliest possible moment, the more particularly as however incomplete, it will show that views very different, in some cases absolutely opposite, from those prevalent during the epidemics of 1830 and 1831 are now adopted by the Russian authorities relative to the question—practically and medico-politically so important—whether the disease is or is not contagious.

“Remembering the desolating career of the cholera through the extensive districts of the empire at the periods just mentioned, it was not without alarm that the Russian Government, in the autumn of 1846, learned that a deadly pestilence was decimating the population of Persia. Such a report rendered exact and trustworthy information immediately necessary, and in the beginning of October the same year Doctor Zimmermann was ordered from St. Petersburg to Saratoff, whence, in company with Dr. Salomon, the Inspecting Physician of that government, he was

to continue his route to Persia, for the purpose of examining on the spot the real character of the epidemic. In connexion herewith, a number of measures were ordered to be carried into effect to prevent the spread of the disease into Russia. In every government and in every district most exposed to its ravages, Boards of Health were established, empowered to control every thing connected with the general health. It was also ordered that merchantmen, towing vessels and lighters arriving from places infected with the disease, should be strictly examined, so that any patient on board, should be taken to a distant hospital, the vessel itself undergoing a quarantine of eight days. Passengers in good health and other travellers were allowed a free passage. Should the disease actually break out in any place, notice should be immediately given thereof and the inhabitants encouraged to take the steps found most advantageous and effective. That medical help might be at hand with the least possible delay, every town was to be divided into districts, and provided with its own physician, bound to attend whenever his assistance was called for; and in addition thereto, separate cholera hospitals for from 600 to 800 beds were established in every town, for the reception of all unable or unwilling to be attended in their own homes.

“In the meantime, the Medical Commissioners had arrived at Tiflis. They here learned that the disease was, as had been feared, the Asiatic cholera, and that it had already ceased in Persia and had crossed the Russian border. The attention of the Government was therefore now directed with redoubled energy to the city of Astrakhan, which, distinguished as it is for extensive communication both by land and water, was now threatened on two sides. A hospital with 700 beds was already established in the city, which numbers 46,000 inhabitants, and all the other steps recommended by the authorities had already been taken, when, on the 21st of June (the 3rd of July) in the present year, the cholera broke out at the quarantine station, eight Swedish miles from the town, and two days afterwards in Astrakhan itself. Under such circumstances it was thought impossible to preserve the central Government from the pestilence, and the idea of establishing quarantines—a thing altogether impossible in a country with such incessant and extensive communication—was entirely given up. The progress of the disease was now unchecked in two routes, along the great lines of communication formed by the Volga and the Don. Its advance was principally in a north-western direction, sometimes radiating to several districts in its neighbourhood, till on the 30th of July (August 11), it appeared in Saratoff, and on the 10th (22nd) of August, in Woronesh.

“Moscow being thus rapidly approached, so that the outbreak of the disease was now daily expected there, the authorities could not but be prepared for its reception. They had altogether

abandoned the old theory of the spread of the disease by contagion, a theory which had led in 1830 to the most extravagant hopes from the benefits to be derived from cordons and quarantines, and which dictated the removal by force of every indisposed person, as a suspected cholera patient, to newly established cholera hospitals. The first step of the Government was therefore to open a separate cholera ward in every hospital in the city, whether civil or military. Not until these were full, or special local circumstances justified the same, was it allowed to have recourse to the temporary hospitals, four of which had been established, all in the most complete state possible. It was also announced that every cholera patient would be received at once, and without any formality whatever, at any hospital to which he might be taken, where he would be attended gratis. But it was also important to provide speedy medical assistance, when such was required, in the *home* of the patient. To each of the 17 districts of the city was therefore nominated a staff of four medical officers, whose names and residence were publicly announced. It was provided that one of these four should always be present at the district police office, carriages being also in waiting for patients who might require to be transported to any hospital or for the physician himself, to expedite his medical visit. An Imperial Ukase had ordered the formation of a great Board of Health for the city. A section of this, consisting principally of physicians, was separately organized, calculated by its position to represent to the Governor-General the condition and requirements of the poorer classes. They were empowered to report any infringement or neglect of the official sanitary regulations, each member having for this purpose a separate part of the town under his inspection.

“While occupied with all these preparations, several scattered cholera cases occurred, but most of these were of so mild a character that it was judged improper to regard them as the real epidemic. In the beginning of September (O. S.), however, they became more general, and on the 14th (26th) of that month a woman died in the general hospital with symptoms of undoubted Asiatic cholera. A couple of similar cases immediately followed, and at last, on the 18th (30th) of September, it was officially announced that the cholera had reached Moscow.”

In our First Report we pointed out the demoralizing effects arising from the popular notion of the contagious nature of the disease. The Swedish physicians, in their report, thus describe the moral influence of the knowledge of the facts which establish the opposite conclusion.

“This intelligence of the outbreak of a pestilence which had so lately spread such ravages in their city, was received by the inhabitants with a tranquillity quite extraordinary. Our own conviction is, that it must be explained, to a great degree, by the fewness and mildness of its first attacks. But we think that a

second and equally powerful cause has been, the wise regulation permitting every inhabitant to be master of his own person. In this manner, the general habits and daily employments of the people are interfered with as little as possible, while the arrangements made are such, that even the most thoughtless part of the population are assured of every necessary assistance when the hour of danger arrives.

“The principal reason for our coming to this conclusion is, that nothing so rapidly develops the disease, or so easily gives it a fatal character, as the action of the passions in general, and especially of fear. Everything therefore calculated to strengthen the mind, and calm the popular apprehension, cannot but have a favourable influence on the spread of the disease. If this is correct, the advantage must be very great, at least in the beginning, and before the fact of the presence of the disease has penetrated every class of society, in cholera patients *not* being carried to hospitals, whose solitary situation encourages the popular belief in the pestilential nature of the sickness, and where they see at once that they are struck with what they have long, and even at a distance, been accustomed to regard as terrible. It is also undoubtedly a very great benefit to the serving and middle classes, among which the disease almost exclusively selects its victims, to know, whenever its ravages are spoken of, that each one continues entitled to the same relief, and the same physician, to which he has heretofore been accustomed.

“But this is not the only advantage connected with this measure. No one, we apprehend, will deny that the sick are much better attended in an establishment in which the mechanical routine necessary in every department is already in full operation, and where all, from the highest physician to the humblest nurse, can administer immediate relief, than in a newly-formed refuge, where the mechanism must jar at every turn from the newness and unaccustomedness of the persons employed. It will also at once be admitted that the interests of science, and consequently of suffering humanity, require the diseased, especially in cases so difficult and obscure as the present, to be watched and attended by persons of fixed medical habits; and, we may add, more especially bound to obtain a clear idea of the signification of the phenomena exhibited by the disease, and the proper treatment consequently required.

“The beneficial effects of the arrangement in question are thus abundantly evident, both as regards the popular mind, and every individual patient; and of this the authorities themselves must have been well aware, or they would not have thrown open to cholera patients, infirmaries and hospitals unequalled in all the rest of Europe for architectural magnificence, inward elegance, the most studied cleanliness, and an undoubted generosity of furniture and arrangement.”

From a table furnished by the Commissioners, it appears that

the progress of the disease in Moscow during the first four weeks, that is, up to the period for which they were able to obtain the official returns, was as follows:—

	Cases.	Deaths.
During the 1st week . . .	18	10
2nd week . . .	80	28
3rd week . . .	276	95
4th week . . .	460	180
5th week . . .	776	408
Total in five weeks . . .	1610	727

Within certain places south and south-east of Moscow, there were, for example, in—

	Cases.	Deaths.
The city of Astrakhan, 5th July to 17th August, 1847. . .	2261	1306
The arrondissement of Enatojewsk, 19th July to 11th August . . .	661	386
The town of Woronesh, 22nd August to 14th September . . .	4945	2348
The town of Saratoff, 11th August to 12th September . . .	2598	2348

It is further stated, that while the epidemic of 1830 ran its course in Astrakhan in three weeks, and in Woronesh in five weeks, it did not cease in Moscow till after a period of six months; that, in Moscow, the epidemic of 1830, which broke out in the middle of September (old style) extended to every part of the town in 17 days, and reached its maximum, of 244 cases and 118 deaths per day, after a duration of one month, when it gradually declined, but was long obstinate in its character, and numerous in its cases. “This year’s epidemic, on the contrary,” continue the Commissioners, “shows great variations, and, though now in the sixth week of its visit, is still principally confined to those parts of the town which lie south of the Moscow river, the cases in other districts being but few and scattered. Perhaps one reason for this difference may be, that the population south of the river (for the most part consisting of the poorer classes, and subsisting on miserable or raw kinds of food) have only the impure river water to drink, while the inhabitants of the northern side have most excellent drinking water. This issues at once from fountains, to which it is led by massive iron pipes, which communicate with the springs, two Swedish miles (18 wersts) from the city. In 1830 these water-works did not exist.

“In spite of the gradual spread of the disease, and the fact of its being principally confined within a certain district, the cases individually appear to exhibit about the same intensity as where the progress of the disease has been far more rapid. At least, this is the opinion of the physicians in Moscow. Such of them as studied the disease both here and in other places in 1830, will not admit that there is any striking difference, either in the strength of the symptoms, or in the phenomena exhibited by dissection.

“It will be seen by the measures taken to check the disease, that it is not now regarded as exhibiting the same strong contagious principle as was formerly everywhere believed to be the case when it first spread its ravages through Europe. Among all the physi-

cians of Moscow, there is certainly not one who believes that a cholera patient communicates the disease by the touch. Daily experience is too decided on this head. As yet, not a single death has occurred among the numerous physicians occupied in the sickness, or at the dissections connected therewith; and those hospital servants who have been attacked, have doubtless taken the disease from late watching and over exertion, rather than from infection. It is, consequently, the universal opinion here, that the pestilence is entirely a miasmatic sickness, which, when it has once gained its footing in any district, attacks indifferently persons who avoid all contact with the sick, and those who are daily in free communication with them."

The representation thus strongly expressed of the decided conviction on this subject of the medical men at present observing and treating Asiatic cholera as it is now prevailing in Russia, is in perfect accordance with the most recent opinion of Indian practitioners. "I have never observed," says Dr. Parkes, "any indication of contagion. In common with the great majority of Indian writers, my evidence is on the negative side. When cholera prevailed for some months in Tenasserim, and traversed indeed the whole of Eastern Asia, I never heard human intercourse alleged as a means of introduction into any place. The Burmese and Tailiens never considered it contagious, and showed no wish to avoid their relatives when sick, or to omit the customary ceremonies over them when dead. For months, as already said, the disease was raging in one particular part of Moulmein; intercourse between this and other portions was certainly not in the least interrupted on that account, and yet there was no corresponding extension of the disease,

"No precautions were taken to prevent the European soldiers from going into the bazaar; yet they were not attacked till nine months after its first appearance in the town. The sepoy's of two native regiments mixed still more freely with the natives and yet they were untouched throughout.

"During the epidemic attacks in 1843 and 1845, among the Europeans, there was a large extra allowance of hospital servants and coolies: these men were constantly in the cholera ward, aiding the sick men in and out of bed, putting them into baths, rubbing their cramped limbs, emptying the close-stools, and performing all the offices demanded by the patients, usually so restless and fretful in the earlier period: and yet not one of these, nor any other of the hospital servants, were attacked. The medical officers were constantly on duty, receiving and inspecting the sick, examining the dead bodies, &c. and yet enjoyed the same immunity. In the post-mortem examinations of cholera patients, I have accidentally inoculated myself many times without ill effects.

"So also in the gaol hospital, none of the medical men or

attendants were attacked. When I was engaged in the post-mortem examinations in the gaol, I employed several Hindoos to assist me, and we spent many hours every day in a temporary shed that we used as a dead-house, and yet no one ever thought of any danger from contagion. In fact I may sum up my own knowledge in the assertion that I have personally never witnessed in India any fact which would have led me to believe that the poison of cholera possessed the character of contagious virus, namely, the power of multiplying itself by its action on the living human system."

We have thought it desirable thus to bring under review the facts most recently observed, and the conclusions to which they have led on this subject, because we entirely concur with the opinion expressed by the Metropolitan Central Board of Health of 1832, that "next in point of real utility to the cure of epidemic disease, stands a knowledge of the circumstances which contribute to its diffusion, because upon that knowledge the right application of preventive measures must depend."

The Swedish Commissioners after bearing their decided testimony against the opinion, that the diffusion of cholera is at all dependent on the communication of the healthy with the affected, state that in their judgment there is still another subject of inquiry. "Another question," they say, "equally important remains—How is the disease transported from one district to another? Does this also take place entirely miasmatically, or may we not suppose that it is often carried by a person? The Russian history of the present epidemic includes numerous data decidedly in favour of the latter theory; and, during his long residence in South Russia, where the colonies (military settlements) had sometimes shut themselves in of their own accord, Dr. Zimmermann occasionally saw the sickness kept at a distance till the cordon was in some way broken; and occasionally he traced its progress from one place to another in the track of persons who had travelled from an infected place to a healthy one, where they had sickened, and formed as it were a hearth for the quickly developed miasma."

The Metropolitan Central Board of Health of 1832, arrived at a similar conclusion. "From the official reports of several local Boards," they say, "it appears that the first case of cholera which occurred in their respective districts, had been either directly imported from or was traceable to an infected community; and that the disease immediately spread from these first cases to one or more of those about them, and from these last to others, though in some of these instances during the progress of the local epidemic, no immediate connection could be traced between the newly attacked and the previously affected."

After a careful examination of the cases cited, which were collected from the Reports of the Local Boards throughout the United Kingdom, we have to observe that these cases would indeed accord

with the opinion, that one mode by which this disease is propagated is by communication from person to person, if that opinion were established by other and satisfactory evidence, but they are quite insufficient of themselves to prove its truth. All these cases, in fact, admit of a different and more probable mode of interpretation: they are comparatively few in number; the great majority of the Local Boards observe and report no such coincidences, but point out the ordinary local conditions which appeared to favour the spread of the disease. Again, in a country with numerous towns in close proximity, and which keep up a free and constant communication with each other, there must necessarily have happened, with an epidemic steadily advancing through the kingdom, many such coincidences; a far greater number, would probably have been found, if they had been sought for, in the recent spread of influenza from town to town, and among the individual members of families; and finally, no such mode of propagation, as the one in question, is known or suspected in the countries in which this disease derives its origin, is the most intense, and exhibits in their completest form its distinguishing characters. The following statement affords an example of the usual manner in which such coincidences are viewed and explained in India:—

“In one single instance,” says Dr. Parkes, “we adopted precautionary measures. In April, 1843, a small relieving detachment of 34 men was sent by the European regiment from Moulmein to Mergui, by sea; immediately after their arrival at Mergui two fatal cases of cholera occurred. The relieved detachment returned to Moulmein five or six days after these deaths, without the occurrence of any fresh cases: it was deemed prudent, however, to put these men in quarantine three miles from the European cantonment: here they remained in perfect health for 14 days, and were then marched into barracks; this occurred either on the 14th or 15th of May. On the night of the 21st of May the first case of cholera appeared; of course this was in no degree attributable to the junction of the detachment, which had seen no cholera for 25 days at the very least. I mention these dates thus particularly, because a loose statement that cholera broke out in a regiment after the junction of a detachment which had suffered from cholera, might be supposed to be some proof of contagion.”

“In the year 1830,” says Mr. Orton, “when the disease prevailed at Orenburg a man went from thence to Ragapua; immediately after his arrival at that place he was attacked with cholera and soon died. Four days after this man’s death several of the garrison of Ragapua were attacked with cholera. A most careful inquiry was immediately instituted, whereby it was proved that not one of those who were taken ill had seen or attended on or been near the man who was alleged to have brought the disease

from Orenburg, but on the contrary, several persons who had visited this man, and attended on him during his illness, escaped without suffering any sort of indisposition."

We may add, that the peculiar condition of the body in cholera renders it less likely to be propagated by contagion than perhaps any other epidemic disease. There is no power in the system to generate poison, and no activity in any part of the excretory apparatus to throw it off. All epidemic diseases, commonly regarded as contagious, are diseases of excitement, during the inordinate actions of which the fluids of the body become vitiated, and the excretions often so highly offensive that they appear to possess a septic or putrefactive tendency. The exhalations from a person labouring, for example, under bubo plague, or malignant typhus, contaminate the air to such a degree that the respiration of it for a few minutes by a person previously in sound health may occasion instantaneous sickness, and produce a powerful and lasting impression on the nervous system; especially if such exhalations have been allowed to accumulate in a close, ill-ventilated room. But in cholera no such vitiated excretions are formed; the processes, both of secretion and excretion, are, in fact, to a great degree, arrested; the activity of the whole apparatus of the organic life is enfeebled; a poison rapid in its action enters the blood, and so alters its crasis or constitution that its fluid and colourless portion can no longer be retained in its vessels; its thicker constituents and its red particles progressively become an inert mass, unable to maintain the circulation; hence the coldness, the shrivelled aspect, the utter prostration, and the other characteristic symptoms; and hence, also, the comparative innocuousness of a cholera patient to those around him; all the discharges from the body being in general not only without pungency or *foetor*, but even without colour or odour, producing no appreciable effect upon the senses of the bystander, and no impression upon his system.

From the whole of what has been stated, it appears that the result of recent inquiries has been the gradual abandonment of the opinion, that the propagation of epidemic disease is mainly dependent on a specific contagion emanating from the bodies of the sick; and a progressive approach to the conclusion, that the injurious effects produced by the exhalations from the living body, whether in health or disease, are confined within much narrower limits than was formerly supposed. The rapidity and completeness with which such exhalations are diluted and rendered innoxious by free admixture with pure atmospheric air, is now better understood than at any former period. Concentrated in confined and crowded apartments, they exercise a most injurious influence on the progress of disease in the sick; concentrated still more they affect the healthy, and under circumstances in which ventilation is neglected, or cannot be

efficiently applied and maintained, first the nurses, then the members of the family who may have been only occasionally in the sick chamber, and last of all the medical attendants suffer; at the same time casual visitors are liable to be attacked in proportion to the concentration of the poison, and the weakness and susceptibility of the constitution; and persons so attacked and going to ill-conditioned and confined places, may form new centres of disease. It is the occurrence of such facts that gives countenance to the popular belief in the contagiousness of the disease. Fifty years ago, it was the general belief among medical men that influenza was contagious, and the evidence adduced to support the opinion, was precisely similar to that which is now relied on to establish the contagious character of cholera. Thus the following case was recorded at the time, to prove that the epidemic influenza of 1782 was carried and propagated by an infected person. "A serjeant of the Grenadier Guards, visited London on furlough, when the disease raged there. He returned in a few days to St. Alban's affected, and communicated the disease to the people in whose house he had his billet. It was the first appearance of the disease there, and thence spread rapidly all over the town."

This is the kind of cases recorded in the official reports of the Local Boards of Health in 1832, to show that "the first case of cholera which occurred in their respective districts, had been either directly imported from or was traceable to an infected community, and that the disease immediately spread from these first cases to one or more of those about them, and from these last to others."

The investigation we have thus resumed of the special subject of Asiatic cholera enables us to present evidence which displays, as it appears to us, more clearly than has yet been generally observed, one highly important practical fact connected with the history of the disease, and to this fact we now beg to call attention.

It is commonly supposed that Asiatic cholera, of all epidemic diseases, is the most sudden in its attack, as it certainly is the most rapid in its progress; and this opinion is countenanced by the fact that the mortal seizure often takes place when the individual appears to be in his usual health, and is engaged in the ordinary business of life. A close attention, however, to the early symptoms which denote the invasion of the disease, has afforded indubitable proof that this prevalent opinion is erroneous; that this suddenness of attack is apparent only, and not real; and that before the malady assumes its mortal character, it gives warning of its approach, in general, in time for the employment of efficient remedies to arrest its progress. In the alarm that prevailed during the first invasion of cholera, this warning was not indeed observed or understood; in the novel

and difficult position of the medical practitioner during his actual encounter with a malady so new and so formidable, this premonitory symptom did not sufficiently attract and fix his attention; it is only on retracing the history of the disease, and reflecting on the phenomena it presented, that the constancy of the occurrence of this premonitory symptom, and its value as announcing the approach, and even presence of this dreadful malady, while yet there is time to stop its progress, became apparent. It appears to us that the knowledge we have acquired of the general, if not uniform, presence of this premonitory symptom, is the most important practical lesson, especially with reference to individual safety, which our past experience of cholera has taught; and as this subject has not hitherto been elucidated with the distinctness, nor promulgated to the extent which its importance deserves, we think it desirable to state the evidence we have been able to collect respecting it.

The whole tenor of that evidence shows, that the premonitory symptom of an attack of Asiatic cholera, is looseness of the bowels. This may be accompanied with pain in the bowels, or it may be entirely without pain. The looseness itself may vary from one to three, six or more additional evacuations daily. The evacuations at this period are generally fœcal, and of their natural colour and odour, altogether unlike the discharges at the more advanced stage, when they are rice-coloured and without their natural odour. The pain, if any is present, consists merely of the sensation of griping or uneasiness in the bowels, but the discharges, even when accompanied by this uneasy sensation, produce so little inconvenience, that it is difficult to regard them as indications of illness, much less as the commencement of so terrible a malady. Yet this is the real beginning of the disease, which consists of two stages—first, of this, the stage of simple diarrhœa; and secondly of the stage of collapse, or blue stage, to which alone the name of the disease, Asiatic cholera, is commonly applied, all the symptoms characteristic of the malady being present only in this stage.

The first stage, or that of simple diarrhœa, may continue from a few hours, to two, three or more days. If proper remedies are employed at this period, the progress of the disease is generally and easily checked, and the second stage never comes on; but if neglected, the second stage commences suddenly, with all the violence which distinguishes this dreadful malady. But this suddenness is merely apparent; the disease has been actually present, and has been making progress several hours, perhaps days, and it is the second, the violent, the unmanageable, and mortal stage that has really come on suddenly.

Any deviation then, on the side of looseness, from the natural state of the bowels, during the prevalence of Asiatic cholera, is the real commencement of that disease; a single additional evacuation daily, beyond what is natural to the constitution, nay,

even a looser state of the daily evacuation must, under such circumstances, be so regarded.

Asiatic cholera appears to be caused by a poison diffused in the atmosphere, which acts with peculiar intensity on the mucous membrane of the alimentary canal. The irritation set up in this membrane, in most cases, is not violent at first; but if it be allowed to continue unchecked many hours, it produces such an extraordinary change in the membrane, that the thinner and colourless portion of the blood is poured out from it with the same rapidity as it would be, if a large opening were made in the great vein of the arm.

Mr. Hodgson, of Birmingham, who has paid great attention to this subject, and who on his examination drew our attention in a special manner to the important consideration of the means by which cholera may be arrested in its first or premonitory stage, speaking of persons in the second stage, says:—

“The immense discharge of serum from the blood reduces them to such a degree that they rarely rally. To expect them to rally is like expecting a patient to rally in whom a great blood-vessel has been opened, and from whom nearly all the blood of the body has been drained: the material of life has been taken away to such an extent that few only can sustain it.”

The view which we have now presented, of the importance of attending to the very first stage of this process, the commencement of which is indicated by any increase beyond the natural discharge from the alimentary canal, is in perfect accordance with Indian opinion and practice.

“It is,” says Dr. Parkes, “the universal practice in the Indian army, immediately on the occurrence of cases of cholera, to issue orders directing the attention of the non-commissioned officers and men to the importance of attending to any deviation from the ordinary health, and particularly to any symptom of bowel complaint; and it is a positive order that any man so affected should report himself sick. It is always found that many men at such times do, in accordance with this order, report themselves sick, proving the prevalence of such complaints. Many men, however, do not conform to this order, the affection being often so slight and so entirely without pain, that they cannot be induced to regard so apparently trifling an ailment as disease; hence of the men admitted into hospital, many when seen for the first time present the developed stage of the disease. In the great majority of cases there can be no doubt that this first stage indicated by this premonitory symptom does exist. I witnessed two epidemics, the first, the slightest, in which the premonitory symptom was almost universal. In the second, the disease was more rapid, and appeared, in some cases, to present itself at once in its developed stage. These cases, however, even in India, appear to form an exceedingly small minority.”

“With regard to the duration of the premonitory stage in India,

I do not think I ever myself witnessed a case in which the diarrhœa had existed longer than four days, and the usual time would in general be only a few hours; that, however, would afford sufficient time for the application of remedies, capable, in the great majority of cases, of preventing the further progress of the disease."

The opinion and practice of Russian physicians at the present time are in perfect accordance with their views. In all the accounts that we have recently received, the medical men who are treating the epidemic which is now prevailing, first and prominently urge, "THAT THE GREATEST ATTENTION MUST BE PAID TO THE DIARRHŒA," which they say, "PRECEDES CHOLERA."

From advices which we have just received from Constantinople we learn that diarrhœa was prevalent and severe in Trebizond during the whole month of August, before cholera broke out in its Asiatic form early in September, and that in those persons in whom the disease advanced to this latter stage, diarrhœa was an early and prominent symptom.

It is notorious that diarrhœa was extremely prevalent in all the towns of the United Kingdom in which Asiatic cholera broke out in 1832, though at that time the observation had not been clearly and generally made that it constantly precedes an attack, and is in fact the actual commencement of the disease. In the detailed accounts of particular cases occasionally transmitted from the Local Boards to the Central Board of Health, constant mention is made of the presence of diarrhœa, often two or three days before the violent attack came on. But, perhaps, one of the most interesting and instructive illustrations of the extent to which this premonitory system is present in a population in which cholera is prevalent is afforded by the remarkable history of the progress and termination of this epidemic at Bilston and the neighbouring district in 1832. This pestilence raged in Bilston with greater violence than in any other part of the United Kingdom. Out of 14,700 inhabitants, 3568 were attacked with cholera, out of whom 792 died in less than seven weeks; that is, one-fourth of the whole population were subjects of the disease, and one-fifth part of those attacked died.

The Rev. William Leigh, the enlightened and benevolent clergyman of Bilston, whose exertions to mitigate the sufferings of his parishioners during this melancholy visitation were most exemplary and indefatigable, gives the following description of their condition:—

"The pestilence," he says, "continues its ravages amongst us in a frightful manner. Our necessities are increasing every hour, and our resources are fast failing us. Three hundred pounds have been granted to the Board of Health out of the poor-rates; but this sum will not pay for the coffins of the dead. All kind of business is at a stand. Nothing reigns here but want and disease, death and desolation. Two of our medical

men have perished; two more have left the place to recruit their exhausted strength; and my respectable neighbours are nearly worn out by mental anxiety and exertion. I have been confined to my house since last Thursday, and nearly the whole of that time to my bed."

In this extremity the inhabitants applied to the Privy Council for medical aid, and Dr. McCann, who had seen much of cholera in India, was sent to their relief. The first thing he did was to open a dispensary; to secure the attendance of medical men there night and day, and to placard the town with notices that, whoever was attacked with looseness of the bowels, might receive gratuitously, at this institution, instant advice and relief. Two assistant surgeons, paid by the Board of Health, were in constant attendance, and the resident surgeons of the town, three in number, undertook to visit the institution daily at regular intervals. The dispensary was opened on the 26th of August; on the following day 270 persons applied for relief for bowel complaints; and in the course of eight days the number increased to 1100, all of whom, on their personal application, received the appropriate remedies for such complaints at the institution. The effect was most striking; for it appears from the official Report of Dr. McCann, that in the course of a single week the mortality was reduced one-half.

"I have," he says, "the satisfaction to state, that the mortality in Bilston parish from cholera has been reduced during the last week to less than one half what it was during the preceding; the number of deaths from that disease during those two periods respectively, as taken from the burial registers, has been as follows:—

From 20th to 26th August	275
From 27th August to 2nd September	132

"For this happy change, and happy it is comparatively, we are, I have no doubt, mainly indebted to the beneficial influence of the Public Dispensary for the Bowel Complaints; upwards of 1100 personal applications having been made and attended to at that institution, for such affections, during the last eight days. From this fact, the public may at once perceive the extent to which disease, and disease, too, connected with cholera, prevails in this district, and at the same time be enabled to form some accurate notions of the advantages to be derived from placing within reach of the poor the means of obtaining prompt and proper relief for bowel complaints in times like the present; for I have no hesitation in saying, that a large proportion of the cases above alluded to would, under existing circumstances here, have passed into cholera if neglected; and that, of the choleric, a large proportion would have died. In all places, therefore, where cholera prevails, or when it is expected, I would again, as I have repeatedly done before, exhort the local authorities to establish, without delay, public dispensaries, where the poor, without trouble, or favour, or expence, may receive prompt and effectual treatment for bowel complaints. It cannot, indeed, be too often repeated, that *looseness of the bowels is the beginning of cholera*, and that such looseness *admits of an easy and effectual cure*, whilst cholera itself, or that stage of the disease in which

vomiting, and cramps, and prostration, are added, or succeed to looseness, is one of the most fatal and intractable diseases known."

The following week Dr. McCann reports:—

"I have again the satisfaction to announce a remarkable decrease in the mortality at this place from cholera: the number of deaths from that disease, in this parish, during the week which has just terminated from the 3rd to the 9th instant, (both inclusive) having been only 44, or one-third of the number (132) which had taken place during the preceding seven days. The number of applicants at the Dispensary also (new cases) for relief for bowel complaints has undergone a sensible diminution during the last few days; but the daily average for the past week (upwards of 130) is sufficient to show that the epidemic influence still prevails amongst us, and to a much greater extent than the cholera reports taken independently would seem to indicate. We have here, therefore, a new proof or illustration of the good effects resulting from such institutions, for although renewed and indefatigable efforts have been made here during the past week to relieve the wants, and add to the comforts of the poor in other respects; yet no one practically conversant with the subject, can doubt but that all those efforts must have proved, in a great measure, unavailing towards arresting the progress of the pestilence, if measures had not, at the same time, been adopted to extinguish, as it were, in each individual, according as he became affected, the seeds of that cruel malady.

In nine days from this period, namely on the 19th of September, the epidemic was extinguished, and on the same day the Bilston Board of Health addressed the following letter to the Privy Council:—

"Board of Health, Sept. 19.

"The Board of Health are anxious to convey to the Lords of the Council, their grateful acknowledgments for the important and valuable services rendered to the township by Dr. McCann during his sojourn among them. To his unwearied diligence in the discharge of his arduous and perilous duties, to his humane and unremitting attention to the poor, and above all, to his wise and salutary arrangements for arresting the progress of cholera in Bilston, the Board feel that, under God, they owe, in a great degree, the present favourable change in the condition of the inhabitants; and so fully are the Board convinced of this, that they cannot refrain from expressing most respectfully, their anxious hope, that measures may be adopted under the sanction of their Lordships, for carrying into effect in other places where the pestilence may unhappily prevail, or where its approach may be apprehended, similar arrangements to those from which they themselves, under God's good providence, have derived such signal advantages.

(Signed) "W. LEIGH, *Chairman.*"

By similar means, under the same superintendence, a similar result was produced at Wolverhampton, where cholera was prevailing very extensively at the time that Bilston obtained this "melancholy pre-eminence in suffering."

Of the correctness of this account we have received the following

confirmation from Mr. Nicholas McCann, who states:—That he is a surgeon, and resides in Parliament-street, and that Dr. Francis McCann, who went down to Bilston, is deceased, and was a relative of his. He died two years ago. He had been in India, and was well versed in the treatment of cholera.

“I was perfectly familiar,” continues this witness, “with his treatment at the time, and adopted it. Whenever I was called in early enough to take advantage of the premonitory symptoms, I usually found his treatment successful, never once losing a patient. In the police division, which was under my care, I scarcely lost a man; the order being from me, for an early application upon any disordered or relaxed state of the bowels. Some certainly were lost, where the premonitory stage was not taken advantage of, according to the plan of treatment I pursued. At the period cholera made its first appearance in Westminster, in the years 1831 and 1832, the opportunity then afforded me was extensive, being connected with the largest and only dispensary in the neighbourhood of Parliament-street, and also being surgeon to the metropolitan police.

“From my own observation and experience, I have arrived at the conclusion that in ninety-nine cases out of every hundred, the premonitory symptoms (in other words, diarrhœa) precedes each and every attack, showing the necessity of making the earliest application for medical aid, and the great danger the patient incurs in neglecting such a necessary precaution.”

Mr. Hodgson, one of the two medical officers appointed by the Government on the Board of Health at Birmingham, states that in consequence of his connection with the Cholera Board, he paid great attention at the time to all the circumstances connected with the disease; that—

“The disease raged very much at Bilston, and went on to a frightful extent, till the Government sent down to Bilston Dr. McCann, who had seen a good deal of the cholera in India, and I believe, in Persia. When Dr. McCann came to Bilston, he formed a cholera dispensary, or dispensary for bowel complaints, and drew attention very strongly to the importance of attending to the premonitory condition. He told me, and almost everybody whom I have talked with who knows anything about the subject, confirms it, that they never knew an instance of any person who had the second stage, who had not the premonitory stage, perhaps only to a slight degree. I remember hearing of some ladies being attacked who were out at a party one evening, one of whom was dead the next day: but even in those instances, if you could learn the particulars, you would find, I believe, that there has been the premonitory stage of diarrhœa to a greater or less extent.”

This witness being further asked—“Even though there were only one or two motions in the day, you would regard one additional motion as a premonitory symptom,” answers:—

“Any deviation from the usual healthy action of the bowels on the side of diarrhœa, I should regard as the early stage, as it were the blossom of the disease.

“So that if a person was accustomed to have only one evacuation in the day, in a solid form, and that were changed into a loose state, you would still regard that as a premonitory symptom?—I should.

“Whilst you were watching the cholera in Birmingham, did Dr. McCann’s recommendations come to your knowledge?—We were acquainted with what was going on at Bilston, but it was after it was all over that I saw Dr. McCann, and conversed with him upon the subject. I have always felt since that time that so far as my knowledge of the matter went, that if cholera ever threatened this country again, it would be a very manageable disorder, provided Dr. McCann’s ideas were fully explained and acted upon, namely, that cholera consisted of two parts—the premonitory condition, and the condition of collapse, and that if you catch the disease in the premonitory condition you may stop it at once, but that when it comes to the other condition there is great danger.

“Dr. McCann’s proceedings, I verily believe, furnish a key to the management of this terrible malady. I ascribe to Dr. McCann the merit not of having first said that there is a premonitory stage, and pointing out that part of the history of the disease, but of having insisted upon, and of having drawn particular attention to this point, namely, that there is a stage at which you may stop the disease at once and readily, but if it gets into the other stage, there is no known treatment upon which any reliance can be placed. I conversed with nearly all the medical gentlemen, who went to Bilston to attend the cholera patients there, and also with many medical friends residing in the neighbourhood of Bilston, where cholera prevailed, particularly at Wolverhampton, where cholera was fatal in 193 cases, and they unanimously agree in opinion as to the importance and efficiency of Dr. McCann’s views and proceedings.”

With regard, therefore, to the means of prevention to be taken by individuals against an attack of cholera, should this pestilence again return, the first and essential precaution is instantly to stop looseness of the bowels. The means of accomplishing this are simple, if the proper remedies are employed immediately the looseness comes on; and the proper remedies are aromatic, opiate, and astringent medicines; twenty grains of the opiate confection, for example, taken in peppermint-water, weak brandy and water, or the common chalk mixture, and repeated every hour until the relaxation of the bowels ceases. By this simple remedy, if employed in this early stage, the evidence adduced justifies the expectation that the progress may generally be arrested of a malady which, if allowed to advance unchecked to its second stage, is the most fatal and intractable disease known; in the treatment of which the most opposite modes of practice—the most powerful and the most inert remedies—bleeding, brandy, opium, calomel, ammonia, quinine, croton-oil, cold water, the warm bath, the cold affusion, all varieties and contrarieties of treatment possible, have been employed alike in vain.

During the seven days which immediately *preceded* the opening of the dispensary at Bilston, by Dr. McCann, for the treatment of bowel complaints, 309 deaths from cholera were

recorded; during the seven days which immediately *followed* the opening of that dispensary, and in consequence of the prompt attention that had been paid during that time to the very commencement of the first stage of the disease, the deaths fell to 139; that is, the mortality was diminished more than one half in a single week; and from that period the prevalence of the disease continued rapidly to lessen, and the pestilence was totally and finally extirpated in the space of twenty-three days from the first adoption of this plan.

“Wherever,” says Mr. Nicholas McCann, “I was called in early enough to take advantages of the premonitory symptoms, I usually found Dr. McCann’s treatment successful, never once losing a patient. Where only a slight looseness of the bowels existed, with or without pain, he gave at once a small dose of calomel, with rather a large one of opium; if the dejections continued, he administered the chalk mixture, combined with aromatic confection, ammonia, and tincture of bark; if the contrary effect were produced, namely, constipation, small doses of castor-oil were prescribed to regulate the bowels. An embrocation of heated turpentine and laudanum was at the same time rubbed over the chest and abdomen, as a counter-irritant and sedative.

“In carrying out my friend’s views and his mode of treatment,” continues Mr. McCann, “I made a division of cholera into two stages: namely, the premonitory and the collapse, for, unfortunately, but a short period elapses between the one and the other, particularly if the former be neglected, which, he said, was always to be known by the sensation of griping or uneasiness in the bowels, accompanied sometimes with one or more evacuations than ordinary.

“I, consequently, taking advantage of his experience, subdivided the two stages, which led me to the following conclusions respecting the premonitory symptoms of cholera:—

“1. That the appearance of true choleric symptoms (vomiting and purging of fluids, neither feculent nor bilious, with cramps and great debility) was preceded, in the majority of cases which have occurred, by a marked relaxation of the bowels, that is by frequent fluid dejections, constituting the complaint denominated simple diarrhoea.

“2. That this diarrhoea, in a great many cases, presented for a time no peculiar character, so that no medical man could conceive, when called early to a patient labouring under it, whether an attack of cholera was impending or not.

“3. That in other cases the evacuations were, from an early period more like those which take place in cholera than in diarrhoea (more fluid, whiter and less feculent), and that this character was assumed, more or less, in many cases before the invasion of the usual choleric symptoms.

“4. That cases of premonitory disease have been met with and successfully treated by the ordinary remedies such as I have before described.

“5. It would appear that in England an attack of cholera has, generally speaking, been preceded by a relaxed state of the bowels, and that the dejections connected therewith have, sooner or later, presented to the medical observer some indications of the danger to which the patient was exposed.

“6. On this account an early attention to bowel complaints of all kinds must, as a measure of precaution, be of the greatest importance to persons located in districts which are infected.”

“I have now by me,” says Mr. Hodgson of Birmingham, “some of the packets of medicines which were given gratuitously to the poor, and at a small cost to others. Various stations were appointed in the town from which these packets were distributed. Each packet contained three boluses, and each bolus consisted of 20 grains of opiate confection. The patient was directed to take one bolus every hour in a little warm water, or weak brandy and water, until the relaxation of the bowels ceased. Also in each packet there was a small bottle of strong sal volatile, of which a tea-spoonful was to be taken in warm water, frequently, if the patient was cold, faint, or exhausted. Printed directions, as to the use of these remedies and other matters, were enclosed in the packets, and the patients were strongly urged to apply immediately for medical advice.”

We deem the above to be the most promising evidence, regarding the successful treatment of cholera, of any that we have received; and we therefore present it at the earliest opportunity. In addition to medical treatment, the presence of the premonitory symptom would of course suggest to the intelligent practitioner the necessity of enjoining an immediate adherence to a strict regimen; together with warm clothing, the avoidance of cold and damp, and the adoption of every means likely to maintain the health and strength in the greatest vigour.

The following case, the exemplar of thousands and tens of thousands, affords a clear and striking illustration of the mode in which an attack of diarrhœa commonly comes on during the prevalence of cholera, and shows in a manner likely to make an impression upon the mind, the extreme danger, under such circumstances, of delaying even for a short time the use of the proper remedies:—

“I must call the attention of my readers,” says the Rev. W. Leigh, of Bilston, “to the death of Thomas Lee, a miner, aged 39, a poor but very industrious man. On the morning of Monday he found himself unwell from a relaxation in his bowels and went to the Hospital for advice. The surgeon in charge gave him medicine, with a direction to take it immediately. Having a large family of children to support by his daily labour, and suffering no pain, he said to his wife on his return, ‘The doctor has given me some physic, but I won’t take it till Sunday—I can’t spare the time.’ She endeavoured to persuade him to do as he had been ordered but in vain. He continued to go to his work as usual with the bowel complaint upon him, but still without pain. On the Thursday evening, four days from the first attack, he came home for the last time: on the Friday he was seized with cramps and vomiting, and on the Saturday he was buried. I wish this unfortunate case could be known far and wide—it shows so clearly the extreme importance of checking the disease in the beginning. Had not the bowel complaint been neglected, in all human probability the man’s life would have been saved: and the lives of very many more under the same lamentable circumstances. The poor (the error is not confined to the

poor) are apt to estimate the amount of danger by the amount of pain, and so long as pain is absent, they consider themselves safe. This fatal mode of reasoning was too evident at Bilston, and I cannot help attributing the excess of deaths among the lower classes to this rather than their poverty, or habits of living. The difficulty of impressing this truth upon the minds of the poor was not removed till a Dispensary had been opened, where they might apply for instant relief free of all cost, in case of any relaxation in the bowels."

"Suppose I were in charge of the health of a town," says Mr. Hodgson, "and the question was asked me, 'Here is cholera in this town, what shall we do?' The course I would adopt would be this; I would stick up notices about the town to this effect—'Let every body who has relaxed bowels, or who has had more than one motion in a day, call at the dispensary;' then, when they called, I would advise them to avoid the use of fruits and vegetables, and to attend to the general state of their health, and I would give them aromatic opiates, and in that way I believe we should stop the disease."

Dr. McCann himself says:—

"I neither recommend nor countenance, anywhere, the establishment of *Hospitals* for the treatment of bowel complaints, but Dispensaries simply, that is to say stations, where the poor labouring under such complaints may receive without delay, or trouble, or expense, proper advice and treatment and medicines for the same; and by the word proper, I here mean advice and treatment under the eye of a qualified medical practitioner: for the indiscriminate administration of drugs by ignorant and unprofessional men I hold to be absurd and injurious at all times, and more especially so in times like the present, when the life of every man whose bowels are unduly relaxed *hangs as it were by a thread* wherever cholera prevails. Nor can any difficulty exist with respect to medical aid, for the country is full of well-educated professional men, ready and willing to devote themselves to any duties, however hazardous or laborious, if they be properly treated. Establish, therefore, and open without delay, a public dispensary; engage medical men, and treat them liberally, but see that they do their duty; and if any difficulties should arise relative to organization and arrangement, an application to the Central Board of Health will, doubtless, procure for you any assistance necessary to remove them."

In the advice thus given by this distinguished physician to the Chairman of a Local Board of Health, which had been established under the immediate apprehension that cholera was about to invade the district in question, we entirely concur.

Under the circumstances in which the nations of Europe are again placed, with the advance made by cholera on its former track, and with the extraordinary prevalence in this country of the very diseases, namely diarrhoea and influenza, which, in 1832, preceded, in so remarkable a manner, the general outbreak of this pestilence, it appears to us to be highly important that these views and proceedings should be extensively promulgated, and that they should engage in a special manner the attention of medical men.

Founded on the evidence which we have here adduced, we have to add to our former representations the further recommendation that preparation be made for the establishment of dispensaries at convenient stations, at which, should cholera anywhere break out, the neighbouring inhabitants may immediately apply for the proper remedies and advice when attacked with bowel complaints; that properly qualified medical men be appointed to such dispensaries, to give assistance night and day to whoever may apply; and that proclamation be made in every town, in which cholera may be actually present, of the places where such dispensaries are situated, and of the names of the medical men appointed to attend them.

From returns to inquiries which we addressed to the medical officers of the metropolitan Unions, with a view to ascertain the present state of disease in their several districts, and particularly among that portion of the population in which cholera chiefly prevailed at its last visitation, we learn that diarrhœa, in some localities, is, at the present time, co-extensive with typhus, and that in a few it even predominates. It must be borne in mind that the impure atmosphere which so powerfully predisposes to cholera, when that disease is epidemic, predisposes to diarrhœa, whether cholera be epidemic or not; that diarrhœa is the constant precursor of typhus, as it was in 1832 of cholera; that diarrhœa and typhus frequently pass into each other, and that diarrhœa, like typhus, is never absent from certain undrained and filthy localities, where it divides the reign with typhus, and produces the like mortality. It was observed by Sydenham, who has left a record of the epidemics that prevailed in London in the middle of the 17th century for a successive period of 16 years, including the time immediately before and after the great plague of London, that a prevalent epidemic destroys in a great degree all other diseases, by assimilating them to its own nature; and that in accordance with this law a remarkable change was noticed in the character of fevers and other epidemics before the outbreak of the plague; the type of disease in general approximating in several striking features to the distinguishing characteristics of the pestilence at hand, some time before that dreadful malady assumed, which it did suddenly, its distinct and proper shape. The same observation was made and recorded by one of the physicians of the London Fever Hospital six months before the first visitation of cholera; during which period of six months the type of fever so entirely changed, that typhus, which for a long time previously had been essentially an inflammatory disease, became a disease of debility, so closely resembling cholera, that the fever into which cholera patients commonly fell when that disease did not prove rapidly mortal, could not be distinguished from the idiopathic or primary fever found in the wards of the Fever Hospital when cholera was at its height,

which had appeared there for the first time six months before, but which has never disappeared since.

It is remarkable that a similar observation has been made by the professors of veterinary medicine and surgery as to an analogous change, namely, a change from an inflammatory type to one of debility, which has taken place within the same period of time in the general character of the diseases of all classes of domestic animals; that this is particularly the case with regard to all the diseases properly considered epidemic to which these animals are subject; and that this change is so complete that it has been found absolutely necessary to alter the entire system of treatment, and instead of using bleeding and other means of depletion, suited to diseases of an inflammatory type, to employ remedies of a sustaining and stimulant character, suited to diseases in which the powers of life are depressed and feeble: precisely the change that has taken place in the wards of the London Fever Hospital.

It is this assimilating power of a predominant epidemic that renders the present prevalence of diarrhœa a subject of apprehension; because though in the absence of Asiatic cholera, diarrhœa like typhus is a distinct species of disease, it is very readily converted into cholera on account of its close resemblance to that malady; the organ first and prominently affected being the same in both diseases; the kind of affection in both being similar, and the extension and intensity of both being clearly and greatly increased by the same local sanitary conditions. A remarkable increase in the general prevalence of diarrhœa, under circumstances which threaten the re-appearance of Asiatic cholera, may, therefore, be justly regarded both as prophetic of its actual and, perhaps, near approach, and as a predisposing condition highly favourable to its rapid extension if it should come.

That some conception may be formed of the actual extent of the prevalence of diarrhœa at the present time in certain localities of the metropolis, we cite the following statements, rather as an example than as a full account of the answers returned to our inquiries by the medical officers of the metropolitan Unions, these statements referring to the amount of disease among the pauper population only. From the Lambeth return it appears that there have occurred in this district within the last six months, chiefly in seven short courts and alleys, 638 cases of diarrhœa, together with 77 cases of typhus and 72 of scarlet fever. In one district in the parish of St. George the Martyr Southwark, there are reported 113 cases of diarrhœa and 187 of typhus; in another district 51 of diarrhœa and 91 of typhus; and in a single street 20 cases of diarrhœa, 11 of typhus, and 3 of scarlet fever. In Bermondsey, in 12 streets, with an average of 18 houses in each, there were 120 cases of typhus; and in another part of the same district, 50 of typhus to 18 of diarrhœa. In Deptford there were 48 cases of diarrhœa, with 30 in addition, that passed into

English cholera, together with 186 of typhus and 88 of scarlet fever. In Whitechapel Union, in 10 streets, of about 17 houses in each on an average, there were 642 cases of typhus to 126 of diarrhœa. In Christchurch Shoreditch, there were 426 cases of diarrhœa, many of which passed into typhus, the amount of typhus and scarlet fever together being 722. In Holywell, Long-alley, and its neighbourhood, there were, of diarrhœa, 210; of typhus, 259; and of scarlet fever, 30 cases.

In the suburban and less crowded districts it is stated—that, in certain spots in Wandsworth, diarrhœa constantly prevails, together with typhus; and that in those places the same persons have been repeatedly attacked in the course of the last six months. In the pleasant village of Hampstead, where such an amount of disease could hardly have been expected, there occurred 78 cases of diarrhœa and 58 of typhus; and of these, 18 of diarrhœa and 34 of typhus took place in one street of only 26 houses. In the Hackney Union there were 269 cases of diarrhœa to 66 of typhus; in West Hackney, 44 of diarrhœa to 3 of typhus; and in Tottenham, 62 of diarrhœa to 12 of typhus.

As a specimen of the present sanitary condition of these districts we quote from the returns the following statements:—In Lambeth there are numerous open ditches of the most horrible description; and in general the cleansing, paving, and water supply, and consequently the internal cleanliness, is either totally wanting, or grievously defective. The whole district of Bermondsey is reported to be intersected by open ditches of the most offensive character, and abounding in several parts with “fever nests.”

The streets of St. Olave and St. Thomas are stated by the medical officer to be “a disgrace to the civilized world.” Deptford is described as “perhaps the worst regulated town in the empire in a sanitary point of view.” In the streets of the Whitechapel Union, where disease has been so prevalent and mortal, there is neither sewerage, drainage, cleansing, paving, nor a good supply of water. In Wandsworth there is no drainage, and the cesspools and privies are constantly overflowing. In Hampstead the sewerage and drainage are lamentably defective, and there is only a single street of those where the cases above cited occurred that is well supplied with water. The characteristics of the streets of Hackney are stated to be the presence of overflowing cesspools and privies, cow-yards, and piggeries, with a loathsome ditch, which has been causing disease for 20 years.

In this recital we distinguish the familiar names of the places in which it is now notorious that cholera first and principally prevailed. In one part of the Lambeth district, for instance, in which 291 cases of diarrhœa and 58 of fever are reported in the last six months, that is, in 183 days; in 1832 there were 336 cases of diarrhœa and 132 of Asiatic cholera, in 599 days; which makes the amount of disease in 1847 about double that in 1832. The

diarrhœa and typhus now ravaging Bermondsey are prevailing chiefly in 14 streets, several of which adjoin a most offensive mill-stream, the receptacle of every kind of filth, the very spot in which Asiatic cholera first broke out in 1832, and in the immediate neighbourhood of which several hundred cases of this disease occurred. In the Whitechapel Union, already alluded to for its present enormous amount of typhus, there were in 1832, in those very places, 140 cases of Asiatic cholera, one-half being fatal. In Islington, which yielded in the last six months, chiefly in a set of most abominable courts, 67 cases of diarrhœa and English cholera, in 1832 yielded 272 cases of diarrhœa and Asiatic cholera.

The returns uniformly state that in the great majority of these districts little or no improvement has taken place since 1832. In Lambeth the whole amount of improvement in 14 years is the drainage of four streets, and a considerable extension of paving. In Bermondsey there has been scarcely any improvement, and in the worst parts of it none whatever. In a few portions of the Whitechapel Union some additional sewers and drains have been made; but the great majority of its confined and crowded streets, courts, and alleys remain without air, water, or any arrangements for the removal of its accumulated filth. Wandsworth and numerous other places remain without a single sewer, and the general result of our inquiry is that the improvements reported since 1832 have not been even commensurate with the increase of building and population, so that in the present sanitary condition of the metropolitan districts, not only is there no reasonable ground to suppose that were cholera to re-appear in them it would be less extensive and mortal than on its former visitation, but on the contrary, as the density of the population is in many parts increased, there must be a proportionate increase in the density of the deleterious agencies in operation.

Instances, however, are recorded in which improvements have been effected, in general with decided and striking benefit. The reports present such statements as the following:—In the Holywell and Long Alley district, with 500 recorded cases of diarrhœa and typhus, within the last six months, in one particular place, namely, Long Alley, which is a long, narrow, and close passage, crowded with inhabitants, the drainage, contrary to the general rule, has been put in good order, and this place has remained exempt from disease. Two courts in Whitechapel, that were in an exceedingly damp and filthy condition, and in which fever had prevailed for some time in every house, ceased to be affected with disease on being drained. In Dulwich, fever was arrested by cleaning out drains. In Hammersmith, diarrhœa disappeared in one street after the emptying of a cesspool that had overflowed, a new drain having been built at the same time. In the Acton district, no fever is reported, and only two cases of diarrhœa, the external and internal cleansing having been well attended to. In

St. George's Hanover-square, the cholera of 1832 prevailed in 19 streets; of these two were mews; in 12 the sewerage and drainage were bad, but now these are bad only in four; cleansing, which was then bad in seven, is now good in all; paving is now good in all, the water supply having been good then as it is now. In 1847 there were but three cases of typhus in three streets, and 16 of diarrhœa in six streets where the house drainage is still bad. The whole case of this parish is an example to prove that if drainage and cleansing were properly attended to, the diseases in question would in all likelihood never be heard of.

Meanwhile, the influence of the contaminated atmosphere, arising from the want of proper arrangements for cleansing, is shown in a striking manner by the great mortality during the last year of medical men, clergymen, and relieving officers, both in the metropolis and in many provincial towns, who have fallen victims to typhus and diarrhœa, though breathing but for a comparatively short period this poisoned air. Medical men and clergymen, who, in the discharge of their arduous duties, are obliged to live in such districts in the metropolis, have represented to us, in forcible language, the pernicious influence of this atmosphere upon themselves and their families; some of them stating, that the feeling of health is wholly unknown to them, and that their wives and children suffer so much from the effects of vitiated air, that the attendance of the physician is constantly necessary, and that a residence in the country during some portions of the year is indispensable. Mr. Garwood, the Secretary of the City Mission, thus describes the effect of this atmosphere, even in ordinary times and seasons, upon the working members of this Society—a select body of men, not permitted to enter on their office without a previous medical examination as to the soundness of their health:—“Through the neglect,” he says, “of attention to the sanitary condition of the poor districts, our Society are very great losers, by means of the constant loss of service which they sustain, in the failure of the health of their missionaries. Although we admit none except between the ages of 23 and 45, and after careful examination by medical men, and although as soon as they are at all ill, they are allowed to lay by, have the best medical attention gratuitously afforded to them by the Society, and receive the privilege of going into the country to houses provided for the purpose, and although further, they have a fortnight's holiday every year, even if well, and are allowed not to reside in the very close parts, yet with all these advantages, and although they have many of them previously been born and bred in poor districts, and accustomed to hard and trying labour, a considerable number of them are continually laid aside, and very many who promised best have to give up altogether in a few years. Indeed, I may say, very few of our missionaries, with all these advantages, can stand many years' work on the really bad districts of London,

although 36 hours visiting each week is all which is required of them. I consider that we sustain as much loss of life and health in prosecuting missionary work in London as those Societies do the object of which is to send missionaries to foreign parts, many of which are notoriously unhealthy. And I cannot but consider that this is a reproach to the metropolis of our country. There are some districts, respecting which we almost feel sometimes a question, whether we ought to expose the health and life of men, by placing them on them; and there are other districts on which missionary after missionary has broken down, when located there, while even in a large number of our districts, the energy, strength, and vigour of our missionaries become impaired by their constant exposure to impure air."

We are informed that the experience of the district visitors of other charitable associations, of the effects of regular daily, or often repeated visits within the same districts, is similar to that above described.

If these are the effects of such an atmosphere on men who were previously in sound health, who are well fed, temperate in their habits, and who do not reside in the worst part of these districts, can we wonder at the statement which they have made to us in other communications—a statement which embodies the result of their large and intimate observation and experience of the classes for whose improvement they labour, that, "while the poor are permitted so to live, decency, modesty, and religion, are no less set at defiance, than health, economy, and comfort."

In our First Report, we endeavoured to guard ourselves against giving countenance to the impression, that however completely any principles of amendment recommended by our predecessors, or by ourselves, might be adopted, the execution of combined measures for their application could be any other than a work of careful labour and time. The immediate adoption, however, of any available provisional measures, though it may be short of what is desirable, can scarcely fail to be of advantage for the interval.

We have received much testimony, that the inspection of the dwellings of the labouring classes during the former prevalence of cholera, and the means of cleansing which were then afforded, were attended with great benefit; and these representations have been accompanied by expressions of regret, that such inspections and exertions should have ceased as soon as the epidemic had passed away.

The report of the medical inspectors as to the extent and nature of the accommodation for destitute cholera patients available in the Union hospitals, shows that it is far less than we had reason to expect in those establishments; and the special accommodation yet to be looked for, greater; in providing which, the District Boards of Health might lend important aid.

The District Committees already formed, suggested by the pastoral letter of the Bishop of London, are likely, in the present state of sickness and suffering in the depressed districts, to be attended with highly beneficial results; but the members of these Committees, earnest to accomplish their benevolent objects, apply for the needful counsel and direction; for authority to take immediate measures, and to defray necessary expenses.

We therefore feel it to be our duty to express a decided opinion, that the present state of the health of the country renders it desirable that the powers vested in the Privy Council by the Cholera Prevention Act be revived and put into operation; and that local Boards of Health be constituted, and authorised to carry into effect all practicable measures of external and internal cleansing; to promote the more effectual execution of the law in respect to the removal of nuisances dangerous to health, and to diffuse information among the people as to the importance, should cholera return, of paying immediate attention to the premonitory diarrhœa, as to the proper medicine and the right mode of living to check this the first stage of the disease, and as to the food, drink, and clothing, calculated to put and keep the system in the best health and strength. These measures would be desirable, even if there were no grounds to apprehend the return of cholera: the prevalent epidemics having for some months past produced, and still continuing to produce, a rate of mortality, such as has never before, or at least never in recent times, and so far as we have any record, been experienced in the metropolis; but the steady advance of cholera in Europe, the rise and extraordinary spread of diarrhœa since the date of our First Report, and the unexampled prevalence and mortality of fever, of the same type as that which preceded the first outbreak of cholera, appear to us to be decisive reasons why this measure of precaution and prevention should be no longer delayed.

In reference to measures of alleviation and prevention, we have received evidence as to the effects of solutions of the chloride of zinc, of the nitrate of lead, and other substances, intended to decompose noxious gases. The evidence on this subject will be found to be of scientific interest, though it is to some extent conflicting, and the conclusions undetermined. Dr. Lyon Playfair, Professor Graham, Professor Hoffman, and Mr. Cooper, concur in attributing disinfectant properties to chlorine and certain acid gases, in the case of typhoid fevers, but not in cholera; but they deny to nitrate of lead and other so-called disinfectant salts or any similar substances, the possession of qualities to effect more than to deodorize decomposing animal or vegetable substances. Dr. Lyon Playfair affirms, with respect to chlorine, that he has had abundant proofs of its power of diminishing and mitigating infection in the case of typhoid fever: it destroys all decaying emana-

tions. Dr. Leeson and Mr. Grainger, on the other hand, consider that the disinfectant salts have more powerful and more valuable properties for decomposing the noxious gases. One of our colleagues also has used the nitrate of lead extensively in the London Fever Hospital, during the late extraordinary prevalence of fever, and from his observation of its effects, he is of opinion that it has apparently assisted in maintaining the purity of the air; so that, as compared with recent years, the convalescence of the patients has advanced more steadily and with fewer relapses; there has been less sickness among the nurses and the official residents; and erysipelas, a disease which is very apt to spread through a hospital when the air is impure, and which, therefore, affords a good test of its comparative purity, has not extended in a single instance, though several patients have been admitted with this malady upon them. Mr. Sankey, the resident medical officer of the hospital is also of opinion that the use of this fluid has contributed to the maintenance of the purity of the air of the wards. Dr. Leeson, who adopts the same views, and believes that the nitrate of lead affords an auxiliary not to be neglected, though in common with every one who is competent to form an opinion on the subject, he thinks its use should not diminish the strictest attention to ventilation and cleanliness, was asked:—

“Practically, if you, *pro tanto*, diminish the impurity of the air, or increase its purity, which are convertible terms, by suppressing the smell in a hospital, ought you not to see the effect of that in the increased rate of convalescence of the inmates, or in some other way, distinctly marked upon the patients? I think we do so. Our present practice, contrary to that of former years, is to place our typhoid cases indiscriminately among the other patients, and we then depend upon good ventilation for the protection of the other patients. We introduce so much pure air into the wards that we largely dilute, and thus pass off those noxious exhalations, whatever they may be, which, in the close-crowded chamber, would, no doubt, have been the occasion of spreading the disease. We found that when we concentrated the patients in one ward, the air was rendered so impure that it spread the disease, and that it was more fatal than when we disseminated the cases among the other patients. Now, we very seldom find it spread; and our mortality, as compared with former years, is very much diminished.

“That is by dilution with the external or with purer air?—Exactly, and by increased ventilation, constantly removing the vitiated atmosphere.

“And increased ventilation alone?—Yes.

“Would you say that, by increased ventilation, you put an end to the smell by extending the dilution by pure air?—In a great measure.

“And you trust to that alone?—I believe myself that is the most effectual method that can be adopted.

“If you could not have ventilation, do you believe that if you introduced some so called disinfectant substance which your medical and chemical knowledge has placed within your reach, you would produce the

same effect as is now produced by fresh air?—We should not produce the same effect but only purify the air to a certain extent; because I have already stated my belief, that what vitiates the atmosphere is not one gas only, but a combination of several gases. I think it is difficult at the present moment to say what may be due to particular gases, and what may be the result of all the gases which are the products of putrefaction; but to the extent that you remove any of those deleterious gases, for instance, in the removal of sulphuretted hydrogen and hydro-sulphate of ammonia, you would remove two of the most deleterious gases, and in my opinion, to that extent you would decidedly purify the air, and compensate in some measure for the deficiency of ventilation.

“Have you made the experiment of using nitrate of lead, or any other substance, for that purpose; and marked the consequence on the health of the patients, as improving them to the extent to which you succeeded in subduing the sulphuretted hydrogen?—We have such excellent ventilation in our hospital (St. Thomas’s), and we have paid so much attention to the ventilation, that we have not thought it necessary to have recourse to any of those disinfectant fluids; therefore, I cannot speak to that.”

As to nitrate of lead, the result of Dr. Leeson’s experiments was that it decomposed sulphuretted hydrogen gas, but had no effect on phosphoretted hydrogen gas, which is admitted to be injurious to health.

The following questions were put to Mr. Grainger:—

“But even if these substances were ten times more efficacious than you have any experience of, you would not, on that account, be less scrupulous in removing all filth and excrementitious matters as quickly and completely as possible?—Certainly not. It is most important that every kind of filth, and every description of decomposing matter should be removed, because as decomposition is continually going on, unless the decomposing agents which are to check it are continually applied, there will be the same mischief continually renewed.

“You say that you would remove from the neighbourhood of dwellings all decomposing substances. Now, destroying smell as you do by this agent, according to your reasoning you destroy the poisonous gas. Then why should you remove all decomposing substances?—I think there appear to be various obvious reasons:—First of all, the difficulty of insuring the immediate application of the correcting agent. Secondly, that if the decomposing matter is in any considerable bulk, unless care is taken on the part of the person who applies the liquid, and that he applies a sufficient quantity, the remaining portion of matter not affected by the liquid will still undergo decomposition.

“But where the bulk of the fæces is not very considerable, if care is taken by the use of the liquid to extinguish the smell, why should the fæces be removed in a hospital for instance?—In answer to that, I should first of all repeat what I have already said. And secondly, that in the report upon M. Ledoyen’s fluid it is not stated that every smell, or that every gas connected with feculent and decomposing matter, is removed. And until we know what is the efficient cause of fever, no pathologist can undertake to say, but that certain gases that still remain, or certain subtle matters which remain, may, although perfectly ino-

dorous and although inappreciable by the senses, be either the efficient cause of fever or a cause of its spreading."

These answers appear to us to indicate correctly the present state of practical information with relation to these fluids. Besides their known uses in hospitals, for external applications, as goulard for example, some of them have been used with decided advantage for deodorizing, and rendering the feculent matter of cess-pools inoffensive at the time of its removal.

We have directed our attention to the circumstances connected with the late extraordinary increase of mortality among all classes of the population, but particularly among the poor residing in the more unhealthy districts. The country in general, and the metropolis in particular, have been visited by two epidemics which have rendered the mortality of the last quarter of the year 1847, higher than that of any quarter of any year since the new system of registration commenced. Typhus fever, which began to prevail epidemically in April, successively increased in the summer and autumnal months, and during several weeks produced four-fold its ordinary mortality; and its ravages still continue with little abatement. Towards the latter end of November influenza broke out, and spread suddenly to such an extent, that it is estimated that within five or six weeks, it attacked in London no less than 500,000 out of 2,100,000 persons. Altogether the excess of mortality in 1847 over the mortality of 1845, is 49,000; and in the metropolis there were within 11 weeks, 6145 deaths above the ordinary number: an excess greater than the entire mortality produced by cholera in the 21 weeks during which it prevailed in the year 1832.

From returns which enable us to ascertain the comparative degree in which the several districts have suffered from the visitation of disease, we find that the cholera districts, the typhus districts, and the influenza districts are the same, and that the local conditions which favour the spread and increase the intensity of these and all kindred maladies are everywhere similar. The proof of this is found in the fact, that in the districts in which we have already shown that cholera principally prevailed, and from which typhus is rarely if ever absent, influenza was twice, and in some instances four times as fatal, as in the more salubrious parts of London.

We have already shown the influence of humidity and fog in favouring the transmission and spread of cholera. From a careful comparison of the facts connected with the prevalence and intensity of influenza, it appears that there is the like connexion between this disease and similar atmospheric conditions, and the consideration of those conditions assumes greater interest when it is borne in mind, that, from remote ages, influenza has preceded and accompanied the great and mortal epidemics which have devastated

this country at distant periods. There is reason to believe that it preceded the plague of the Black Death in the fourteenth century; it is certain that it preceded the Great Plague of London; for Sydenham states, "that it committed great slaughter at the end of March, 1665;" the winter having been exceedingly cold, with a dry frost, which lasted till spring, when a sudden thaw took place in March, probably with the evolution of much moisture. It followed the epidemic typhus of London in 1803, and preceded it in 1837. It preceded the breaking out of cholera in the Polish armies in 1831; it was epidemic in London from May till July in 1831, under very hot and damp weather, cholera breaking out in Sunderland in October; and it accompanied cholera, raging with considerable violence through the following year.

The result of our investigations is in accordance with that presented by the history of epidemic influenza, wherever an authentic account of its progress has been recorded, namely, that its spread is intimately connected with an unusual degree of humidity, combined with sudden and great alternations of temperature.

The historical accounts of influenza uniformly agree with recent observations in connecting it with an unusual prevalence of moisture and fog:—

"Short says, that thick 'ill-smelling fogs preceded some days the epidemic catarrh of 1567.' In reference to that of 1580, it is stated that 'after a long continuance of hot moist weather, attended with southerly winds, at the rising of the dog-star came a cold, dry, north wind; and from the middle of August to the end of September raged the malignant epidemic catarrh.'" "Sydenham attests, 'that the epidemic catarrh of autumn 1675, immediately succeeded cold and moist weather, which suddenly followed an unusually warm summer.'" "De Jussieu says, that 'the influenza of spring 1733, appeared in France immediately after offensive fogs, more dense than the darkness of Egypt.'" "Huxham remarks generally that 'the cause of epidemic catarrh seems to depend on a thick, moist, cold air.'" "Dr. Hamilton tells us, with regard to the influenza of spring 1782, that 'from the first of January till the end of May, throughout most places in the kingdom, the weather was uncommonly unfavourable, and the latter month was remarkable in all the meteorological annals of Europe for its unusual degree of cold and humidity, with a gloomy and uncommonly disturbed state of the atmosphere.'" "The influenza of spring 1803, was supposed to be owing to a cold and humid autumn succeeding a dry and hot summer." With regard to the weather that preceded and accompanied the influenza of 1831, "an intelligent captain of a regular trader in the English channel declared, that for thirty years past he had no recollection of such a long continuance of a thick and foggy atmosphere, as he has had occasion to observe within the last eighteen months, between this country and the south of Ireland. He went so far as to

state, that he had scarcely made one clear passage to Liverpool and back again during this whole period."

On referring to the weekly returns of the mortality in the metropolis for the months of November and December, we find that the first great increase of deaths from influenza and diseases of the respiratory organs, occurred in the week beginning with the 21st of November; the total number for that week being 670, while the number for the week preceding was 297. It appears further, from the improved meteorological registers, which the Registrar-General has presented, in connection with the mortality returns, that on the second day before the commencement of the fatal week, namely, on Friday, the 19th of November, the average temperature was 23° below what it had been four days before, a difference nearly as great as that between the mean temperature of winter and summer. On Saturday the 20th, the thermometer was still very low, and there was a dense fog the whole day; and from this time to the end of the month, although the temperature rose considerably, the air continued to be charged with an excess of moisture, in the shape of thick heavy mists, with very frequent falls of rain. It is therefore probable that the sudden fall of temperature and the extreme humidity of the atmosphere, were intimately connected with the extraordinary mortality of the period.

From returns that have been received from the Metropolitan Police Force, which state the number of seizures among the men employed in the force, for each day from the 1st of November to the 18th of December, it appears in like manner, that the period of greatest severity occurred between the 18th of November and the 4th of December. During the first 17 days of November, on an average, 12 were taken ill each day. On the 17 days following (Nov. 18th to Dec. 4th) 598 were seized, which make a daily average of 35. For the 14 days succeeding, the daily average was 17. In the course of the middle period (Nov. 18th to Dec. 4th), every eighth man on the force was laid up. It does not appear that there was an extraordinary degree of malignity on any one day, or that the epidemic had the character of an instantaneous shock, for while the average of the 17 days of extreme severity, was 35, the greatest number on any one day was 48, this number happening twice, namely, on the 25th and on the 30th of November; but although these two days would seem to have been very oppressive from the moist condition of the atmosphere, they were not, in any notable respect, the worst days of the period.

It thus appears that the sudden diminution of the temperature, with the incessant evolution of mist, was the chief antecedent of the epidemic; but that the effect was aggravated, by the humidity that oppressed the atmosphere for a fortnight afterwards, many who escaped unhurt from the first blow falling under the continued pressure, especially such as were not strong, or were subject to more than ordinary exposure to the naked air, or had to encounter it under a state of accidental depression.

The conclusion that the extraordinary prevalence of influenza is closely connected with a sudden change of temperature combined with an excess of moisture, is strikingly confirmed by the experience of Edinburgh and Leith. Dr. Stark, in his Report on the Mortality of Edinburgh and Leith during September, October, and November, 1847, writes as follows:—

“Influenza suddenly made its appearance on the 18th of November, and within a fortnight, attacked more than half of the population. It is important to note that this disease suddenly attacked great masses of the population twice during the course of November; *first*, on the 18th, and *again* on the 28th day of the month. In both these cases, the influenza appeared during keen frost, and an excessively damp thick fog, which came on rather suddenly, after a few days of very mild weather.”

Here the sudden and severe cooling of warm air, full of moisture, threw out a large quantity of invisible vapour into palpable fog; and the cold and fog combined struck the population with a blow that took almost instant effect. On the 18th the thermometer fell from 51° to 26°, which would probably convert into fog more than half of the whole vapour of the atmosphere. Air so loaded could not long be breathed with impunity by any human being.

Dr. Stark remarks also that the more sheltered situations suffered less than such as were high and exposed.

The general characteristics of the places where the inhabitants appear to have suffered least from the epidemic, are dryness, warmth, and shelter from the humid atmosphere. Thus we are informed, that in the model lodging-house, Glass-house Yard, where a comfortable temperature and a good ventilation are kept up, there were very few cases indeed. Mr. Bowie, the surgeon says—

“Whilst influenza was stated to me to be prevalent in almost every family, and in almost every house in Glass-house Yard, in the model lodging-house itself, where a comfortable temperature, as well as ventilation, is kept up, we had very few cases indeed. The comparative freedom from influenza was quite as great as the comparative freedom from typhus, which I have before mentioned.”

So the better regulated prisons have, as we are informed, been characterised by marked exemptions. In the Westminster House of Correction, which is in a sheltered situation, and kept at a moderate temperature, only six prisoners out of 700 were affected by the influenza. Mr. Lavies, the medical attendant, attributes the exemption “very much to the excellent drainage, the very great cleanliness, and the thorough ventilation of the building. He also considers that the liberal diet,* which he conceives is required to keep up the stamina of persons exposed to the depressing influences which operate on prisoners, has had a beneficial operation.”

* The cost of this diet it appears, averages 3s. 2d. per head, per week.

In the Pentonville Model Prison, which has a higher exposure, one in every six of the prisoners were attacked; whilst of the warders and other attendants of the prison, who are a stronger and less susceptible class, but who, after performing their services in the prison during the day, sleep outside the walls in common habitations, and are otherwise more exposed to the weather, the number attacked was one in two and a half.

In none of the prisons of the metropolis has a single death occurred from influenza; a circumstance of itself proving that the attacks among the prisoners have been less severe than amongst the general population.

On comparing the mortality from influenza in an aggregate of gravelly districts within a few miles of London with the mortality in an equal amount of population in the clay districts of the suburbs, it is found that the proportion of the former to the latter is as 19 to 47, or nearly as 1 to 3.

The mean age of death amongst the different classes during the period of excessive mortality, accorded with what is known of the different degrees of exposure to the noxious influences. The mean age of young and old in the labouring class that died within the week ending 4th December was—males 20, females 30; of master tradesmen—males 32, females 39; of gentry—males 50, females 52. For the week following, the average ages were, labourers—males 24, females 26; master tradesmen—males 34, females 39; gentry and professional classes—males 55, females 56.

The results of the examination of the comparative mortality between district and district, are in accordance with the conclusions deducible from the other evidence examined.

Looking at the increase of deaths in the five great divisions of the metropolis, which took place in the six weeks following the 20th of November, over the rate of mortality of the week November 13th to 20th, we find that, in proportion to the population, the north districts, including Marylebone, St. Pancras, Islington, Hackney, and Hampstead suffered most of all; that the south districts were nearly as much affected as the north: that is, St. Saviour, St. Olave, Bermondsey, St. George Southwark, Newington, Lambeth, Wandsworth and Clapham, Camberwell, Rotherhithe, Greenwich, Lewisham. Next to these, and considerably more exempt, were the east districts of Shoreditch, Bethnal Green, Whitechapel, St. George in the East, Stepney, Poplar. Still less was the increase of mortality in the crowded central districts; and it was least of all, and comparatively very small in the western districts. Calling this last increase 1, the increase in the central districts was rather more than 2, in the east districts about 3, and in the north and south districts about 4. With regard to deaths from influenza in particular, the divisions stand in nearly the same order; but the differences between them are much smaller. The west has fewest deaths, and the east, central, south, and north divisions follow in succession.

Now if we consider that the ordinary rate of mortality in the north districts is but little above the ordinary rate of the west districts, it is a very remarkable fact, that on the visitation of the influenza the increase in the north should be four times the increase in the west. It is also deserving of consideration why the densest part of the town should be much less severely visited than three of the suburban districts.

The marked prevalence of the epidemic typhus in the suburban districts, which we have already had occasion to notice, as well as of influenza, and the applications that we had received from the inhabitants of several of them, called our attention to the circumstances immediately affecting the condition of these districts.

We find, upon such investigations as we have been enabled to make, that not only their condition, but the condition of the interior of the metropolis itself, is powerfully acted on and depressed by the state of the extensive marshes and ill-drained land in their immediate vicinity. These influences have long been observed by medical practitioners in the suburban districts. Thus Mr. Bowie, whose range of practice has included Poplar and the districts to the east of London, considers the parts of Essex adjoining London, to be healthy in summer; but during winter, the most unhealthy of any places he knows any where near the metropolis. After a rainy period, and during the drying up of the stagnant moisture of the marshes, marsh fever, scarlet fever, and other analogous diseases prevail. The neighbourhood of Wanstead, itself a clean village, inhabited by highly respectable inhabitants, is uniformly unhealthy in the end of autumn, and in the spring. The overflow of the river Roden, which happens to some extent every year after the snow of winter, and after heavy rains in summer, always causes, on the subsidence of the water, an outbreak or an aggravation of marsh diseases. The agricultural labourers of Essex are rarely free from rheumatism. Influenza prevailed extensively there, and does so every year about the same season. On the occurrence of an east wind, there is always an increase of catarrhal and febrile diseases in London, which Mr. Bowie attributes, in a great measure, to the wet and miasma from these marshes. Whenever any disease breaks out towards Dagenham, Wanstead, or the marshy districts, the same disease is sure to occur in the lower parts of London, near the river. The marsh fever is not unfrequent in the squares of Somers'-town, and in the neighbourhood of Tavistock-square, and other places in the hollow of the northern district, which affords free access to the deleterious marsh winds. The eastern side of Blackheath is so invariably afflicted with these winds, that Mr. Bowie cautioned a family against taking up their residence there; and the consequence of their disregarding his advice was repeated attacks of the marsh illness, which at last compelled them to remove to the other side of the hill, where their health became much better. The result of many years' experience has led Mr. Bowie to form

a decided opinion, that the drainage of the marshes to the east of London is, next to the improvement of the sewerage, the most important measure for the improvement of the sanitary condition of the metropolis.

We have been informed that a north wind blowing over the Essex marshes, often produces aguish attacks on the other side of the river. At Greenwich, fogs are reported to be frequent; east winds bring them from the marshes farther down the river, and west or south-west winds bring them from the marsh lands towards Lewisham. At one time ague prevailed in the neighbourhood of the town; not on the marshes and lowlands themselves, but along the brow of the rising grounds above the town.

As happens elsewhere, the inhabitants of these suburban districts appear to suffer more from the vapours of the marshes than the inhabitants of the marsh land itself. The population, dwelling in houses situated between a marsh and a rising ground, are always exposed to a large quantity of fog, when the wind from the marsh blows over them, the obstruction of the high ground serving to retain the vapours, or to make them accumulate over one place.

Throughout the urban districts there is a large amount of decomposition constantly going on, from the action of the air on the filth and impure remains that are allowed to accumulate; and the presence of warmth and moisture promotes the decomposition. An accession of moisture to aid the process visibly arises both from the defective drainage of the town itself, and from the suburban marshes. Moreover, the diseases engendered by decomposition, or produced from other causes, are aggravated by excessive humidity. This effect has been experienced during the period of epidemic influenza. The increase of mortality from the two great classes of diseases, termed zymotic and respiratory, the first including typhus, scarlatina, measles, diarrhœa, remittent fever, ague, influenza, &c., and the second, comprising pneumonia, bronchitis, consumption, &c., over the average of the five winters preceding, was as follows:—

INCREASE ON TWO GREAT CLASSES OF DISEASE, during Eleven Weeks, or from Nov. 20th to Feb. 5th.

—	Nov. 27th.	Dec. 4th.	Dec. 11th.	Dec. 18th.	Dec. 25th.	Jan. 1st.	Jan. 8th.	Jan. 15th.	Jan. 22nd.	Jan. 29th.	Feb. 5th.	Total.
Typhus, } Scarlatina, } Diarrhœa, } &c. }	204	427	572	418	178	209	236	204	195	156	180	2979
Respiratory } Diseases . }	301	661	580	324	58	164	63	121	118	128	137	2655
Total excess	505	1088	1152	742	236	373	299	325	313	284	317	5634
Influenza } alone . . }	33	195	371	267	139	124	99	99	86	53	56	1522

We have no direct means of deciding how far the defective drainage of the site of the metropolis may have contributed to these results ; but, judging from the comparative lightness of the attacks in better districts, where the drainage is apparently good, though not superior to what we believe it might everywhere be made, we can have no doubt that the mortality of the late visitation, as well as that of ordinary seasons, could have been very much reduced, and that it may for the future be reduced, by proper external and internal drainage.

Complaints have been made of the stagnant waters within the metropolis in the shape of canals and ornamental waters ; and to these are traced a considerable proportion of the mists that diffuse themselves at nightfall and in the mornings. It is a matter for serious consideration whether some form of railway conveyance ought not to be substituted for the canals, and whether the ornamental and other ponds ought not to be filled up, or means taken to quicken their flow. Within a town any water-surface is objectionable, and stagnant water invariably attracts and gives forth foreign substances of an injurious kind.

The police, who perambulate the metropolitan districts at all hours, testify, that where the drainage has been improved or extended, a diminution of mists and fogs has been perceived ; and that the higher grounds and sites, from which water most speedily flows off, are the places where the evening and morning mists are lightest and of shortest continuance.

It is reported by competent observers, that in the district near Tottenham, as well as in other parts of the country, the drainage, imperfect as it is, that has already taken place has sensibly improved the climature ; there is less cold, less fog, and less ague and rheumatism, in the parts where the improvement has taken place. Formerly the cold morning fogs in the spring and autumn ranged from eight to ten feet high near Tottenham : where the drains have been opened by cleansing, scouring, and deepening, they are not half the former height. It is reported to us that agues and remittent fevers in Gravesend and the vicinity have been greatly reduced, after the drainage, although very imperfect, which has been accomplished in the town and neighbourhood. It has been remarked in travelling from one end of England to the other during the last forty years, that fogs diminish in number and in height in proportion to the drainage. The drainage which has been carried on in some parts of Lincolnshire, has reduced the fogs to full one-tenth of what they were forty years ago. The diminution of these morning colds and fogs have a very beneficial effect on the alacrity and industrial habits, as well as the health of the population. Fever and other diseases from the decomposing refuse left to accumulate amongst the more populous districts, now take the place of rheumatism and the intermittent fevers that were formerly prevalent. It is stated to us that some years

back, a great portion of the parishes of the Eastry Union was under water from the end of autumn to the early part of the following spring: then agues and fevers of all characters prevailed to a very great extent. Although the malaria may not produce diseases of any decided character, yet, during a wet spring or autumn, there are always cases of inflammation of the lungs, of bowel complaints and of rheumatism, both in their acute and chronic forms.

It appears from the Statistical Account of Scotland, that the effects of drainage in the Scotch counties have been very beneficial to the health of the population; the following notices, taken as a few, out of many examples, will serve to show the changes that have been produced.

“ Kincardine : *Fordoun*—so ‘ much drainage that now no swamp ; formerly agues common, now quite unknown.’ Angus : *Carmylie*—‘ health improved from draining.’ Kinross : *Kinross*—‘ agues prevalent sixty years ago in consequence of marshes, now never met with. *Oswell*—‘ ague prevailed formerly, but not since the land was drained.’ Perth : *Methven*—‘ the north much improved by draining.’ *Redgorton*—‘ healthy ; no prevailing disease ; ague was frequent formerly, but not since the land has been drained and planted.’ *Moneydie*—‘ healthy ; an immense improvement by draining.’ *Abernyte*—‘ since the land was drained, scrofula rare and ague unknown.’ *Monsie*—‘ healthy ; a good deal of land reclaimed.’ *Auchterarder*—‘ much draining, and waste land reclaimed ; climate good.’ *Muckhart*—‘ great improvement in agriculture ; ague formerly prevalent, not so now.’ And similar statements are made from the rural districts in all parts of the country.”

A land covered with stagnant water, cannot be dried up by the sun of an ordinary winter’s day ; still less can the ground be so far heated as to put in motion the upward current of air that constitutes the ventilation of the soil, and carries off watery and other vapours. What would be a dry and pleasant day, with six or seven hours of upward ventilation on a well-drained soil, is a day of stagnant mist over a watery surface.

We have directed examinations to be made, as to the condition of the suburban districts of the metropolis, and as to the means of their amendment, by engineers and land-surveyors, practically conversant with the improved modes of land-drainage; and in presenting the results of these examinations, we are anxious that they should be considered in connection with the fact already stated, that during the worst period of influenza, the increase of mortality in the north and south districts, was four times the increase in the west districts.

It appears that in the northern suburb, and especially between Primrose Hill, Hampstead, Highgate, and Holloway, there is a

great amount of low lying, wet, clay land, the drainage of which is quite practicable, and which if effected, would render the atmosphere much drier and more wholesome. Also throughout the whole extent from Hampstead to Homerton there is observable a want of attention to ditches, by-lanes, and water courses; the water in these being kept in a state of stagnation, till carried off into the atmosphere.

The greater part of the land in the western suburb, or in and between the neighbourhoods of Chelsea, Fulham, Hammersmith, and Kensington, is occupied as market-garden ground and well cultivated and comparatively free from fogs. It is stated that there are seldom any thick fogs so far up the river as Fulham. But there are still some localities that might be much improved by a better drainage. We are informed that on a number of fields about Shepherd's Bush, and between that and Hammersmith, the earth has been removed to the depth of from four to six feet for brickmaking, and the ground being left in a rough and undrained state, it has become a swamp; several acres of it are covered with reeds and flags, which are allowed to rot where they grow; and a portion, amounting to about 70 acres, has been converted into willow beds of about 12 or 15 feet width, with trenches between them of three or four feet, filled with water. Along the south side of the Uxbridge road, and also along the West London railway, the process of forming swamps by excavating for brick-clay is still going on; and no means are taken to prevent these swamps from being a nuisance to the neighbourhood. It is stated that ague frequently occurs, and that rheumatic complaints are very prevalent among the inhabitants in these places. "On the road sides between Shepherd's Bush and Hammersmith, a considerable number of houses have lately been built, and some are in course of building; but no proper sewage is provided for any of them." The common ditch, which is the only sewer there is, is said to be so shallow that the drains from the houses cannot be made more than a foot below the level of the ground. We are also informed, that on the north side of the Uxbridge road, near the Old Oak farm, there are 20 houses and cottages, whose sewage is collected into a shallow ditch, which is in a most offensive state. The market gardeners in the neighbourhood complain of these shallow sewage ditches, as obstructing the drainage of their lands.

The suburban districts on the Surrey side, correspond in character with the northern, rather than with the western suburb. Battersea is a flat, low, wet district. The surface drainage is in a very neglected and defective state. The ditches by the roadside are filled with impure water, and are made a receptacle for refuse and rubbish of all sorts. It appears that on the Battersea fields there are a number of old brick clay pits, and a multitude of ponds and ditches, and something like the course of a brook, all filled with stagnant water and offensive to the smell. On some of the lower lying parts of these fields near the course of the brook, the ground is of

the character of a marsh or bog. On the south of Battersea, there is a flat, low, and very wet piece of land, known by the name of Latchmore, through which a sluggish water-course stagnates. The water in it is nearly level with a great part of the surface of the land, which is all exceedingly wet. This land is let in allotments to the poor of Battersea parish, and we are informed that influenza was very prevalent among this class of occupiers. "The water-course may be traced through the marsh to near Lambeth, stagnating and emitting offensive effluvia; the land along its whole length is flat, wet, and unwholesome. The workmen in this district suffer very severely from rheumatism. From South-ville towards Camberwell, the land, from its lying higher, and having a subsoil of sandy gravel, needs little draining; but the lanes and by-roads are in very bad order; and in various places sewage water runs into the ditches, and reduces them to a very filthy state." South of Camberwell, and from the rising grounds about Herne Hill and Champion Hill, commences the plastic clay surcharged with water. Towards Forest Hill the soil is cold and wet; water runs in streams from every field. South of these hills, or about Sydenham, and from thence down the valley of the river by Lewisham, the land is of an excellent quality, but all more or less charged with water. Some of the back streets of Lewisham were found exceedingly wet and dirty; and the inmates of the houses bore, in their sallow shrunken countenances, witness to the unwholesome state of the place.

With regard to the Plumsted marshes we are informed, that to a very great extent, they are so wet, that an equal pool of stagnant water could not afford a greater amount of evaporation. Although possessing in the soil all the elements of fertility, the fields produce only a coarse pasture grass, abundant in quantity, but insipid and defective in nutritious qualities, when compared with the grasses on drier land. It is observed that the wetter parts of these marshes and the lines of ditches are covered with thick fogs, while the dryer portions are almost free of mist; and that the air when so charged, has a chilly feeling, and a languid and depressing odour. Ague and influenza have been unusually prevalent there during this winter; and the pallid aspect of the people, proves the unhealthy nature of the locality. There is no obstacle to the drainage of these marshes; and with the ditches filled up, and hedges substituted instead, and with a complete underground drainage, the unwholesome fogs would give place to dry air; and the pestilential fields might be converted by cultivation into the gardens of the metropolis.

On the Isle of Dogs, the soil is exceedingly rich, and the pasture luxuriant, where the ground is dry enough to let it grow. But the ditches are represented to be in a most wretchedly neglected state, "with the water dammed up in them, full of weeds and filth, stagnant, and stinking abominably;" being in a much

more offensive state than the open sewers that receive the sewage from the buildings and factories. Some of the lower parts of the grounds "have the appearance of peat moss; which, however, is not peat, but a mass of decayed grasses, reeds, rushes, and other vegetable matter, almost resembling a dung heap. The margins of many of the ditches are without grass, and trampled like a road by the horses and cattle, impelled by thirst, yet loath to drink, traversing the sides of the ditch in search of purer water." The isle is extremely cold in winter, and experiences strongly the want of shelter. In summer, it is said to be offensively hot and close, owing to the whole surface of the land being a mass of decayed matter, and constantly in a moist state. If made sufficiently dry, it might become a piece of very profitable market-ground, and would require no manure for many years. A portion of it, that happened to be cut off by the East India Dock, was brought under cultivation, and is now rented at 10*l.* an acre; whereas the best of the land in pasture returns only 4*l.* 10*s.* an acre. But as it at present stands, its value, even as grazing ground, has been diminishing; what formerly let at 5*l.*, is now let at only 4*l.* an acre. It is reported to us, that by drainage and cultivation, the whole might be made equal in value to the portion already taken in, and would yield employment to nearly 1000 labourers.

It is calculated that the Essex and adjoining marshes contain about 3,500 acres, or upwards of five square miles, of undrained land in a constant state of unwholesome evaporation, and upwards of 200 acres of ditches, many of them exceedingly offensive from being aggravated by the addition of sewage-water. The following is an abstract of a statement made to us on this head:—

"The marsh land along the River Lea from Stratford to the Thames is of an excellent quality for market garden ground; both it and about half of the Plaistow Level, comprising together, about 1600 acres, might be more than doubled in value by drainage: and as garden ground, twenty persons might be employed on it, for one employed at present. About 800 acres of the Plaistow Level, and the whole of East Ham Level, which contains about 1700 acres, might by drainage, be very much improved for pasture, and rendered fit for cultivation. As pasture land, the value would be increased at least 1*l.* an acre; for although a less weight of grass would be produced, the quality would be greatly improved, and it would yield a larger amount of hay. The grass of the marshes is of a rich succulent character; and cattle brought to feed upon it are rendered feverish for a month or two at first, and if in a sickly state they die. Butchers will not purchase sheep or cattle that have been only a short time on the marsh pastures; and hence these cannot be made available, as they might be, in feeding up for the shambles, animals brought from a distance half-fed, or two-thirds fat. The same remarks are applicable to the Hackney Marshes. The Tottenham Marshes, having a gravelly subsoil, need little drainage other than a free outlet to the surface water; which is prevented by the mills and canal locks that obstruct the river."

By the thorough drainage of all these marshes, not only would the metropolis be saved from a vast amount of noxious vapours, but an additional value of many thousands of pounds annually would be conferred on the land in those districts.

We have received evidence to prove that the drainage of land has a sensible effect in raising the temperature of a district. Such increase has been proved, by comparisons made with appropriate instruments, to amount, on some occasions, to six degrees of the thermometer; and it is made manifest to the feelings of the inhabitants by the comparative absence of the evening chills that are experienced in ill-drained localities.

The field and road ditches, existing everywhere over the suburbs, have been a subject of special investigation by the Commission. We have received regarding them such reports as the following, which is drawn up by Mr. George Donaldson, an experienced agricultural surveyor, who was requested by us to examine various portions of the suburban lands.

“The marsh land east of Greenwich is divided into fields by ditches filled with water let in from the river by small sluices under the care of the wall-reeve. These ditches are on an average 9 or 10 feet in width, and about 3 feet deep of water. They answer the purpose of fences, as well as watering places for cattle, and serve in some degree for drainage.

“Some of the workmen upon the marsh attending to cattle, &c., stated that in some states of the weather, where the ditches are not kept well scoured, they smell very much, or in their own words, ‘stink terribly,’ when the water is low. The smell arises from the rotten weeds about the sides of the ditch. They stated that at this season there is little or no smell from the ditches, but to me it was quite perceptible at the time I was speaking to them, although they seemed unconscious of it.

“These ditches are a bad substitute for fences. Neat hedges would take much less land, and they would give shelter, which is much wanted. For the purpose of providing water for cattle, not one-fourth of these ditches are necessary. The drainage could be much better effected in a different manner.”

Similar accounts are given in respect to portions of other suburban districts.

It must be recollected also, that the occupiers of the new suburban dwellings have often no other means of drainage than the common ditches, and that these ditches frequently perform the office of sewers as well as of land drains.

We find, therefore, that a large proportion of the means of suburban improvement, namely, that relating to the water courses and the road ditches, would come within any systematic operations of public drainage.

At present the duty of clearing and keeping open the ditches of roads, is charged upon the surveyor of highways. But the

effectual drainage of the roads, as well as of any portion of land, can seldom be carried on within the boundaries of a parish, and are almost always wholly dependent on the general arrangements for the whole natural drainage area, extending perhaps beyond the bounds of the county.

From examinations which we have directed to be made, we find that in subservience to the larger drainage arrangements, and with proper outfalls, the road drainage by open ditches may be superseded, by means of tubular tile drains, put in at proper depths and inclinations, which the officers of the Commissioners of Sewers, who will have charge of the general survey, may with the aid of that survey determine accurately.

The objections to the present road drainage by ditches of the common forms and sizes, are analogous to those we have made to the common forms and sizes of sewers: namely, their unsuitableness to small runs of water; wide bottoms intended to be flat, but so irregularly shaped as to impede effectually the current of all but very large floods of water with considerable flows.

If the road drainage were placed in its proper subordination, as part of a system of drainage, the ditches, which are usually only about two feet deep, might be filled up, and the roads drained into pipe drains of from four or five inches in diameter and upwards, according to the length of the road and its position in serving as an outfall for the land drainage.

We are assured by persons engaged in carrying out agricultural improvement by land drainage, that the roadside ditches commonly form the most serious obstructions to their work. Covered tubular drains, such as we propose as substitutes for the open ditch, would of themselves effect extensive land drainage; and in some suburban lands, closely intersected with by-ways and public footpaths, which should be deep drained, would sometimes supersede the necessity of any other drainage.

Mr. Smith of Deanston, long since abolished all open ditches in his own farm, with great advantage. Mr. Josiah Parkes, concurs with other practical witnesses, in our view, that the drainage of the roads, by covered drains, would greatly benefit the adjacent land. The extent of this drainage by the covered drains would, of course, be dependant on the depth of the road drain, and the permeability of the adjacent land. On a very stiff clay soil, a road drain might not act more than from 12 to 15 feet on either side of it. But in freer soils, several practical witnesses agree in stating, that a single drain would frequently drain from one to two chains. Mr. Parkes mentions an instance of one drain, from five to seven feet deep, which drains a field of about 20 acres. The road drains would commonly serve as excellent outfalls for the drainage of the land; and Mr. Parkes, and other land surveyors, think it would be of great advantage to the farmers, if they had the right of carrying drains into them.

Mr. Parkes attests the fact (in which other experienced drainers examined by us concur), that a proper covered drain, of the same depth as an open ditch, will drain a greater breadth of land than the ditch can effect. The sides of the ditch become dried and plastered, and covered with vegetation, and even while they are free from vegetation, their absorptive power is inferior to the covered drain. A mile of double road drains would drain from 15 to 20 acres of the adjacent land; and the increased value to the land itself would, considering the common rates of charge for land drainage, be worth the expense. A piece of land surrounded by roads, as often happens in the suburbs of towns, might be completely drained by the road drains.

On a mile of road, having ditches on both sides, the extent of evaporating surface of stagnant moisture with decomposing vegetable and animal life, would be from three-quarters to an acre per mile; that is, three-quarters of an acre in extent could be gained as dry road or as cultivable land.

The wall-reeve of Poplar Marsh, states to us, that the area of open ditches or sewers within the open part of his district of 520 acres is 21 acres; or in the proportion of one acre of water to 25 acres of land. He states that he is of opinion, that the whole of the 21 acres of open ditches and sewers might be made available for grazing and other purposes, if pipes were laid and the ditches covered in.

Mr. Donaldson states, in reference to the marshes east of Greenwich—

“ I have made a rough estimate of the ditches upon these marshes, taking care that my statement shall be within the actual measurement. I find upon an area of 450 acres of land, that there are 13 miles of ditches. The surface of the water in these averages 9 feet in width. The entire water surface is therefore 15 acres. The average of the entire width of the ditches is 11 to 12 feet; there is thus $18\frac{1}{2}$ acres of land occupied with ditches out of 450, or one acre of ditch to 24 acres of land.”

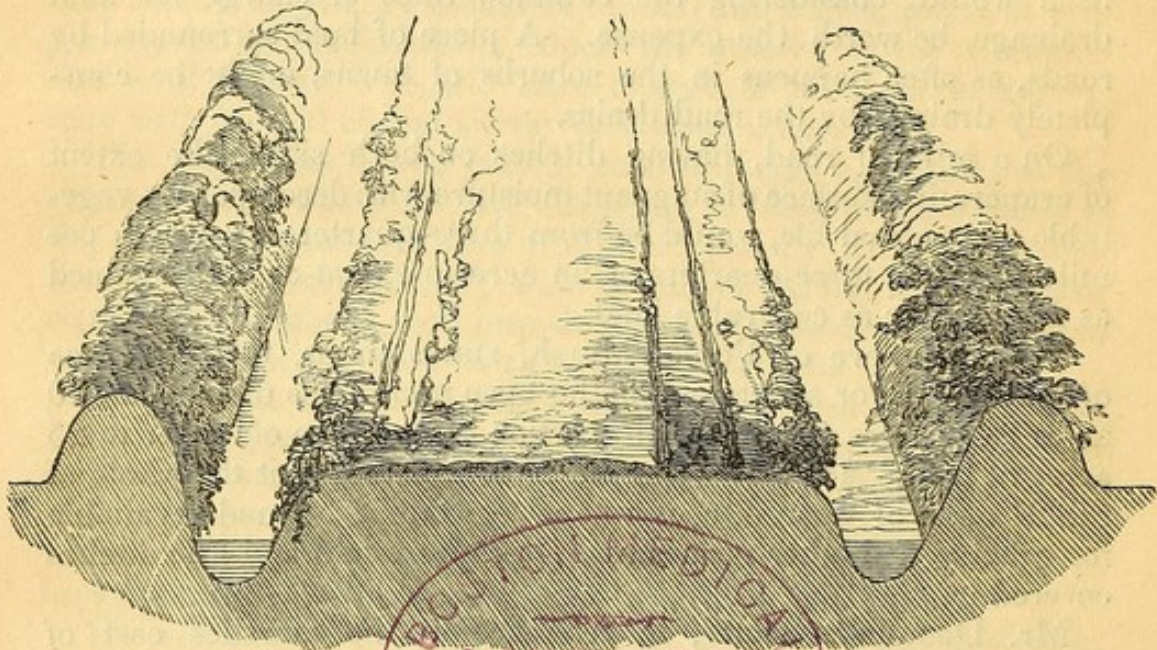
It appears that there are nearly, if not quite, 70 miles of open ditches, amounting to upwards of 60 acres, the greater portion of which serve as sewers, within the districts of the Surrey and Kent Commissions of Sewers.

If stagnant and open ditches were abolished in places where agricultural improvement is backward, as it generally is in the marshy districts, the good that would be seen to arise from the drainage of the land situated near the road drains would, with proper facilities, tend to the voluntary extension of general land drainage, for which the new and extended surveys that have been proposed would be of very great importance.

The following diagrams represent the appearance of the ditches along with hedges, which sometimes have ditches on both sides. The lower diagram gives the view of the position of the tubular drains. The road water may be discharged either through a layer of broken stones or permeable gravel, to stop any silt, as at A,

or through a small earthen vessel, as at B (into which silt would fall and be arrested, and which could be cleaned out conveniently by hand, from time to time), and enter the drain below by a drain-pipe acting as a gully shoot. In general the space occupied by the ditch may be advantageously added to the road, as at B. In other cases, where there is a sufficient width of road, it might be given to the land.

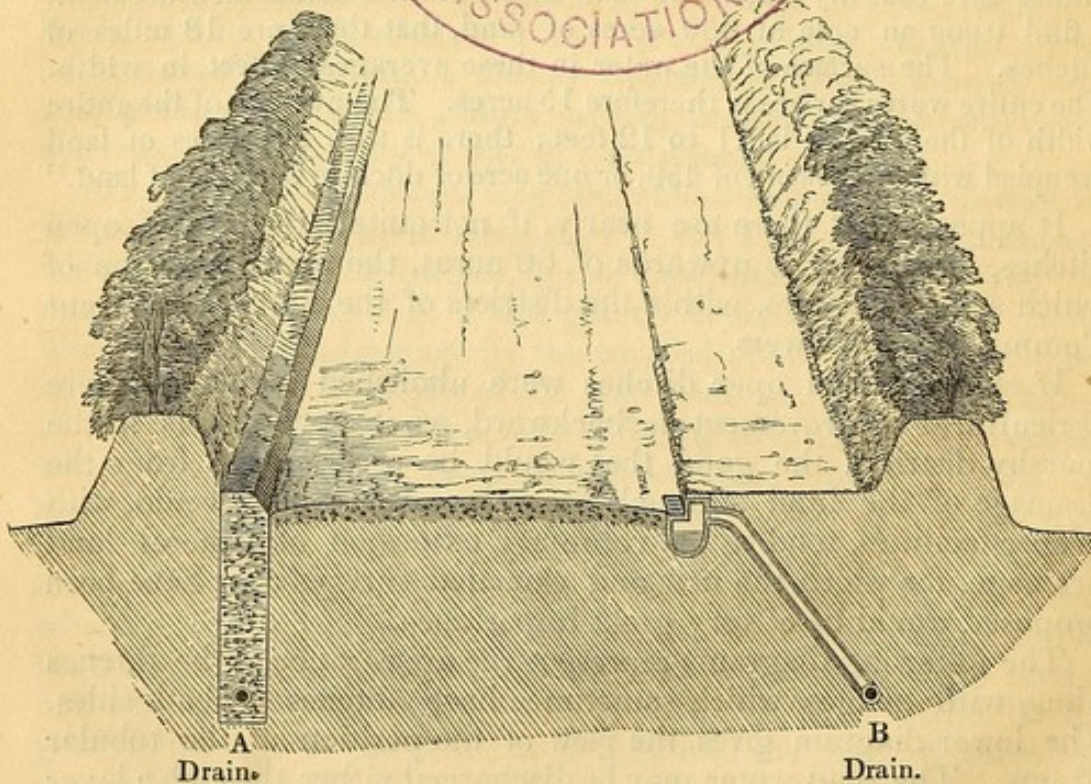
Section of Road, with open Ditches.



Ditch.

Ditch.

Section of Road, as proposed, with covered Drains.



A
Drain.

B
Drain.

Mr. Stewart, a land surveyor and land agent, who has been

extensively occupied in the draining of land, and has been recently engaged in the drainage of some lands between Greenwich and Woolwich, states that the lands in the suburbs of the metropolis are all very full of water, and excessively in want of drainage.

Being asked—

“Have you, in the course of your experience, observed the effect of the drainage of land in preventing ague or marsh fever?—Yes, everywhere; there cannot be the slightest doubt of it. In the very district now in question, some years ago, I recommended to the late Mr. Angerstein to erect some habitations on a particular spot of land on his estate. He asked me whether I was aware that no one could live on that spot without getting the ague. He at various times has had servants there, and all of them were obliged to be taken away on account of the ague and aguish fevers. I replied, that the infliction of the ague was owing to the want of drainage, and that if he would allow me to drain the land, I should not object to live there myself. He did allow me to drain the land, and to erect gardens, and a set of necessary buildings upon it, and there has never since been in them a single case of ague, or anything resembling it.

“How far do you believe the suburban lands may be improved for vegetable production, or for the health of stocks, or to speak of the health of the population, by suburban land drainage?—I can give an idea of the improvement as respects the value of land. About five years ago, I cut only one drain, through the river bank, and took in about 20 acres. The land has been recently let to a gardener, at double the former letting. Generally speaking, by proper drainage the low and wet lands may certainly be advanced in value from 25 to 50 per cent.

“The Commissioners have been led to inquire, as to the practicability of superseding the road drainage by open ditches; and substituting drainage by covered tubular tile drains. Do you concur in the eligibility and the practicability of the proposed substitution?—I do indeed, most fully: there is no doubt of its answering perfectly, by proportioning the pipes to the quantity of water which they will have to carry; but I do not think that it will be requisite to have very large pipes in any one case for the purpose.

“What do you expect would be the effect of such drainage, independently of other land drainage, in the districts with which you are acquainted?—I do not think the other drainage would be complete without it. If you are about to drain the land in any district, it would be inconsistent to leave the ditches as they generally are, say about 2 feet deep.

“On the low lying lands you would drain very deeply would you not?—Yes, where there is the means of sufficient outfall; in some of those lands I have found it necessary to drain as deep as from 6 to 8 feet.

“To what depths have you been accustomed to drain agricultural land?—I never sink the drains of the outside of fields less than four feet if I can get an outfall to that depth. I often go double, and sometimes three times that depth.

“How long have you practised this deep draining?—All my life, where I have had the power.

“Then to allow the ditches to remain along with such land drainage would only be leaving stagnant surface moisture?—Nothing more.

“What would be the effect of stopping up the open ditches in the district between Woolwich and Greenwich, on which you have been en-

gaged?—The effect of deep tile drainage of the roads in those parts would be, first, to get rid of the dreadful stench of the stagnant water and rotten vegetables in the ditches, which is at times enough to make any man sick, and does so. The health of the population would therefore be greatly improved by it. In the next place, the roads would be easier kept in repair, because they would become more solid. At the height at which the water stands in these ditches, very often within a foot of the surface of the adjoining land (sometimes higher), it keeps the road soft, and the land adjoining much wetter than it ought to be, often a quag.

“Where the fields are small, and the roads very near, would not the deep tile drainage of the roads very often suffice for the land drainage?—Very often it would, provided the subsoil is composed of gravel, sand, or matter pervious to water. I have now in hand some land where one roadside drain, if it were laid deep enough, would drain the whole field, the subsoil being shingly gravel.

“With respect to road drains, what would be, as a general rule, the best minimum depth to be of service to the adjacent lands?—I should not wish to go less than four feet and a half, and I would prefer to go six feet; but three feet would be better than none.

“Will not the extension of the road drainage be of peculiar advantage in the case of small ownerships, or small occupiers?—No doubt; it will be of very great advantage.”

From particular as well as from more general reports, it appears then that the excess of water and moisture in the marsh and ill-drained lands, so injurious to the population, is detrimental to the health and value of stock, to vegetable production and to good husbandry; and for its amendment, needs only facilities and provisions formed with reference to the interests of agriculture, apart from all views to the health of the suburban or of the urban population.

The chief impediments in the way of the effectual drainage of these marsh lands appear to be those common to agricultural districts, namely, the division of the natural drainage area into ownerships of different description and extent, and the sub-division of the ownerships into different occupations; the want of such powers and identity of interests as would cause the execution of proper works; the want of means to resist exaction from the occupiers or owners of outfalls, and the possessors of water rights in the lower districts; and the want of a disinterested and competent authority, to compel the adoption of a common plan of works, to distribute charge of contribution in return for benefits, and to protect reversionaries. Provision would require to be made for compulsorily taking up, on granting compensation for, the rights of water power, the use of which for mills is now being generally superseded by the application of steam.

To show how the proposed change from ditches to drains might be accomplished, and the saving that would arise from it, we sub-join Mr. Donaldson's estimate of the operation:—

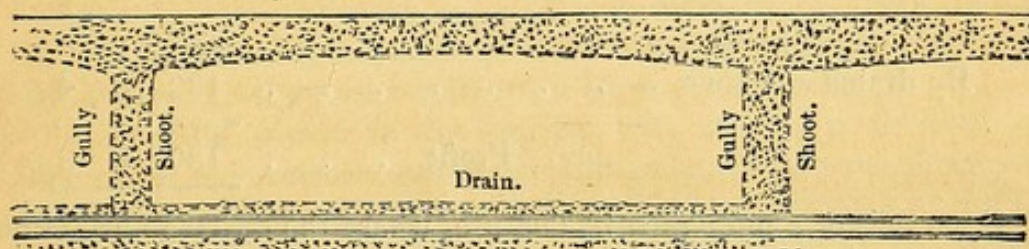
“With reference to the annexed plans, I beg to state in explanation,

that I take as a sample a by-road of average width, with 12 feet of roadway between the ditches; the ditches being supposed to be $3\frac{1}{2}$ feet in width at the surface, and 2 feet depth. Ditches of such depth are of no use for drainage; they soon become partially filled with rubbish, which obstructs the flow of the water in them, and thereby keeps the adjoining land wet.

“ Instead of these ditches, the plan would be to substitute a pipe tile-drain of $4\frac{1}{2}$ feet depth, with pipes of 3 or $3\frac{1}{2}$ inch bore, jointed with collars, which secures a perfect junction of the pipes.

“ And along the roadside, just over the drains, there should be a channel 10 inches wide and 12 inches deep, filled with gravel, with gully-shoots of 12 inches square, from the channel down to the drain pipe. The gully shoots also are to be filled with gravel; one gully-shoot for each 5 yards along the channel, as shown on the plan; and by these channels and gully-shoots the surface water will percolate freely into the drain. The roadway being rounded a little, the rain water falling on it will run off to the side channels, and sink into the gravel with which they are filled.

Longitudinal Section of a Road-side Drain, with Gravel Channel and Gully Shoots.



“ The road fences being mostly of post and rail, they might be placed near the channels, leaving for the roadway a width of $15\frac{1}{2}$ feet, instead of 12 feet as before; and the extra $3\frac{1}{2}$ feet of width occupied by the ditches, might be laid to the adjoining fields.

“ By this the land-owners would gain 1 rood $31\frac{1}{4}$ poles per mile of roadway.

“ The annual cost of scouring the ditches by the roadside is not less than 1*d.* per rod of $5\frac{1}{2}$ yards, or 2*l.* 13*s.* 4*d.* per mile; which, valued so low as ten years' purchase, amounts to 26*l.* 13*s.* 4*d.*

“ Upon level land with a gravel subsoil, such as the district about Hammersmith, Walham-green, Little Chelsea, Earl's-court, and Battersea, the road-drains would effect the drainage of the adjoining lands to the distance of 100 or 120 yards on each side of the road; that is, allowing a fall of 3 feet in 100 yards for the water percolating through the gravel towards the drain; and I am of opinion that less fall would be found sufficient. At this rate, each mile of the road-drains will effect the drainage of 80 acres of land, which, at the very low estimate of 5*s.* an acre of improved annual value, makes for the whole 20*l.* a-year, amounting at 25 years' purchase to 500*l.*

“ These items may be set against the cost of the road drainage. The cost of the road-drains will necessarily vary a little in different districts, with varying distances for cartage, &c. I estimate the probable cost per mile of single drains as follows:—

	£.	s.	d.
To cutting and filling of drains, 320 rods at 9d. per rod	12	0	0
To 5280 pipe-tiles at 90s. per 1000	23	15	0
To 5280 ditto collars at 30s. per 1000	7	16	8
To 250 cubic yards of screened gravel, carting and putting in channels, and at 4s. 6d. per yard	56	5	0
Total	<u>99</u>	<u>16</u>	<u>8</u>

Or, per mile of double drain £199 13 4

In comparing the cost and benefit of such drainage, the account per mile will stand thus:—

	£.	s.	d.
To land reclaimed from ditches, 1 rood 31½ poles, at 4l. rental per acre, at 30 years' pur- chase	53	8	6
Purchase value of the annual cost of clearing ditches	26	13	4
Improved value of 40 acres (one half) drained	250	0	0
	<u>330</u>	<u>1</u>	<u>10</u>
By drains as above	199	13	4
Profit	<u>130</u>	<u>8</u>	<u>6</u>

Upon soils of a more retentive nature, where the drainage would not be so extensive, the road-drains would serve as main drains for the adjoining land, to the extent of 220 yards on each side of the road on level land, or one side of a road on a declivity.

“The average proportion per acre of the cost of main drains is about 12s.

“Therefore on level land where the road drains will answer to drain on both sides, they will serve for the drainage of 160 acres per mile, which, at 12s. per acre, amounts to 96l.

“And on such land the account would stand thus—

	£.	s.	d.
By cost of road drains as above	199	13	4
To land reclaimed £53 8 6			
To cost of ditches saved 26 13 4			
To value of drainage to adjoining land, 96 0 0			
	<u>176</u>	<u>1</u>	<u>10</u>
Balance	<u>22</u>	<u>11</u>	<u>6</u>

“In this instance the actual outlay for better roads, with a facility for drainage and getting quit of the offensive and unwholesome ditches, is only £22. 11s. 6d. per mile. But over the greater part of the lands in the suburbs where such drainage is most required, the soil is of that gravelly porous nature which, as above, shows a positive profit to the land-owners from the road drainage.”

The subject of the application of town manures will be one for detailed investigation hereafter ; in the mean time it may be observed that, in respect to the heavy undrained clay lands, the marsh lands and the lands generally surcharged with moisture, their present condition unfits them for the advantageous reception of manures in any form. For the immediate application of the rich manure of a city, it is peculiarly important that the soil should be permeable and absorbent, so as to receive it in the liquid form—the only form in which large masses of it can be conveyed, the form in which it is generally considered to be most productive, and is most rapidly and completely absorbed, with the least loss from decomposition and evaporation—processes which are so extensive, injurious and offensive when manure is applied in the solid form as “top dressings.” The improvement in the condition of the land in the immediate vicinity of the urban districts, for the reception of manure, must be one means of relief from the present necessity of throwing away large masses of it into the river.

We believe that, by the course of amendment now described, the effect on the sanitary condition of the urban districts would be considerable ; that the influence on the population of the suburbs would be equally beneficial, and still more immediate ; and that the increased attractiveness of these districts would tend to relieve the interior of the metropolis itself from overcrowding.

The usual answer to the inquiry, why nothing is done to raise the value of suburban grazing or tillage land by means of drainage, is, that the land will, sooner or later, be required for building purposes. But on all recognized principles of sanitary legislation, the erection of dwelling-houses on marsh or undrained land must for the future be prohibited ; and drainage must always be enforced as an essential preliminary to building. The general works requisite for draining the roads, and adapting the land for tillage, will commonly serve to prepare it for building purposes, and will in the mean time be highly remunerative. It has, however, been proved by evidence, that from the sub-division of ownership and various other causes, the land is often retained in a state of marsh, notwithstanding the loss of produce thereby occasioned. But when land is allowed to remain in a marshy condition, with pools of stagnant surface water, and animal and vegetable matter in a state of decomposition, giving off exhalations injurious to the health of the population, it comes within the principles of the law in relation to other nuisances having the like effects, and, we apprehend, calls for the application of an efficient legal remedy.

We now beg leave to submit the chief conclusions which appear to us to be deducible from the investigations we have made since we submitted our First Report.

Having received much additional information as to the progress

of cholera towards Europe, and as to the means of its prevention, we find—

That the disease, as it has recently appeared in Persia, in Trebizond, and in Russia, is unchanged in its general character, and that it is at the present time, according to the latest information, in a similar position to that in which it was in 1831, when its progress was arrested by the frost, previously to its advance upon Europe immediately after the thaw took place.

That the more recent experience in Russia has led to the general abandonment of the theory of its propagation by contagion: a conclusion in which, after a full consideration of the evidence presented to us, we fully concur.

That the views which we adopted in relation to the inexpediency of special Cholera Hospitals, except in cases of peculiar necessity, have been confirmed by the coincident adoption of the same conclusions in Russia.

That we have received much information, tending to establish the conclusion, that cholera is not the sudden disease which has hitherto been supposed; that the commonly known form of the malady is, in reality, its second stage; and that its first stage is manifested by the premonitory symptom of diarrhœa, which is commonly unattended to, but which, if met by the strict observance of proper regimen, and by appropriate medicine, may be arrested before passing into the more violent and fatal stage of the disease.

That, in addition to our former recommendations, we further recommend, that preparation be made for what appears to us to be one of the most important measures of alleviation, the establishment of local dispensaries, where persons affected with the first stage of the disease, as manifested by the premonitory symptom, may be immediately placed under the proper treatment for arresting the further progress of the malady.

Having examined, as closely as the time and means at our disposal would permit, the late extraordinary increase of mortality in the metropolis, amounting in eleven weeks to 6145 deaths above the usual average, an excess of mortality during those eleven weeks greater than the entire mortality from the cholera in the metropolis during the 21 weeks when it prevailed in the year 1832; we find—

That of this excess of 6145 deaths, 1522 deaths were registered as deaths from epidemic influenza, but that the deaths from epidemic typhus, and from pneumonia, bronchitis, and the whole class of diseases of the lungs, commonly brought on at all times by cold, damp, and atmospheric impurity, have also been very numerous; the number of deaths from typhus having been during the eleven weeks 999, and the number *above the average* from diseases of the lungs (apart from influenza) 2655.

That sickness and mortality from diarrhoea and from typhus of precisely the same type as that which preceded the former visitation of cholera have been excessive amongst the population of the low, ill-drained, ill-cleansed, and overcrowded neighbourhoods that are marked as the cholera tracts of 1832.

That the climatorial changes observed, as antecedents to this recent excess of mortality in the metropolis, have been an excess of humidity in the air, and rapid and extreme changes of temperature: and that such excessive humidity has been the chief observed antecedent to former visitations of influenza.

That the inmates of a model lodging-house, and the prisoners in the chief prisons in the metropolis, where the drainage, cleansing, dryness, ventilation, and warmth, are better than ordinary, have been distinguished by proportionate immunity from typhus, influenza, and other epidemic diseases, affording an exemplification of the freedom from such disease, which would probably follow the extension of similar sanitary arrangements.

That in the lower, the ill-drained, and the worst cleansed districts, in the close streets, courts, and alleys, chiefly occupied by the poorer population, typhus and other epidemics are now prevalent, with an increasing frequency and intensity, constituting, in our opinion, the state of evil contemplated by the Contagious Disease Preventive Act, which authorizes the appointment of local Boards of Health, with powers for cleansing and the adoption of other preventive measures.

That seeing the advantages derived from the visits and exertions of such Boards in 1832, and the probable length of time which must elapse before new and combined works of drainage, cleansing, and water supply could be executed, we recommend that Boards of Health should be immediately constituted, with a view to carry out, more especially in the districts where the visitations of epidemics have of late been most severe, such measures as may be practicable, as well for checking the progress of typhus and other prevalent maladies as for making preparation against the probable invasion of Asiatic cholera.

Having observed the excessive mortality in the northern districts and certain of the suburbs, as compared with the central portions of the metropolis, we directed our attention to their sanitary condition, and we find—

That large tracts of suburban land, namely, the Poplar Marsh, the Isle of Dogs, the Essex marshes, and the Greenwich and Plumsted marshes are in an exceedingly bad condition; and that much of the uplands in the other suburbs consists of stiff undrained clay land, excessively charged with moisture.

That these marsh and undrained lands are extensively intersected with open, ill-kept, and stagnant ditches.

That there being no systematic land drainage, and no proper

Summary of Conclusions as to affording facilities for,

pre-appointed system for the drainage of land intended to be used for the sites of houses, or of new suburban dwellings, when new dwellings are constructed, a great part of the drainage from the suburban houses is carried into these open stagnant ditches.

That in one of these marshes the proportion of open ditch is $18\frac{1}{2}$ to 450 acres, or one acre of ditch to 24 acres of land: stagnating and giving off emanations from the decomposition of animal as well as vegetable refuse; and that in the Surrey district of sewers alone there are nearly 70 miles of uncovered ditches and open watercourses, complained of as being stagnant, as receiving house-drainage, and as giving off much offensive moisture.

That marsh diseases prevail at times amongst the agricultural population of the Essex, Plumsted, and other marshes; and that after the wind has prevailed for some time from these ill-drained lands in the direction of dwelling-houses, marsh diseases are constantly noticed among the adjacent population.

That there is no doubt that the mists and humidity arising from the suburban ill-drained land is carried amidst the habitations of the adjoining districts, and exercises at all seasons a pernicious influence on the health of the population.

That there are perceptible differences in the amount of epidemic disease, in the agricultural suburban districts, according as they are well or ill drained; and that where drainage works are properly carried out, the amount of humidity and mist is speedily diminished.

That the excess of moisture on the marsh and ill-drained land is detrimental to the productive power and value of the land, and to good husbandry.

That the operations for improving the land by drainage are obstructed by the exceedingly imperfect drainage arrangements; only some of those arrangements being, while all of them ought to be, within the general drainage jurisdiction of the Commissioners of Sewers.

That powers should be given to the Commissioners of Sewers, enabling them to cover in all open ditches; to drain roads; and to substitute for ditches, tubular drains, in connexion with the general drainage levels.

That if such drains are properly laid down, and connected with the general drainage works, the quantity of stagnant surface water will be diminished to a very important extent; the roads will be kept drier, in consequence of the greater depth of their drainage, and the more rapid discharge of surface water; the lands adjacent to the roads will be greatly relieved of surplus moisture; and valuable outfalls will be formed for the land drainage, which is now much obstructed by the state and construction of the open ditches used for the drainage of roads.

That in connexion with the general drainage works, under the direction of the Commissioners of Sewers, facilities should be given

to owners and occupiers, for the drainage of the lands adjacent to the suburban districts by advances on loan, repayable by instalments, with the advantage of the general survey, and the aid of the superintendence of the officers of the Commission.

That where land continues in a state of marsh injurious to the health of the population, compulsory powers of drainage should be given and exercised in relation to it.

That however perfect the drainage of the interior of the urban districts may be, the beneficial effects on the population must be greatly diminished, unless the drainage of the suburban land be put in proper relation with it.

All which we humbly certify to Your Majesty.

(Signed)	ROBERT GROSVENOR,	(L. S.)
	EDWIN CHADWICK,	(L. S.)
	T. SOUTHWOOD SMITH,	(L. S.)
	RICHARD OWEN,	(L. S.)
	RICHARD LAMBERT JONES,	(L. S.)

Gwydyr House, Whitehall,
19th Feb., 1848.

MINUTES OF EVIDENCE.

No. 1.
J. Hodgson,
Esq.

No. 1.

Joseph Hodgson, Esq.

You are a surgeon of eminence at Birmingham?—I am a surgeon in Birmingham.

How long have you been acquainted with Birmingham?—I have resided there in the practice of my profession about 30 years.

Therefore, you were in Birmingham during the time that the cholera visited England, in 1832 and 1833?—Yes, I was. I was one of the two medical officers appointed at that time by the Government on the Board of Health in Birmingham.

Then, on account of that, as well as other reasons, you took especial note of everything with regard to that disorder at that period?—No; I cannot say that I took especial note. I did not write down anything, but I paid particular attention to the cholera at the time. We had an inspector and other officers appointed, and it was part of my duty to see what means could be adopted for the purpose of preventing this disease from coming in to the locality, and to secure the safety of the inhabitants.

Have you not made it a special object of your inquiry, by reading the publications or watching the evidence in relation to it, in your own general experience?—The circumstance of my being on the Board of Health brought my attention a good deal to the subject. I do not know that I have read more about the cholera than all medical men ought to do. I may have done. I do not know that I have very specially turned my attention to that subject; but, however, in consequence of my connexion with the Cholera Board, it was my duty to pay, and I did pay, great attention to all the circumstances at the time, and I devoted myself to seeing that the town was purified, and we did what we could to prevent the cholera from coming into the town.

Will you be kind enough to state to the Commission what the phenomena were that struck you with regard to the appearance of that disorder and its spread, and its intensity in Birmingham and the neighbourhood?—With regard to Birmingham, it was remarkably free from the disease; there were very few cases indeed of what was called Asiatic cholera in the town; from Birmingham only 31 cases in all were reported to the Board of Health in London during the whole time that the disease existed in England. To what that immunity was owing I cannot say. The town is peculiarly situated, it is a remarkably healthy town; or, at least, it has been till lately; it is now in an indifferent state. Fever has got its footing there, and when fever once gets into a town it is, I must say, like getting vermin into a house, you can scarcely get it out again.

During the time that the cholera was prevailing in this country, and that Birmingham was so free from the cholera, was it severely felt in the neighbourhood of Birmingham?—Yes; though Birmingham was so free from the disease that scarcely a case of Asiatic cholera could

be said to exist in the town, nevertheless, at Bilston, which is only ten miles from Birmingham, it raged more than I believe in any other place in Great Britain. Bilston at that time contained 14,700 inhabitants, of which number 3568 had the cholera, and 742 died of that disease in less than seven weeks. One in four of the population had the disease, and one in five of those who had the disease died.

Were any precautions taken to prevent the disease spreading between Bilston and Birmingham?—None. And there were communications constantly between the towns; coaches and other conveyances went through. I do not suppose the people came quite so much to Birmingham as at other times. I was going to mention this. The disease raged very much at Bilston, and went on to a frightful extent, till the Government sent down to Bilston Dr. McCann, who had seen a good deal of the cholera in India, and I believe in Persia, or abroad somewhere; and when Dr. McCann came to Bilston, he formed a cholera dispensary, or dispensary for bowel complaints, and he drew attention very strongly to what I am aware the Government directions, and, indeed, the directions circulated in Birmingham drew attention to, viz., the importance of attending to the premonitory condition, as it is called. The cholera consists of two stages, if I may so term them; one the premonitory stage, and the other, which has been called the stage of collapse, or the Asiatic or spasmodic cholera, or blue stage. The first stage consists entirely of diarrhœa or discharge from the bowels of matters which are fœcal and generally bilious. This continues for a greater or less time, and more or less excites the attention of the patients. Sometimes they will have two or three evacuations in the day, but they are of a loose kind; and in other instances they will have half a dozen or a dozen or more evacuations in the day; this continues for some time. Dr. McCann told me, and almost everybody that I have talked with who knows anything about the subject confirms it, that they never knew an instance of a person who had the second stage who had not had the premonitory stage.

Dr. McCann paid particular attention to the matter, and examined into it.—Yes; and since that time that remark has been confirmed by almost all persons with whom I have had an opportunity of conversing upon the subject of the cholera—medical men and others; in nearly every case that I have heard of, there has been the premonitory stage, though perhaps only to a slight degree. I remember hearing of some ladies who were out at a party one evening, one of whom was dead the next day; but even in such instances, if you could learn the particulars, you would find, I believe, that there has been the premonitory stage—the stage of diarrhœa—to a greater or less extent.

Even though there were only one or two motions in the day, you would regard one additional motion as a premonitory symptom?—Any deviation from the usual healthy action of the bowels on the side of diarrhœa, I should regard as the early stage, as it were—the blossom of the disease.

So that if a person was accustomed to have only one evacuation in the day, in a solid form, and that were changed into a loose state, you would still regard that as a premonitory symptom?—I should; because when you speak of an evacuation from the bowels, it might be an ounce or it might be thirty times that quantity; the number of evacuations is not a proof of the effect produced upon the system.

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Or of their former condition?—No; I was going on to state, that from all I could learn, and all I have ever heard of the cholera, this state of diarrhœa is the antecedent to the second stage—the stage of collapse, if I may so call it, the Asiatic stage, or the spasmodic or blue stage, as it has been termed. When Dr. McCann came to Bilston, he gave public notice to an effect something like this—I cannot exactly state the words—everybody whose bowels are disordered, is requested to come to the dispensary. The population of Bilston is a low population; there are a great many workers in mines and iron works, and so on. The people called at the dispensary, and he gave them, I believe, some astringent aromatic opiate medicine, and told them to come again, or he gave them something to take away, and told them not to take vegetables or fruit, and from the time he adopted this plan the cholera ceased; it was catching the disease in the bud, if I may so call it, in which stage it is easily arrested. Then comes the second stage; the second stage is the Asiatic stage, the blue or spasmodic stage, or the stage of collapse, which I believe is the best word to use. Now, when we come to that, whoever will read what has been done in our profession in the treatment of cholera, will, I think, say that the medical profession deserves very little credit with regard to it. Every kind of treatment you can imagine—all kinds of opposite modes of practice were adopted—some bled, some gave salt and water, or mustard and water, some gave brandy, some gave opium, some gave calomel, some quinine, some cajeput oil, some croton oil; others used hot baths, and others cold affusion; and almost every variety of treatment possible was adopted, and each had its advocates; so that it appears to me, that in the stage of collapse, when you look at the inconsistency in the medical treatment, the recovery depended upon the vital power of the individuals suffering from the disease. The immense discharge of serum from the blood reduces them to such a degree that they cannot rally. To expect them to rally is like expecting a person to rally in whom a great blood vessel has been opened, and from whom nearly all the blood of the body has been drained; the material of life has been taken away to such an extent that few only can sustain it, and those who do get through it appear to do so more in consequence of the degree of vital energy remaining in their systems than from any medical treatment that is applied to them.

You had cases of cholera in Birmingham that were imported?—There were a few, but it was a most extraordinary thing that with a population of 180,000, and within ten miles of the very worst seat of cholera, if I may so say, we had so little of it. One physician, who went to Bilston from Birmingham to attend the cholera patients there, caught the disease; he came home and died of it in Birmingham.

Did you employ means for dealing with the premonitory symptoms?—We did. I have at home some of the papers that were connected with the Cholera Board in Birmingham; they came into my possession, and I have some of the packets of medicines which were given gratuitously to the poor, and at a small cost to others. Various stations were appointed in the town from which these packets were distributed. Each packet contained three boluses, and each bolus consisted of twenty grains of opiate confection. The patient was directed to take one bolus every hour mixed with a little warm water, or weak brandy and water, until the relaxation of the bowels ceased. Also in each packet there

was a small bottle of strong sal volatile, of which a teaspoonful was to be taken in warm water frequently, if the patient was cold, faint, or exhausted. Printed directions as to the use of these remedies and other matters were enclosed in the packets, and the patients were strongly urged to apply immediately for medical advice.

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Had you in Birmingham many cases in which the premonitory symptoms appeared?—Not a great many; but the people were very much alarmed, and they came for those packets.

Had you more diarrhœa than was usual?—I cannot say that we had. I think that the people paid more attention to the matter, but whether there was more diarrhœa or not I cannot say; there was no epidemic of the nature of diarrhœa.

But many persons did, in point of fact, come for those remedies?—Many did; but I think they came more from fear than necessity.

You stated that very soon after that plan of Dr. McCann's was adopted in Bilston the cholera cases diminished in number?—Yes.

The result of your observations upon the march of the cholera in Birmingham and its neighbourhood was, that it was not communicated by the constant traffic going on between Bilston and Birmingham, and also that in the premonitory stage, so to speak, it was easily treatable, but that if it once passed that stage and assumed the Asiatic form, so far as you are aware, it was not treatable by any mode of treatment of which you can give an accurate account?—I should say this, that the cholera, or the condition of prostration or collapse, is preceded by the premonitory condition, which consists of simple diarrhœa; that in that stage the disorder is easily managed, and easily arrested and stopped; by using aromatic opiate and astringent medicines and by attention to diet it is very easily stopped in that stage; but when it has gone to the extent of the stage of collapse, there is no treatment upon which certain reliance can be placed. With regard to the other part of the question you put to me, as to the communication between Bilston and Birmingham, I do not know the extent of the communication between Bilston and Birmingham, but communications constantly took place between the two towns.

Whilst you were watching the cholera in Birmingham, did Dr. McCann's recommendations come to your knowledge?—We were acquainted with what was going on at Bilston, but it was after it was all over at Bilston that I saw Dr. McCann, and conversed with him upon the subject. I have always felt since that time that so far as my little knowledge of the matter went, if cholera ever threatened this country again it would be a very manageable disorder provided Dr. McCann's ideas were fully explained and acted upon, namely, that cholera consisted of two parts—the premonitory condition, and the condition of collapse, and that if you catch the disease in the premonitory condition you may stop it at once, but that when it comes to the other condition there is great danger. I wish to state that I consider that very great merit is due to Dr. McCann; there is no merit due to me except that of pointing out to my friend Mr. Chadwick the importance of Dr. McCann's proceedings, which I verily believe furnish a key to the management of this terrible malady. I ascribe to Dr. McCann the merit not of having first said that there is a premonitory stage and pointing out that part of the history of the disease, but of having insisted upon, and of having

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drawn particular attention to this point, namely, that there is a stage at which you may stop the disease at once and readily, but if it gets into the other stage there is no known treatment upon which any reliance can be placed. I conversed with nearly all the medical gentlemen who went to Bilston to attend the cholera patients there, and also with many medical friends residing in the neighbourhood of Bilston where cholera prevailed, particularly at Wolverhampton, where cholera was fatal in 193 cases, and they unanimously agreed in opinion as to the importance and efficiency of Dr. McCann's views and proceedings. I beg leave to call the attention of the Commission to a very interesting narrative of the melancholy occurrences at Bilston during the prevalence of cholera there by the Rev. W. Leigh, the truly benevolent, zealous, and enlightened clergyman of that town, which fully bears out the statements which I have made. It was thought by some of the medical gentlemen there that Wolverhampton, which is only two miles from Bilston, would soon have been in as bad a state as Bilston if Dr. McCann's views had not been adopted in that town.

Was the period at which Dr. McCann adopted that plan such as to give you perfect confidence that the stoppage of the disease was not a stoppage arising from its having run its course, but was a stoppage arising from the use of those means applied to the premonitory stage?— I have reason to believe that it was owing to his stopping the disease in the premonitory stage—of course these matters are not capable of distinct proof—upon this as upon almost all medical questions you must act upon the doctrine of probabilities. Perhaps I may be allowed to state the reasons upon which I have adopted the opinion that I have now expressed. The first case of cholera occurred in Bilston on the 4th August, 1832; in 22 days from that time, 1812 persons had the disease, and of that number within that time 503 died; on the 23rd day from the commencement of the disease, the dispensary for bowel complaints was opened, after which time the disease continued in Bilston 27 days. During these 27 days, 1756 new cases occurred, of which number 239 were fatal; and of these fatal cases, 134 occurred in the first five days after the opening of the dispensary. After these first five days, when the dispensary had come into full operation and the people were aware of its benefits, although the number of new cases continued to be nearly as great as previously, the number of fatal cases very much diminished; and in the course of 20 days, the fatal cases altogether ceased. Indeed, during the first five days from the opening of the dispensary, the number of fatal cases, as compared with the number in the preceding five days, had decreased from 227 to 134; in the second five days, the number was reduced to 59; and on the eighth day from the expiration of that time, being the 18th day after the opening of the dispensary, not a single fatal case was reported; whereas during the seven days immediately preceding that on which the dispensary was opened, the number of deaths daily had varied from 36 to 50. After that time, namely, 18 days after the opening of the dispensary, only eight fatal cases occurred during the existence of the disease in the town. Now these facts show that, after the 23rd day, some important agency had checked the fatal progress of the disease, and inasmuch as that no other agency was known to be in operation, and the new cases during the subsequent ten days were as numerous, or nearly so, as in

the ten days preceding the opening of the dispensary, it is fair to conclude that the proceedings then adopted, by stopping the disease in its first or diarrhœal stage, prevented its progress to the second or collapsed and fatal stage. Such was the conviction of the professional and other attendants upon the cholera patients, not only at Bilston but also in the neighbouring towns where these facts became known. Again, the abiding of the disease at Bilston, where its attacks were so numerous and so fatal, was shorter than in most of the towns of about the same population both in that neighbourhood and in other parts of the kingdom; and it is reasonable to believe that this was owing to its duration at Bilston having been cut short by some agency employed in its treatment there, such having been the case, and no other cause of its stoppage being apparent. In Bilston it continued seven weeks; at Wolverhampton, Dudley, Wednesbury, Sedgley, Willenhall, and West Bromwich, all of which are in the neighbourhood of Bilston, according to the returns received by the central Cholera Board in London, it remained a longer time; and in Tipton, where it was very fatal, which is an adjoining parish to Bilston, and from which place it was believed to have extended to Bilston, it continued from June to October. Nor was the disease extinguished in the country generally about the time when it ceased at Bilston. It continued at Wolverhampton, Dudley, Tipton, Walsall, and other places in the mining district of Staffordshire after it left Bilston. It appeared also after its cessation in Bilston, in Bedfordshire, Oxfordshire, Devonshire, and Cornwall; then it occurred in several places in the north of England, and subsequently committed great ravages in various towns in Scotland. It first appeared in England in November, 1831, and it disappeared, I believe, in December, 1832, having destroyed in Great Britain upwards of 52,000 of its inhabitants. It may also be remarked that no recurrence of the disease took place in Bilston, which was probably owing to the inhabitants having become aware of the importance of attending to the premonitory condition; in several places where it had existed in a severe degree, as in Northumberland, London, and some other towns, recurrences, or fresh outbreaks of the disease, did take place. The facts which I have now stated appear to me to confirm the opinion, and I think I may say to prove, as far at least as such events are capable of proof, that the stoppage of the disease at Bilston was not owing to the disease having as it were burnt out, or run its course there, but was a stoppage arising from the means applied to its first or premonitory stage.

You attach great importance to the adoption of means for checking the disease in the premonitory stage?—Yes, and avoiding fruits and vegetables and acids. The medicines we gave in Birmingham, when the cholera packets were not used, were a drachm and a half of opiate confection to eight ounces of peppermint water, or chalk mixture. I gave that very frequently.

You do not attribute the great immunity of Birmingham from this disease to the following up that particular course of attention to the premonitory symptoms, but you attribute it to other causes which you do not pretend to explain?—Exactly; we were not so fully aware of the importance of attending to the premonitory symptoms till after the disease had disappeared at Bilston; my impression on this matter is rather the result of the opportunities of inquiry that that visitation of

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the disease afforded than of any previous knowledge. I would just mention, that although the Cholera Board in London, and indeed all writers on the subject, drew attention to the premonitory symptoms, they did not insist upon it as being important in the way that Dr. McCann did, as being in fact the condition which is very relievable, and by attention to which the disease may be stopped. Cholera, as it existed in England in 1832, I look upon it, is a particular condition of the body produced by some specific cause or epidemic influence acting upon the mucous surface of the alimentary apparatus, and occasioning a lowering diarrhœa which produces another condition of the body, which is the collapsed state of cholera. The merit, in my opinion, which is due to Dr. McCann is that of having pointed out the facility of stopping the disease if you catch it at that early stage. Suppose I were in charge of the health of a town, and the question were asked me, "Here is cholera in the town, what shall we do?" The course I would adopt would be this; I would stick up notices about the town to this effect— "Let every body who has relaxed bowels, or who has had more than one motion in the day, call at the dispensary;" then, when they called, I would advise them to avoid the use of fruits and vegetables, to attend to the general state of their health, and I would give them aromatic opiates, and in that way I believe we should stop the disease.

Would you not also advise the removal of all depressing influences, by cleansing as much as could be done without producing a depressing influence by the *modus operandi*?—My opinion is that there is a condition of low health which is favourable to the reception and progress of epidemic and contagious disorders of all descriptions, and that that state of health is very much increased, and often produced by impure air, by noxious exhalations from decomposing animal and vegetable matters, by improper diet, by want of suitable nutriment, and by depressing passions.

Therefore, while you would check any increased diarrhœa which is an indication of the disease, and while you would regulate the diet, you would attach great importance to cleanliness, and the removal of all those decomposing substances which have a powerful influence in depressing the constitution?—Certainly. It is a matter of importance to keep the body during the prevalence of disorders of that kind in a state of good general tone and health, and of course the removal of all those causes that I have named, which produce a low state of health, is extremely desirable and important.

From any observations which you made at the time, or in reflecting upon it since, could you at all point out anything in the condition of Bilston, which made cholera so remarkably prevalent there?—No; I can no more account for the cholera being very prevalent in Bilston, than I can account for its being absent from Birmingham. It is beyond any of the means of knowledge which I possess. I know Bilston well; it is a black sooty place, but I should not say that it was a very unhealthy town. I dare say that the drainage is not particularly good, but I can show you other places where the drainage is worse than it is there.

It has been said, that it has not underground drainage?—That may have been the case; but I know many places where the surface drainage is better than the underground drainage, the surface drains being more

readily cleansed; but in the case of defective underground drainage, there is very often an accumulation of noxious matters in the drains which it is troublesome and expensive to remove, according to the mode in which underground drains and sewers have generally been constructed.

In Birmingham, from the peculiar situation of the town, you have a good natural drainage?—The natural drainage is very good.

From the elevation of the town it may be said to have a better drainage than towns generally?—Yes, it is 450 feet or thereabouts above the level of the sea.

The inhabitants of Bilston have had the reputation of drinking more ardent spirits than the inhabitants of perhaps any other place in the kingdom. Is that the fact?—I do not believe it. Bilston is in the midst of Staffordshire, which is celebrated for its malt liquors; and I believe that the prevailing beverage of the lower classes of people in Bilston and that neighbourhood is beer and ale. I do not believe that the poor women and children, who were great victims of the cholera, were addicted to the drinking of spirits; of the 742 persons who died of cholera at Bilston, 430 were females and children under ten years of age. I may perhaps observe that, independently of the fear that we have of cholera, there is that which, in my opinion, is far more formidable than cholera, namely, the low fever which is spreading through the country, and which, independent of its immediately fatal effects, has a great effect in producing a low state of health, and in causing secondary disorders. Many poor people are brought to us in the hospital with diseased joints and bones, and glandular and other disorders, and when you ask them how the disease arose, their answer very often is, "It came after the fever." That, in my opinion, is the great enemy of this country in a sanitary point of view.

From your inquiries on the subject, do you consider cholera to be contagious?—I think there can be no doubt that the epidemic which prevailed in this country in 1832 was the consequence of a peculiar atmospheric condition, about which we know nothing but its effects. In both stages of the disease, where the patients were much separated from one another, and had abundance of pure air about them, there is great reason to believe that it was not contagious; but where they were crowded together as in hospitals, or in close ill-ventilated rooms, the persons of the patients and their excretions appear to have imparted to the atmosphere properties which rendered it capable of communicating the disease. When the poison in the atmosphere, if I may so term it, was in this way concentrated, the disease appears to have been contagious, but when it was diluted it was harmless. This seems to be the case with contagious diseases generally, and is found to occur in others, which, when the patients are separated or not much crowded together, are not contagious. Thus erysipelas and puerperal fever, when the patients are congregated together in the wards of hospitals or in close rooms, become contagious, although under other conditions they are not so. A certain degree of concentration appears to be essential to cause these atmospheric poisons to produce their effects, as indeed is the case with more material agents of that character. Perhaps my meaning on this point may be thus illustrated: give a man a teaspoonful of prussic acid and you poison him; put a teaspoonful of

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No. 1. prussic acid into a vat of water, and it will do no one any harm. So
 J. Hodgson, Esq. it is with regard to contagion, concentrate it and it will produce the disease, dilute it and it is harmless; and its proper diluent is pure air.

Would you rely upon any of the various substances classed, either as deodorizers, or as disinfectants, for extensive use for sanitary purposes?—In my judgment, they are useful; but I have not knowledge sufficient to enable me to say whether they could be used for sanitary purposes by public bodies, by which I mean whether it is worth while for corporations, and other public bodies, to employ any of them to mix with night-soil, or other refuse, for the purpose of rendering it less offensive or injurious to health.

Have you used any of those substances yourself in hospitals, or otherwise?—Yes, to get rid of smells, I have used them a good deal.

Have you found great relief from the use of them?—Yes; in getting rid of bad smells.

On the principle that all those bad smells are injurious, it is a good thing to get rid of them?—Yes; if you do not substitute any thing that is bad in their place.

Of which you cannot be certain?—Of which I have not sufficient knowledge to be certain; but I think it well to use them, and I do use them, and shall continue to use them, because they lead to the air being changed, which is a great point.

Which is the best substance, in your opinion, to use.—Chloride of lime is the thing which I have most used till lately; I have used Burnett's disinfecting fluid, as it is called, a good deal. I have not had sufficient experience of the others to speak of them. I have never used the sulphate of iron; there are objections to that; it stains the things and turns some of them black.

Are there objections to nitrate of lead?—I am not able myself to give an opinion upon the matter. We are in the habit of using acetate of lead in our lotions, and I have never observed any injury to the health of the patients from using it.

In all cases you prefer dilution by pure air to anything else?—Yes.

And the removal of the decomposed substances?—Yes.

No. 2.

No. 2.
 Nicholas
 McCann,
 Esq.

Nicholas McCann, Esq., states—

He is a surgeon, and resides in Parliament-street, and that Dr. Francis McCann, who went down to Bilston, is deceased, and was a relative of his. He died two years ago. He had been in India, and was well versed in the treatment of cholera: I was perfectly familiar with his treatment at the time, and adopted it. Whenever I was called in early enough to take advantage of the premonitory symptoms, I usually found his treatment successful, never once losing a patient.

The treatment at this stage (the premonitory), where only a slight looseness of the bowels existed, with or without pain, or sickness, was a small dose of calomel, with rather a large one of opium, given at once. Should the dejections continue, chalk mixture combined with aromatic

confection, ammonia, and tincture of bark was to be administered; and if the contrary effect be produced, namely, constipation, small doses of castor oil with peppermint, was to be given to regulate the bowels. An embrocation of heated turpentine and laudanum was to be rubbed over the chest and abdomen as a counter-irritant and sedative.

One doctrine which he enforced was, that whenever any one was seized with cholera, the patient should not be removed. In the removal he thought you lost stamina and time. He was decidedly against removals anywhere, excepting however cases where the patient was deserted. This was my own practice, and very fully carried out.

In the police division, which was under my care, I scarcely lost a man; the order being from me, for an early application upon any disordered or relaxed state of the bowels. Some certainly were lost, where the premonitory stage was not taken advantage of, according to the plan of treatment I pursued.

At the period cholera made its first appearance in Westminster, in the years 1831 and 1832, the opportunity then afforded me was extensive, being connected with the largest and only dispensary in the neighbourhood of Parliament-street, and also being surgeon to the metropolitan police.

In carrying out my friend's views, and his mode of treatment, I made a division of cholera into two stages: namely, the premonitory and the collapse, for, unfortunately, but a short period elapses between the one and the other, particularly if the former be neglected, which, he said, was always to be known by the sensation of griping or uneasiness in the bowels, accompanied sometimes with one or more evacuations than ordinary.

I consequently, taking advantage of his experience, subdivided the two stages, which led me to the following conclusions respecting the premonitory symptoms of cholera:—

1. That the appearance of true choleric symptoms (vomiting and purging of fluids, neither feculent nor bilious, with cramps and great debility) was preceded, in the majority of cases which have occurred, by a marked relaxation of the bowels, that is by frequent fluid dejections, constituting the complaint denominated simple diarrhœa.

2. That this diarrhœa, in a great many cases, presented for a time no peculiar character, so that no medical man could conceive, when called early to a patient labouring under it, whether an attack of cholera was impending or not.

3. That in other cases the evacuations were, from an early period, more like those which take place in cholera than in diarrhœa (more fluid, whiter and less feculent), and that this character was assumed, more or less, in many cases before the invasion of the usual choleric symptoms.

4. That cases of premonitory disease have been met with and successfully treated by the ordinary remedies such as I have before described.

5. It would appear in England an attack of cholera has, generally speaking, been preceded by a relaxed state of the bowels, and that the dejections connected therewith have, sooner or later, presented to the medical observer some indications of the danger to which the patient was exposed.

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6. On this account an early attention to bowel complaints of all kinds must, as a measure of precaution, be of the greatest importance to persons located in districts which are infected.

To carry out this view, a proclamation was issued at the instance of my friend Dr. Francis M'Cann, from Gateshead Board of Health, to induce the people to apply for medical assistance, without loss of time, on the first attack of diarrhœa.

From my own observations and experience, I have arrived at the conclusion, where that disease attacks individuals, that in ninety-nine cases out of every hundred the premonitory symptoms (in other words, diarrhœa) precedes each and every attack, showing the necessity of making the earliest application for medical aid, and the great danger the patient incurs in neglecting such a necessary precaution.

When assistance is not at hand, and cramps in the legs, arms, or belly are felt, with looseness or sickness of the stomach, the treatment suggested by my friend at this particular stage might be adopted. He prescribed a table-spoonful of mustard powder, mixed in half a pint of warm water, a third part of which is to be taken every ten minutes, until free vomiting be produced; after the stomach has been well cleared out with more warm water, thirty minims of tincture of opium should be given in a glass of warm brandy and water, to be followed up by the administration of five grains of calomel and two grains of opium, small doses of both these to be taken at intervals of every two hours, and the chalk mixture, as before described, after every loose evacuation, as also the form of embrocation to be rubbed over the chest and abdomen.

My friend also strongly recommended free ventilation and cleanliness of the apartment; he pointed out warm clothing and well-regulated diet, as some of the chief means of restoring the sick and preventing consecutive fever. He impressed the great importance of keeping the apartment of cholera patients in the cold stage at a temperature of 72° Fahrenheit, and when reaction had taken place, not more nor less than 60°. He also advised the abstraction of a few ounces of blood from the arm at this stage. The most prominent precautions in guarding against such a frightful disease as cholera are:—cleanliness, temperate habits, and warm apparel, which, in addition to an early attention to the state of the bowels, cannot be too much impressed upon the public mind.

With respect to the sanitary condition of the locality in which I reside, I must beg to state that both drains and sewers are very badly regulated in the several streets around me; particularly Crown-street, Charles-street, Gardener's-lane, and Princes-street; the noxious effluvia arising from these streets is of a very pernicious character; so much so, that a most respectable family whom I attend, and who resided in Cannon-row, during four or five years, was scarcely ever free from the deleterious effects of a tainted atmosphere. Both adults and children were constantly suffering from typhoid infection, sore throats, or low fever, until they removed to a healthier locality, though not far distant, where I attend them still; but on account of their improved health, my assistance is now only required in ordinary cases.

This at once proves the foulness of the atmosphere, which must be contaminated with impurities arising from bad sewerage and drainage

and in these localities I do not hesitate to say that cholera would be most likely to rage and become malignant, for even at the present time, from my own personal knowledge, these situations are seldom or ever free from low scarlet-fever, small-pox, and measles, which frequently assume the character of typhus.

I attribute these sad results to the deteriorating influence of the generally contaminated air, although the streets are well supplied with water from the Chelsea Company, whose secretary, Mr. Lind, was good enough to give instructions, by the direction of his Board, that the public might, during the summer season, have a sufficiency of water supplied gratis, to ensure the washing and cleansing of the streets from their superficial filth.

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No. 3.

Dr. Lyon Playfair examined.

Public attention has been a good deal drawn lately to the different disinfectants that are available in the case of epidemics. Have you, as a Commissioner for Inquiring into the means of Improving the Health of Towns, been led to pay attention to the subject of noxious miasmata, and the chemical appliances available against them?—I have, both as a Commissioner of Inquiry and as a chemist, the subject being of a very interesting nature.

How would you define disinfectant substances?—What are commonly called disinfectants may scientifically be divided into three classes; first, true disinfectants—that is, those substances which act upon miasmata, or infection already existing; secondly, disinfectants improperly so called, which act by preventing decay or the emanation of miasm from organic bodies; and, thirdly, deodorizers, or those which take away the odour without necessarily taking away the miasm or infection. I would therefore class them as *disinfectants*, *decay preventers*, and *deodorizers*.

Will you give examples of each class?—The true disinfectants are of various kinds; and therefore, before I can be understood, I must again be allowed to make some preliminary observations. An agent so subtle in its nature as miasm or an infection can only be combated by an agent capable of reaching it, and in this respect somewhat as subtle as the infection itself. Thus it would be almost impossible to act upon a gaseous miasm or a gaseous infection, either by a solid or a liquid disinfectant, because these cannot penetrate into the recesses into which a gaseous miasm can, and therefore a gaseous infection or contagion can only be thoroughly combated by a gaseous disinfectant. It is well known that decaying emanations have a great tendency to be absorbed by porous materials, such as the walls of rooms, or by paper, and no solid or liquid disinfectant acting locally can penetrate into those places into which the gaseous miasm has entered. As an example of a gaseous disinfectant, chlorine gas is one of the most common and efficient. This body acts by destroying the nature of almost all decaying substances in a gaseous state, and forcing them to enter into rapid oxidation by means of the air. If oxidation be once effected, the character of a miasm or infection is lost, and it ceases to be injurious to the

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animal system. Chlorine is a disinfectant, very applicable to some miasms, though often inefficacious for others; for example, in cholera it has not been found to be so advantageous as was expected. In Russia, experience has not been favourable to the use of chlorine in cholera. Sulphurous acid gas, obtained by burning sulphur, and nitrous acid, an acid obtained by boiling starch with nitric acid, have been found more efficacious in many kinds of decaying emanations. Chlorine for ordinary decaying miasms, such as those produced from marshes or heaps of decaying matter, has been found generally efficacious, but it is not such a good deodorizer as many other substances.

You state that chlorine has been found to be efficacious under certain circumstances; where is the evidence, or what papers can be referred to, to show the experiments and the results? How can we consult the evidence?—The papers which are most applicable to the present Commission are Mr. Ramsay's evidence with regard to the use of chlorine and chloride of lime, given at Edinburgh. This evidence was elicited during the late Health of Towns Inquiry: there are also frequent cases of the same character mentioned in the Report of the Health of Towns Commission.

Is there any evidence at all, even with respect to this gas, of its perfect and certain operation? Have you seen evidence that you deem conclusive as to its certain action?—No; certainly not, as to its certain action, but much as to its alleviate character.

In the case of cholera?—I have no personal experience in cholera.

But have you seen recorded, experiments which satisfy your own mind?—Not with regard to cholera. I merely know this from the journals and experience of medical men in Russia.

Are you aware of the chemical composition in use in paper manufactories for bleaching paper?—Yes; it is generally sulphurous acid or chlorine.

Chlorine and sulphurous acid gas?—Yes, or chloride of lime. It differs in different manufactories.

Were you aware that no cases of cholera ever occurred, either amongst the paper-mills or in their immediate neighbourhood?—No, I was not aware of it.

If such were the case, you would attribute it to the use of these disinfectants?—It might be so; but unless I knew the other conditions, I am not prepared to say that it was owing to that circumstance alone.

Are you aware that in Paris, chlorine is used very liberally, but that we have seen, with respect to cholera, no recognition by the French medical men of evidence of its efficacy?—In all the papers that I have read upon the progress of cholera, except in a very few instances, chlorine does not seem to have been a specific against that gaseous infection.

Are you aware of anything like satisfactory evidence of diminution or mitigation of infection from the use of chlorine?—In the case of fever of the typhoid type, I have had abundant proofs, but not with respect to cholera. Mr. Herapath, of Bristol, speaks of instances, and states that his experience is favourable to its efficacy.

With respect to the class of gaseous disinfectants to which you attribute this efficacy, would there be any danger in the use of them popularly?—

An indiscriminate use of chlorine, without understanding its nature, would be injurious. If you trusted the evolution of chlorine, by giving the materials to a cottager, in order that it might be made at pleasure in his own house, he might do himself much injury, by incautiously allowing the fumes to escape. In regard to chlorine, though we have no evidence of its having been extremely favourable to cholera, still as it is known to act in destroying decaying emanations generally, I should be very much inclined to recommend its use in the event of the cholera coming to this country; because, even if it did not act specifically upon this gaseous infection, still it would act on other decaying emanations which are well known to favour the progress of the disease. I would, however, recommend it to be used by public scavengers, or a public body of cleansers. The most useful results have followed this course in Edinburgh, during the various fevers which have raged there. The public scavengers have been employed to fumigate the rooms where fever was supposed to exist, or those rooms where filth had been known to abound; and also to whitewash, very extensively, filthy rooms of cottages where infection had prevailed, or was likely to occur. In such cases, it was usual to put a little chloride of lime in the whitewash; several very decided cases of its efficacy occurred whilst the scavengers were engaged in this operation. In one case which I may mention, a house had been successively inhabited by a number of tenants, and each succession of tenants had been obliged to remove on account of the fever. The scavengers entered into this house by direction of the public authorities, and whitewashed it, after which no case of fever appeared. This was a clear case of fever having successively happened, and after the use of the means, the fever entirely left.

The house continued to be occupied by the same class of people?—Yes; so I understand by the evidence.

Have you not heard of similar results from whitewashing with simple lime?—Whitewash with simple lime is one of those things which might be called a disinfectant; because, where it comes in contact with the contagion, it is almost sure to destroy it; but it is one of those substances which only reaches the immediate sphere of its own action. It cannot penetrate into the recesses into which the gas penetrates. Lime acts by causing the body quickly to decay, and therefore in this sense, it is a disinfectant if it come into actual contact with the infection.

Suppose a room very barely furnished, and the infection chiefly remaining in the absorbent walls, would it not at once be almost certain to be effectual if they whitewashed the room with lime?—Certainly, if contact ensued. In the instances to which I alluded, the instructions to the scavengers were, to be apparently as careless as possible in their habits of whitewashing; thus they were ordered, in washing the walls of the room, to scatter the whitewash all over the furniture and the floor. That was done to oblige the people afterwards to cleanse them; so that the effect of the apparent carelessness of the scavengers was to make a thorough cleansing of the whole house, and a very favourable effect was thus obtained.

I presume that this scavenging process in Edinburgh, to which you chiefly refer, was conducted under foremen of better intelligence than

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the ordinary scavengers that we meet here?—The superintendent of the scavengers was a very intelligent man; the scavengers under him were the ordinary class of labourers. I may mention also, that I have seen the beneficial effects of this whitewashing in Bolton, where it was done very extensively during the late distress, and the effect was highly favourable, as is shown in the evidence in, and the Report upon, Lancashire. When whitewashing is done on a large scale, it is found to be a very economical operation: the expense per tenement being not more than 7*d.*, including labour, or 5½*d.* for materials; and for this small sum, the houses of the poor may be efficiently whitewashed. I coincide with the experience of the superintendent of scavengers of Edinburgh, that it would be a wise expenditure of public money to whitewash gratuitously all houses under a rental of 7*l.*, on the apprehension of an epidemic.

You are speaking more in reference to common fevers than to cholera?—I am speaking more in reference to fevers, and decaying emanations generally, than to cholera; but I think it would be a certain means of alleviation in case of cholera. At all events, it would be a means of reducing the injurious effects of decaying emanations, even if it had no immediate effect upon the cholera, and therefore it would alleviate its action.

Should you not say that that which would be useful in the one case must be useful in the other?—So analogy would lead us to expect.

In reference to the whitewashing which you describe in Bolton and Edinburgh, was there an infusion into the whitewash of a certain portion of chloride of lime?—Only in the case of those tenements in which disease was known to have existed; but extensive whitewashing was undertaken with a view to get habits of cleanliness among the people, as the means of preventing contagion afterwards reaching the place.

Would you recommend, that, in case any provision were about to be made for cleansing, in order to avoid the spread of cholera, chloride of lime should be used?—I think the whitewash would be sufficient except in cases where infection has existed.

Where chloride of lime is used in houses, is the odour of it very disagreeable?—No; being mixed with the lime, it is very slight; and I may mention upon that point, that although chlorine gas cannot be used extensively as a disinfectant by the poor themselves, yet there is one means of using it in private houses, and very easily too; this is by spreading out upon plates a quantity of chloride of lime, and placing them in the different passages of the house. The action of the carbonic acid in the air gradually evolves the chlorine, and this chlorine spreads itself through the house with an odour so faint as not to be disagreeable, indeed, rather agreeable than otherwise; and in that way it may be used beneficially. Chloride of soda would answer this purpose better than chloride of lime.

Could it be used in a room?—Quite well; the smell is so slight that it is rather agreeable than otherwise.

What are the simplest means of producing these gaseous disinfectants on a large scale?—Chlorine may be made by mixing peroxide of manganese with muriatic acid, and heating the mixture by a gentle heat; sulphurous acid is conveniently prepared by burning sulphur in

a chauffer; and nitrous acid by boiling sawdust or starch with nitric acid.

Are those all the disinfectants on record?—They are not all that are on record; but they are the principal gaseous disinfectants, easily and economically available.

You have now described the cheap gaseous disinfectants; will you state what are the liquid disinfectants with which the chemist is at present acquainted?—The liquid disinfectants may be solutions of substances containing those gases. For example, a liquid disinfectant used in France is sulphite of soda, which contains sulphurous acid, which I have described as a disinfectant, united with soda; this salt is a solid usually, but when dissolved in water it acts as a liquid disinfectant, and has been used for that purpose extensively in anatomical theatres. Chloride of lime in solution, which contains chlorine gas, easily available, is also frequently used as a liquid disinfectant. Those are the principal disinfectants in the first class which are mentioned as disinfectants altering the condition of the body, though there are many others that are used to prevent bodies from entering into a state of decay.

Will you state what the value of these disinfectants is, as compared with gaseous disinfectants?—For the reasons I have stated already, I think these liquid disinfectants are not so efficacious as substances in a gaseous state, because they cannot penetrate every crevice and corner into which the subtle miasm or infection can penetrate.

But when they do come into contact with the miasm they are equally efficacious?—Yes, no doubt of it.

You have spoken of gaseous and liquid disinfectants; are there any solid disinfectants?—There are some substances which, having a great absorptive power for gaseous decaying matters, might be called disinfectants. For example, charcoal has a great absorptive power; burnt clay and other such substances might also be mentioned.

That is used for filters?—Yes, for the purpose of removing the decaying and colouring matter.

Has animalized carbon any preference over wood?—It has, because it exposes a much larger surface, and it seems to act always by its surface.

That disinfectant is employed to absorb decaying animal substances in water?—Yes.

Having described gaseous, liquid, and solid disinfectant substances, will you describe those chemical bodies that act in prevention of decay?—The substances acting in the prevention of decay are very numerous; for example, all sorts of mercury, principally corrosive sublimate, which is extensively used for this purpose.

In what way is corrosive sublimate used?—It is either mixed with the decaying substance, or the substance liable to decay is immersed in it. If you want to protect wood from decay, and it is immersed in corrosive sublimate, it does not readily enter into decay. If it is desired to prevent night-soil from becoming putrid, and a little corrosive sublimate is added to it, putrescence is in a great measure prevented.

The corrosive sublimate arrests the decomposition?—It arrests the decomposition by uniting with the animal matter, and that animal matter then does not enter into a further state of change. Arsenious acid, or what is commonly called arsenic, is also very efficacious in

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that respect, and the more efficacious because from the very high equivalent of organic matter, a very small quantity of either of those substances may produce a very great effect. There are other substances which principally by their mechanical action prevent decay, such as putting iron rust round wood or other decaying matter. It prevents the mechanical contact with the air, and therefore decay is prevented. In the same way lime-water is often used: lime-water, by absorbing carbonic acid, forms a crust of carbonate of lime round the substance, and the mechanical access of the air is thereby prevented. But those are not strictly substances which prevent decay by themselves; their principal action is mechanical. There are some other substances which have a tendency to unite with the particular constituents of animal bodies and animal substances, and therefore act partially as disinfectants, but they are easily decomposed. For example, salts of lead and salts of zinc form insoluble components with many animal substances, but they are much more easily decomposed than the corresponding compounds of arsenic and mercury. As an instance of this, the Painter's Colic may be prevented by sulphuric acid, or what is called the Painter's Lemonade, because the sulphuric acid is able to decompose the lead salt formed by the lead with the animal compounds in the body, whereas sulphuric acid has no effect upon the stronger combinations of arsenic and mercury, the compounds formed by them not being thus decomposed.

Having described these gaseous, liquid, and solid disinfectants, and also those chemical substances which prevent decay, will you describe the other class which appear to remain to be described—the substances that, according to your view and the view of chemists, simply deodorize substances giving off the offensive odour of decomposition?—Those substances which are practically used as deodorizers are salts of iron, salts of manganese, salts of lead, salts of zinc, and a variety of salts of other substances.

How long have these been used?—Some of them have been long used; others have not been employed extensively. Sulphate of iron has been applied for a very long time for that purpose. Salts of manganese and zinc have also been so employed for a considerable time. Salts of lead, or nitrate of lead, have not been used before 1845, so far as I am aware.

Will you state in what way those substances produce the effect of deodorization?—Almost all those substances that I have mentioned are, for the ordinary purposes for which they are employed, equally efficacious, and for this reason:—Some of them, such as sulphate of iron, will not take up free sulphuretted hydrogen, and, therefore, will not deodorize sulphuretted hydrogen where it exists in a free state; but in decaying animal matter the sulphuretted hydrogen is rarely if ever free.

That is to say, the gas that gives off an offensive smell?—Yes. It is the hydro-sulphate of ammonia, and not sulphuretted hydrogen, which will be very readily seen from this: in any place where night-soil is, we perceive strongly the smell of ammonia distinct from that of sulphuretted hydrogen, and they could not exist together without being united, so that the deodorizing gas is almost always hydro-sulphate of ammonia; and from this circumstance happens the fact, that almost all those substances are equally efficacious as deodorizers.

Supposing the deodorization effected, is there any evidence, and, if

any, what, that the extinction of the smell affects in any, and, if any, in what degree any noxious miasm that may be supposed to be caused by the decay of the animal substance?—We may take as an example of the most simple, and most powerful of all disinfectants, the heat of boiling water. There is no miasm or decaying emanation that can bear the heat of boiling water without being totally changed in its properties; and no substance in a state of decay can be exposed to the heat of boiling water without the decay being wholly arrested. The heat of boiling water may, therefore, be called the most powerful disinfectant, and yet we well know that putrid beef may have been exposed to the heat of boiling water, and the putridity thus arrested; but the beef will decay as much as ever after it has been exposed to the atmosphere for some time and returned to its ordinary temperature. The arrest of the decay has, therefore, only been temporary. So is it generally with deodorizers of putrid substances; the decay of the substance may be wholly arrested, or even prevented, but the other matter which has not yet gone into a state of decay will decay just as much as if those deodorizing substances were not present, unless such an extraordinary quantity is applied as in fact to render its application wholly unavailable for practicable purposes. These deodorizers, therefore, in certain cases, instead of having a favourable action, may have a decidedly injurious tendency, and for this reason: the odour is the best means of telling us that there is danger of a decaying emanation. There may be a miasm, as is often known, or an infection without the presence of any odour.

It may be presumed that there are cases of fever and of various epidemics which are not accompanied with the antecedent warning of an offensive smell?—Yes. Not accompanied with smell so far as we can ascertain from our senses. Many persons are able to detect odours from their senses being more acute than others; in the same way that many persons cannot hear the sound of crickets, while others hear it very painfully. About 18 out of 20 persons perhaps have no idea of the shrill scream of a bat, whilst two out of the 20 know that it is one of the most piercing cries they can hear. Hence in all instances it is very dangerous to trust to the senses merely. A deodorizer ought, in fact, to be looked upon only as the perfumes about a century since, when perfumes were used merely to conceal the odour of unwashed and filthy persons. Eau de Cologne does not prevent the town bearing its name from being one of the most filthy in the kingdom; and a deodorizer may often be only a convenient means of concealing filth where it exists in abundance. It is going back in our knowledge to require and use deodorizers. The progress of knowledge requires a removal of the cause, which is now known and ought to be removed. If decaying emanations were prevented by thorough cleanliness and ventilation, we would not require so clumsy an artifice for their concealment or mitigation. In cases of hospitals, where night-stools have to be used in crowded wards, deodorizers are useful; but I speak of the subject generally, without reference to such exceptions. People are at all times, by custom, too apt to neglect the warning of smell, and, therefore, if it were thus artificially prevented, carelessness of decaying emanations would be still greater.

Have you had occasion to examine the various deodorizers of the

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class which have been called disinfectants?—I have had occasion—not in my official capacity—to examine them; but I have examined them occasionally. In the case of nitrate of lead, or M. Calvert or Ledoyen's process, Mr. R. Phillips and myself have been called upon officially to examine and report, and though it acted as a deodorizer, it did not, in our opinion, act as a disinfectant, and, therefore, ought not to be used as such.

It would be dangerous to use it as a disinfectant?—I do not know that it would be dangerous to use it as a disinfectant, but it would not have the effect of one.

—How is it with respect to chloride of zinc?—It is a most useful deodorizer, but it does not answer the purpose of a disinfectant; even if it were one, it is a liquid, and not gaseous. I think that chloride of zinc and nitrate of lead are equally efficacious, perhaps, with this one exception, that chloride of zinc is so extremely soluble, that in that respect it has the advantage, but as a deodorizer I would say that they are both equally efficacious.

If you make a very strong solution of salts in water, and wet clothes with them, and let the vapour escape out of these wetted clothes, do not you think that in that way you get diffused subtle portions in a manner closely approaching to a gaseous state, that is, that you get the vapour if not the gas?—I am sure that they do not thus rise into vapours. It is well known to chemists that there are one or two substances only which pass from a state of solution into vapour, and of which the water carries up some portions in suspension. Common salt is an example, and also boracic acid; but nitrate of lead and salts of zinc are known not do so; not the slightest particle of those would escape. A portion might be dissolved in water, the salt having previously been weighed with the greatest care, so as to ascertain its weight within the thousandth part of a grain, and after evaporating the water, you would find exactly the same quantity with not the loss of a thousandth part of a grain of that which you had evaporated.

No appreciable quantity escapes?—No.

But still some subtle portion might escape, though you could not weigh it?—But that is an hypothesis unsupported by analogy. It is more probable, from analogy, that it would not be so than that it would. The cases in which substances do lose by evaporation are only one or two exceptions to the rule; in all the other cases we do not know of its occurrence.

Do these deodorizers, take, for instance, nitrate of lead, stop the decay of animal matter?—Nitrate of lead does so partially in the way I mentioned. It coagulates the albumen, and forms, with part of the albumen, an insoluble compound, and, so far as it does that, it prevents decay; but the small portion which is added to a large quantity of decaying animal matter makes it only such as to be brought within the class of deodorizers, because it probably leaves more than 99-100ths uncombined with the lead, and therefore having still a tendency to decay.

But if you found that these deodorizers destroyed smell, when used in the way I have described by evaporation from wetted clothes diffused through a room, how should you account for that if no portion of the deodorizer in any way were diffused?—I should ac-

count for it simply from the circumstance, that in passing it through the room, it came into contact with the sulphuretted hydrogen, but in no other respect, in my opinion, does it do so, except where it comes into actual contact; when it acts in this way, all that it effects in the case of a gaseous smell is to remove the sulphuretted hydrogen only, not any of the decaying miasm, this substance not having the character of the animal bodies with which only it unites. I may mention that the use of nitrate of lead was communicated to the Academy of Science in 1845, by a chemist of the name of Monsieur Lemaitre de Rabodanges. It is given in the Transactions of the French Institute of 1846, and it is also described in several journals of chemistry as being known and employed abroad; for example, I now hold in my hand the Annual for 1846, in which it is contained.

These annuals are circulated in England?—Yes.

And this which you refer to is also circulated in England?—Yes, very extensively.

With respect to the operation of nitrate of lead in changing colour when it meets with sulphuretted hydrogen gas, had it not been used for that purpose for some time by chemists?—Yes, so constantly that I may mention that when I witnessed the experiments of the patentees of this nitrate of lead in this country, without knowing what they were doing, I had with me papers macerated with nitrate of lead, and bottles containing solutions of nitrate of lead, merely to test whether the odour was thoroughly taken away. That was before I had the slightest idea of what substance it was that they were about to make use of.

Were you told what the substance was?—No, it was kept a secret.

Did you state your belief of what it was?—I stated my belief that it was salt of lead, having no opportunity of knowing what salt, as we were not allowed to take a portion in order to test it. This salt is commonly used in all laboratories for removing sulphuretted hydrogen.

You speak of the nitrate of lead having been confined to laboratories, are you aware of its having been used at all by families as a means of ascertaining whether there was the presence of sulphuretted hydrogen in their water-closets, or in their houses, from sewers?—I may mention that I had constantly used it as a test for many years, for the purpose of ascertaining whether any sulphuretted hydrogen was coming up from the sewers or from the gas, but I do not know of its having been used on the large scale as a deodorizer before 1845.

Chemists had used it, but you are not aware of its having been used generally by families?—No, nor am I aware that chloride of zinc or sulphate of iron were used generally; for there was no knowledge among the public of their action, although every tyro in chemistry was familiar with it.

Does sulphate of iron act as a deodorizer?—In reference to night-soil and animal matter, where there is more ammonia than sulphuretted hydrogen, it has been used for many years.

With reference to the action of sulphuretted hydrogen, is not that action strongly marked on common white paint; the greater blackness in privies of the paint of white lead than in other places?—Yes, very much so.

And also in cities by the rapid change of the colour of the lead

No. 3.
Dr. Lyon
Playfair.

paint?—Yes, especially where gas is. But it must be observed, that sulphuretted hydrogen is very distinct from miasm. To take an example: in gas works, where, from the decomposition of gas refuse, there is always an abundance of sulphuretted hydrogen about the works, in those very works it is matter of common report, that contagious fevers are less apt to come than into other places; at least, in my inquiries in Lancashire, all the managers of gas-works stated that as the result of their experience; so that the miasm and the effect of sulphuretted hydrogen are two very different things.

Supposing the development of ammonia in large quantities to be injurious, can that be remedied by nitrate of lead or any of the other deodorizers?—By far the best substance for that purpose is sulphate of iron, which may be got on the large scale at less than a farthing a pound, and is very efficacious.

How would you use it?—In solution.

What quantity?—It depends entirely upon the state of decay. A moderately strong solution should be put in till the odour disappears. Chloride of zinc and nitrate of lead are also good; but I should recommend both the others for domestic use, in preference to nitrate of lead, from this circumstance, that they are not so apt to be dangerous from ignorant use.

Will you describe the danger attaching to nitrate of lead from indiscriminate use?—It is a highly poisonous salt. Painters who are well aware of the effects of lead upon the system, and who are handling the paints with that previous knowledge, are not able to avoid the colic well known by their name.

Then the use of a strong solution of nitrate of lead in any quantities, if repeatedly used, might be attended with bad effects?—Yes, if repeatedly used, but if only occasionally used there would be no danger. I conceive that you cannot leave a dangerous ingredient in the hands of ignorant people without dangerous consequences; the application of any dangerous remedy is always to be carefully guarded.

Therefore, in point of safety, you would prefer zinc and iron?—Yes, but I would prefer salts of manganese in many cases, on account of their cheapness, and on account of their being rather favourable than injurious to agriculture in the application of manure.

You have paid attention to the application of chemistry to agriculture, which do you think is most applicable to night-soil, with a view to the use of the soil afterwards as manure?—I think they are all useful by retaining the ammonia, which would otherwise escape along with the sulphuretted hydrogen. The strong acid in this salt retains the ammonia, and prevents volatilization. They are all, therefore, equally useful in this respect; and from the small quantities in which they are applied, their injurious action on the soil would be very little.

What would be the nature of their action on the soil?—In some cases: for example, in the case of sulphate of iron, it would be injurious by adding so much iron to soil in a state of protoxide. In other instances, except that of manganese, it would be unfavourable.

What would be the effect of nitrate of lead?—In too large quantities it would be unfavourable. As it is usually applied, it would not be either injurious or beneficial.

You are aware that the abundance of town manure in large towns destroys all the value of it, and that the main expense is the collecting and carting of it, and labour in the application. Should you, on the whole, say, considering the expense of these cheapest applications, that it would be worth the while of a practical farmer agriculturally to employ any of the cheapest of these deodorizers?—Certainly, the cheapest and equally effective fixer of ammonia for the farmer would be common gypsum; but this is not a very efficient deodorizer. The farmer does not care for the removal of the smell. Should he wish the odour removed, then the application of salt of iron and salt of zinc, or, perhaps salt of lead, which is a very expensive form of deodorizer, would prove useful in retaining the ammonia, and also enabling the cesspools to be opened more easily; but I think at the same time we have made very little progress in public hygiene if cesspools be suffered to remain in cities. The whole progress of the recent inquiries into public health has pointed to the necessity for their prevention; and it is not a hopeful sign of progress in the public mind when we see alleged inventions hailed with pleasure, when these relate to subjects which have been repeatedly shown to be inadmissible in a healthy community.

No. 3.
Dr. Lyon
Playfair.

No. 4.

Professor Graham.

REMARKS ON DR. PLAYFAIR'S EVIDENCE.

No. 4.
Professor
Graham.

He quite agrees with Dr. Playfair in his estimate of gaseous disinfectants. They are the only agents which can possibly reach and destroy miasms in the air. Trustworthy observations are all against any dependance upon chlorine as regards cholera. The poison of that disease appears not to emanate directly from the bodies of the sufferers, but to be extraneous in its origin, or at least to require extraneous support, and to be too extensively diffused in the atmosphere for such means of combating it.

There are speculative objections to chlorine in particular. From the energetic chemical affinities of that gas it acts on the ammonia and other matters, besides miasms in the air, and is thus wasted; again, in minute quantity it is quite as likely to assist the action of contagious agents as the reverse, in the way in which it is known to act in favouring vegetation. Sulphurous acid gas (obtained by burning sulphur) is preferable on theoretical grounds. No agent checks more effectually the first development of vegetable and animal life. This it does by preventing oxidation. In the same way it renders impossible the first step in putrefactive decomposition and fermentation. All animal odours and emanations are most effectually and immediately destroyed by it. At the same time typhus in hospitals presents, I believe, a much better field for the application of this gaseous disinfectant than cholera.

In the great chemical works of Messrs. Tennant, at Glasgow, it is found that chlorine does not give an immunity from fever or cholera to those actually engaged in the preparation of it.

Whitewashing with lime, which covers up (or destroys) the sort of

- No. 4. animal varnish in a state of decay upon the walls of inhabited rooms, is undoubtedly a most beneficial practice.
 Professor Graham. Professor Graham concurs generally in Dr. Playfair's conclusions.

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 J. T. Cooper,
 Esq.

No. 5.

J. T. Cooper, Esq.

REMARKS ON DR. PLAYFAIR'S EVIDENCE.

There can be no doubt but that chlorine in some form or other is, of all the substances with which I am acquainted, the best adapted for the purpose of destroying or changing the character of putrid effluvia, to which, I believe, the noxious or poisonous matter given out by decomposing substances, to be owing rather than to any specific poison or miasm evolved by the decay of either vegetable or animal substances.

I should think the acid gases to which Dr. Playfair has alluded, inferior in their action, but nevertheless useful, especially sulphurous acid, as it is easily and cheaply obtainable.

If it be true that cholera did not appear in paper manufactories, might it not arise from the extreme cleanliness observed in every part, as much as from the presence of chlorine?

I am of opinion that the putrid matter given out by decaying substances, which is of course in a vaporous or gaseous state, is absorbed by all porous bodies, and that whether chlorine or any other substance be employed to render it innocuous, the gaseous or vaporous form is the best for the purpose, as stated by Dr. Playfair.

Salts of lead and zinc, as indeed most metallic salts, are injurious to vegetation, hence the employment of them in the sewers would render their contents in some degree inapplicable to fertilization; and as all the sewers discharge themselves into the Thames, mischief might arise to those who drink of that water.

I am of opinion that further evidence is required as to the statement of Dr. Playfair, that boiling water is the most powerful of disinfectants.

I assent to the opinion that deodorizers may have an injurious tendency, as the odour given out by decaying matter, like that of coal gas, is the best test of its presence, and warns us of danger.

What has been, in my opinion erroneously, termed marsh miasma has no perceptible odour, and as far as I know, or have been able to learn from persons living in aguish districts, has never been recognized. I should be inclined to give the preference to chloride of zinc as a deodorizer.

It is difficult to conceive how chloride of zinc could act in removing the noisome smell of a sick ward, but I have been assured by a very high authority that such is the case.

I have known individuals who have been employed for years in an atmosphere largely impregnated with sulphuretted hydrogen, as in gas-works and in tanneries, without appearing to suffer from its effects. In tanneries, incipient putrescence only takes place, and it is animal matter only, or for the most part, that undergoes decomposition. Vegetable matter which decays in the marshes and ditches, and in the sewers (in the latter with animal matter), I think to be the probable

cause of great mischief. Also, in those places where bones are collected in large quantities, and where they undergo various operations, such as boiling, &c., as far as my observation has gone, the individuals appear healthy. It appears to me, therefore, that the decay of vegetable matter is fully as much to be dreaded in its influences on the animal system, if not more so, than that of animal matter. The prevention of the accumulation of either cannot be too strictly enjoined; and where these accumulations occur, if they cannot from circumstances be readily and efficiently removed, cleanliness of the persons and their habitations with fumigations of chlorine, or sulphurous acid, should be insisted on. Not that it is my belief that by this fumigation we act on what has been called miasm or infection, but that we act on the putrid and other tangible matters eliminated. These matters, I conceive, depress the vital powers, and render the system of the individuals under its influence more prone to the attack of disease, and especially to any disease which may be supposed to arise from atmospheric causes.

Mr. Cooper agrees generally with Dr. Playfair's conclusions.

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J. T. Cooper
Esq.

No. 6.

Robert Bowie, Esq., Surgeon.

REMARKS ON DR. PLAYFAIR'S EVIDENCE.

No. 6.

R. Bowie,
Esq.
Surgeon.

I have read with much interest Dr. Playfair's examination, and think many of its points well worthy of being tested by careful experiment.

For my own part I have always placed more confidence in the proper admission of air, light, and regulated temperature, with a strict regard to cleanliness, for the prevention of disease than I have in any disinfectants with which I am acquainted.

As to chloride of lime, I attach but little value to its power of preventing either fever or cholera, for before the outbreak of fever in Globe-street, Wapping, in 1831 (described in my evidence), and during its continuance, the wards were frequently sprinkled with a solution of the chloride during the day, and fumigated by means of the gas every morning. If ever it ought to have succeeded it was there, for it smelt throughout the whole building, and had every chance of having a fair trial, every officer of the asylum placing the greatest faith in its efficacy. It likewise failed in my own house, although used so plentifully as to destroy a few flowers in our upper rooms, some of which we had preserved for years. And I have smelt it in vessels where it had been used to prevent cholera whilst attending patients labouring under that disease.

Believing that bad smells during certain conditions of the atmosphere are likely to excite disease, I am of opinion that the deodorization of decaying matters is of considerable importance; but I hope that by improved sewage and drainage, any experiments made for ascertaining disinfecting properties may be conducted at a safe distance from habitable dwellings.

The lime-washing of the apartments of the poor I consider likely to be very beneficial; but I think it would be desirable to get the occupiers to do the laborious part themselves, encouraging them by the

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loan of pails and brushes, and the presents of lime, and a small quantity of coal to dry their rooms, in order to prevent any injurious consequences from dampness of the floors or walls.

The sending of currents of heated air through badly smelling clothes I have seen attended with most satisfactory results in the Eastern Asylum for the Houseless Poor, where the plan may be seen at work daily.

No. 7.
J. Young,
Esq.

No. 7.

James Young, Esq.

What is your profession?—I am chemical manager at the works of Messrs. Lennant, Clow, and Co. of Manchester.

Have you invented a process for disinfecting manure ; if so, will you describe it?—I will do so, making those preliminary remarks which I think necessary for its comprehension.

The present is a time when anything on the treatment of manures must be acceptable, whether for preserving the various refuse matters for agricultural purposes, or for preventing their decomposition in cesspools and such places, previous to their removal from the town to the country. One great sanitary problem, the solution of which has occupied much attention, is the prevention of decomposition in organic accumulations in towns. This has been partially accomplished by various methods, but the expense in some cases, and the noxious products in others, have proved a barrier to the adoption of any general plan. Any substance to be generally used for this purpose must be cheap ; and must not only have the power of preventing decomposition in the organic matter to which it is added, but must also be free from any noxious effects upon the land or vegetables to which this matter may be applied as manure.

Being engaged in the manufacture of chlorine on a large scale, it occurred to me that the chloride of manganese, which results from that manufacture, might have all those qualifications. The refuse of the chlorine process is principally chloride of manganese with a variable quantity of perchloride of iron, and is at present considered a useless product, one house throwing away 36 tons per day of this solution, of a specific gravity varying from 1280 to 1300.

Having made a number of experiments during the summer, I am satisfied that this solution has in a high degree the property of preventing decomposition in organic matter, several cesspools and other places which gave out the most putrid odour, having been almost instantaneously sweetened by its application, an effect heightened by a small quantity of free chlorine which this liquor always contains.

I need scarcely describe to chemists the action of this salt, the principal effect being that the chlorine combines with the ammonium of the sulphuret of ammonium and the manganese combines with the sulphur, thus forming chloride of ammonium, and sulphuret of manganese. The former is well known as a valuable manure, and the latter being in a flocculent state, will readily supply sulphur or sulphates to vegetables. The salts of manganese and iron are peculiarly fitted for land, both being employed by nature in feeding plants, both being akin to earths, and not possessing acrid metallic properties.

As there are at present in this country not less than 150 tons of this

solution produced daily, which is 5½lbs. per annum for each individual, from the experiments I have made I consider that this is more than sufficient to deodorize all the cesspools in Great Britain.

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I may add, that after considering the matter carefully in the different points of view which would naturally occur to a practical person, I mentioned the matter to Dr. Smith and Dr. Playfair, both of whom fully agreed in the views I had taken on the subject.

No. 8.

Richard Dugard Grainger, Esq., F.R.S.

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R. D. Grainger,
Esq.,
F.R.S.

You are a teacher of general anatomy and physiology in St. Thomas's Hospital?—I am.

The study of the action of physical agents, such as light, air, heat, and moisture on the human body, forms a proper part of your department of science?—It does.

Have you also paid attention to the effect of impure air in producing excessive sickness and mortality?—Yes, I have done so, knowing the vast importance of the question. I have always availed myself of any opportunity which might occur, by direct inquiry and observation, to ascertain the effect upon the human body of noxious admixtures with the air, or of noxious air or atmosphere; and having had, I may say, some experience in the largest towns in the kingdom, in Manchester, Liverpool, Birmingham, Nottingham, and London, I have had some means of forming an opinion upon the subject.

Have you studied the subject of disinfection?—Yes, certainly, as to the origin of infection, and, if possible, its prevention.

Did you not make an official report upon one agent of so-called disinfection?—I did, in common with two other gentlemen to whom the question was referred for examination. In conjunction with them I made a report to the Government upon a liquid proposed for use by a French chemist, Monsieur Ledoyen.

You first examined the effect of this fluid on substances already in a state of decomposition; what was the result of that examination?—In order to test, in the most efficient way, the action of this liquid, various vegetable and animal substances in a state of putrefaction and decomposition were prepared, such as decomposing vegetables and putrid fish, and putrid flesh of other animals, and putrid fæces, the discharges of the human body, which had been preserved in a moist and hot atmosphere for some days, in readiness for the experiment.

Did you preserve them yourselves?—Those were prepared expressly in a hot and moist atmosphere. The liquid of Monsieur Ledoyen was then applied successively to those various matters, and in each case the offensive and penetrating stench arising was almost upon the instant removed as soon as any action began to take place; this was most striking. The general effect seems to have been, to remove the fœtor of putrefaction, and to restore, in every case, the original smell of the matter, whatever it might be, so that when putrid fish was used, it took away the highly offensive odour, or fœtor, leaving, for example, the smell of boiled fresh mackerel. With reference to the flesh of other animals, it took away the fœtor, and left a smell of an oily kind of cha-

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racter, the smell that belongs particularly to what is called adipocire. Its effect was immediate and certain, and observed by everybody present, there being a large number of medical men and others.

Then in fact this fluid did not absolutely destroy the smell, but only removed the fætor?—It removed the fætor, the special smell of putrefaction in every case.

In those cases was the substance covered by the liquid, or to what extent?—In some cases the pieces of the substances being tested were put into the liquid, dipped into it; in other cases the liquid was poured upon them; but some were immersed, and with the fæces it was poured in and stirred. There were many other experiments subsequently of immediate contact with the surface.

In some cases were not the fœtid substances simply wrapped in cloths saturated with the liquid?—There were some pieces that were placed in wet cloths saturated with the solution.

Did you from that examination find this fluid to be possessed of any peculiar efficacy, in preventing substances from undergoing decay and decomposition?—It has the effect of retarding decomposition when it is applied under favourable circumstances. It appeared to me that if it were applied to large masses of the human body (for instance, to the arm), then it checked, but did not prevent, decomposition.

For how long did it check it?—I may mention that one experiment was this: a fresh extremity of a human body, brought for the purpose of anatomy, was injected with this liquid into the blood vessels, and that was kept, I believe, a month—for 20 days, at all events; and then it was examined, and it was found to be preserved. It may be said decidedly that it would have been in a worse condition if it had not been injected; it was preserved to a considerable extent, but it had not entirely prevented decomposition. And my general conclusion from that and other experiments of a similar kind was, that it does act like various other substances in retarding decomposition, but that there are other substances which have been in use for some time which are just as effective for that purpose. My conviction at the time was, that it might, with other agents, be useful for anatomical purposes.

But not possessing any special or striking efficacy for that purpose?—No, not striking, but that it might be useful with others.

You made several experiments to ascertain the effect of this fluid on night soil, will you state what you regard as the more important of the results obtained upon that subject?—The effect of the liquid upon night soil was in every instance without exception most marked and important. Various experiments were tried upon night soil in different states of putridity. Upon some in the most putrid state, giving out the most offensive, penetrating, and nauseating fætor, and in every instance, without exception, where the liquid was applied, it removed, in an instant, as soon as contact was made, that disgusting odour; and I was particularly struck with this, and so was every person who saw these experiments, all the by-standers, that what smell remained was fixed, and not diffusible.

It did not remove all smell?—It did not remove all smell. It seemed to reduce the night-soil to the condition of night-soil that you find on the road-side, in the country, which has been exposed for a long time to the air.

And even that smell you could not perceive at all unless you went pretty close to the substance?—Yes. I perceived, and so did others, that it was more fixed and less volatile. Knowing the importance of this, I took every opportunity of asking different observers of various ranks of life, who were present, what they thought, for I did not wish to trust entirely to my own impression, and their opinion in every case was, that not only was offensive odour removed, but that what remained was remarkably fixed, and could not be perceived at a short distance.

How did you mix the fluid with the soil?—The earlier experiments consisted in mixing the liquid with the night-soil, by stirring.

In what proportions?—In one case this quantity was applied; there were upwards of 2240 lbs. of night-soil, to which were added eight pints of the liquid.

Did you know anything of the nature of the composition of the substance before you took it in hand?—I knew it the day that the first experiment was made.

It being nitrate of lead, do you know the strength of it?—I am not aware of the exact strength.

In the case which you have now been describing, the fluid was intimately mixed with the soil. Did you make any experiments with the fluid merely poured on the surface of the night-soil?—Yes, I was particularly anxious that that should be tried, inasmuch as it occurred to me that if it could be made to act as effectually by that means upon the night-soil as it had been done by admixture, there would be much facility in the application of it for ordinary use. And particularly, it occurred to me, that if a privy was about to be emptied, knowing the horrible nuisance which that generally causes, it would be a great comfort to families and to the neighbours if, by the liquid being previously poured into the privy by the servants, or by one of the nightmen, some days before, the fœtor could by that means be removed. It would of course be of great advantage to the parties concerned. Therefore, that experiment was tried at my suggestion, and in every instance it was found that, when the liquid was freely applied over the surface of the night-soil and of the walls, in an instant the penetrating and nauseous fœtor ceased. Then, in order to try whether the bad smell could be entirely removed, we tried an experiment, in which a portion of the liquid was applied to a large cesspool, and after an interval of three days, the smell in the privy, which had been shut up, was absent. Then, upon plunging a stick into the night-soil and examining it, the smell at the upper part was that which I have spoken of before; the lower part was evidently feculent—of the ordinary fœtor. Then, an additional quantity of the liquid was added, and in two days afterwards, buckets full were taken out, and it was observed by many who were present, builders and surveyors of sewers, that the fœtor was gone; that what smell remained was concentrated, and did not diffuse itself though the wind was blowing.

Was it in such a state then that you think it might have been carted away in the midst of a crowded neighbourhood, in open day, without occasioning any annoyance?—As far as those experiments upon some buckets full would enable me to speak, I should say, yes. As I could not have an experiment, which would be effectual, of large masses and cartage through a town, I asked a surveyor of pavements or sewers, who happened to be present, what was his opinion; and he, whose duty it

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was expressly to look after matters of this kind, said that he was convinced that it might be removed at any part of the day without creating a nuisance. And so also said the builder, upon whose premises the experiment was performed.

What was the quantity of the liquid used in that instance?—That was the experiment where it was weighed. In the beginning, eight pints of the liquid were poured upon the surface of a mass of night soil, weighing 2240 lbs. Three days afterwards, eighteen pints in addition of the liquid were added, and what I have described was the result.

You do not know the proportion of lead in solution?—I do not know the proportion.

Upon the whole, taking the result of all your experiments, have you any doubt that this and similar decomposing fluids may be employed with advantage in preparing privies and cess-pools for the removal of their contents on any system of general cleansing which may be adopted?—I have no doubt that this and similar solutions of metallic salts might be applied with the greatest advantage to the comfort, convenience, and health of the population in towns, and that so long as privies are used, the employment of these substances will be found to be beneficial in the highest sense of the word.

Did you try any experiments with the fluid on privies in constant use?—Yes, that was also done, and with the same result; where there was a very offensive odour, by throwing down a small quantity of the fluid, the fœtor was removed, or, at all events, very much diminished; but I should say, that the experiments in private families were not so carefully performed as the more public experiments.

In water-closets in constant use, where gases occasionally escape in such quantities as to become offensive, do you think it would be attended with advantage to pour down, from time to time, some of this fluid to decompose the gases that are there formed?—In that way, and in various others connected with domestic economy of this kind, I conceive that this and other liquids of the same character, might be used with great advantage to the comfort and to the health of the inhabitants of the house. Because, if you could interpose a quantity of this fluid between the gas and the atmosphere, the former might be decomposed. The gases upon which the foul smell depends, would be decomposed before they could get into the air. And I believe, from some inquiry, that however well water-closets are constructed, it does happen certainly, in most houses, from time to time, that there is an offensive smell. There may be offensive gases escaping, and very frequently offensive and poisonous gases present in the atmosphere, which cannot be recognised by the smell; of which I have seen distinct proof.

Have you made any experiments to test the power of this fluid in purifying and removing offensive odours from a room?—Yes; experiments of that kind were performed where the atmosphere had been very much contaminated by placing the fæces of patients in the hospitals in small, close, and hot rooms, so that the atmosphere became highly offensive, and a person could hardly remain in the room. Then by the application of this fluid, merely to the atmosphere, applying it to the air itself by wet cloths being moved about, the change was, in every instance, most striking to everybody who saw the experiment; the air became immediately relieved of all offensive odour.

Should you infer from that, that it might be made useful in removing

close and offensive smells in the wards of hospitals?—I think, for reasons which I might afterwards give, there is nothing of greater importance in large hospitals, than to preserve, as much as possible, a pure state of atmosphere, because there is nothing which tends so much to the spread of disease as foul air; and this liquid, being proved to remove some of the most noxious gases must, I conceive, be of advantage in hospitals and similar institutions, in assisting other means in maintaining a pure state of the atmosphere.

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Do you think, particularly in the case of malignant fevers, and especially when the wards are crowded, that it must afford some help, and must tend to give security to nurses and attendants?—Yes. It is my opinion, as it is known to all medical men, that a debilitated and unhealthy state of the system particularly predisposes persons to receive disease; that anything which will tend to keep up the health of the attendants, medical or otherwise, of hospitals, where there is fever and other serious disease prevailing, would be highly advantageous, and so far would tend to guard the attendants from their being affected by the fever themselves.

It is stated by physicians of large experience, that in all diseases in which the excretions of the body become vitiated, and particularly in fevers, where the excretions become poisonous in proportion to the intensity of the disease, that persons employed in washing the body-linen, and bed-clothes of the patients, scarcely ever escape an attack of fever if they continue that employment for any considerable period. Do not you think that the immediate immersion of the bed-clothes and body-linen in this fluid, or in similar solutions, would be likely to afford some protection to persons so employed?—Yes; that is the conviction at which I have arrived; the foul linen of hospitals, in fever hospitals particularly, is known to produce frequently disease in persons washing that linen, and as this liquid will remove some of those poisonous gases present in such linen, it must so far be beneficial.

Do you know of any instances in which it has appeared to be employed with benefit of this kind, that is, in preventing the extension of disease to the attendants?—I have heard of such instances, but I have myself witnessed no experiments upon that point; the time during which the investigation has been made is scarcely sufficient to test the fact.

But you have never represented this fluid or any similar substance to be a cure for fever, or to have any direct influence whatever on the state and process of fever?—Certainly not; and I am particularly anxious to avail myself of this opportunity of having the conclusions at which I and my colleagues have arrived placed upon record, inasmuch as they appear to have been misconceived in various directions. As it appeared, in the course of the inquiry, that this liquid had been spoken of by some parties concerned with it, as being a preventive of fever, I and my colleagues, having fully investigated the operation of it, thought it necessary to give an express caution that that was an erroneous opinion; and I should be happy to have this expression of our opinion placed on record: it is contained in a letter which we addressed to Colonel Calvert, relating to the application of Monsieur Ledoyen's Disinfecting Fluid, proposed to be used in the fever hospitals of Ireland.

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“There is nothing in M. Ledoyen’s Disinfecting Fluid that can arrest the progress of fever, or influence the connexion which the history of the human family shows is universal and indissoluble between pestilence and famine. But though this preparation can produce no effect on the primary, it may have some influence on the secondary causes of fever, that is, on those causes which increase its intensity, and favour its spread when once generated.” * * * * * “But we must beg leave to give a distinct caution against this preparation being spoken of as a remedy in fever; for if it be so considered, it must lead to disappointment, and it will probably bring doubt on the properties which it really possesses, and which are capable of being applied in various ways to the public advantage.”

—The conviction with which this letter was written was, that as the efficient cause of typhus and similar fevers is not known, no person acquainted with the science of medicine could presume to say, that a disinfecting agent had been discovered; and I am anxious, as “true disinfecting agents” have been spoken of as existing, it should be placed on record, that, according to the opinion of the best physiologists and pathologists, the cause of fever is not known in its separate form. I have an extract here from the work of Professor Chomel of Paris, who says,

“The causes of typhoid fever are enveloped in the greatest obscurity. We know some of the circumstances under the influence of which it develops itself with a marked preference; but the determining cause, the immediate action of which produces it, escapes in the present state of science all our investigations.”

To that you agree?—I entirely agree. That was the opinion of Professor Chomel in 1834; and it remains a correct expression of the knowledge of the present day, that the efficient cause of typhus fever is not known; nobody knows what it is in its separate form; and, therefore, to speak of a disinfectant is to speak of applying an agent to another agent which is not known, but which it is supposed to control.

Whatever may be the effect of this fluid, or of any similar substance, as a means of alleviation or protection, you do not believe that it dispenses with the necessity of the immediate removal, from the sick chamber, from the wards of the hospital, and from the neighbourhood of a dwelling-house, of all filth and refuse, in short, of all vegetable and animal matters capable of undergoing decomposition?—Certainly not. The removal of all decomposing matter, of every matter which deteriorates the air, is of vital importance in preventing the spread of fever and all epidemic diseases; and any substance, any agent, which will effectively do this, as far as it will do it, must be of great advantage in preventing the spread of typhoid fever. Again, as showing the importance of preserving the purity of the atmosphere, and likewise showing the way in which therefore I conceive this liquid would be useful, I would read a few lines from the opinion of Dr. Copeland, an eminent English physician, who, in his Dictionary of Practical Medicine, says, that there are a variety of diseases which are caused by miasms or exhalations from the soil, which do not propagate themselves. He then goes on to add, “If, however, other causes are super-added, if the persons labouring under disease from this source be confined in ill-ventilated apartments, or breathe a close air loaded with animal exhalations, the disease may change its form and assume one of those which arise from the second class of causes, that is, from animal effluvia,

and thus become consecutively and conditionally infectious." That seems to me to express in a few words the way in which those diseases are propagated when once set up by the deteriorated state of the atmosphere, and the way in which it may be expected that a decomposing agent, by assisting in promoting the purity of the air, will not indeed cure fever, but tend to prevent its extension.

But even if these substances were ten times more efficacious than you have any experience of, you would not, on that account, be less scrupulous in removing all filth and excrementitious matters as quickly and completely as possible?—Certainly not. It is most important that every kind of filth, and every description of decomposing matter should be removed, because as decomposition is continually going on, unless the decomposing agents which are to check it are continually applied there will be the same mischief continually renewed.

And you would use those substances, because, in relation to a subject with reference to which our means of alleviation and protection are confessedly deplorably deficient, you desire not to lose the advantage of any help that can be obtained, whatever the amount of that help may be?—Certainly; and I do not see that it is going back in our knowledge, or that it is improper in any way, that we should avail ourselves of the help of a liquid, which has been proved to be efficacious as regards some of the most poisonous gases with which we are acquainted; which has the advantage of being in itself entirely without odour; and which has, as far as I am aware, no injurious action. On the other hand, some substances are objectionable on account of their smell, and others, as chlorine, because they irritate the organs of respiration.

It is one peculiar advantage of the particular preparation you have been describing, that it is itself without odour?—It is perfectly inodorous, which in many instances, particularly in the internal application of it, either in the wards of hospitals, or the rooms of houses, is a great advantage.

Are the experiments which you have stated, all that you have made upon this subject of deodorization?—What I have stated gives the substance of them; they were greatly varied in number.

Were they the first experiments that you have undertaken of this kind?—Of this kind they were the first.

Have you made any experiments with any other substance?—I do not recollect that I have.

You have not tried acetate of zinc?—No.

Nor sulphate of iron?—No.

Nor any other substance?—I should qualify that answer with reference to chlorides, which I have used, and seen used, again and again in my own family, and elsewhere. With reference to various forms of chlorine, that I have again and again known to be used in various ways.

But what you have stated, you have stated in relation to a special inquiry which you were asked to make, relative to one particular substance, without at all comparing it with other substances?—Entirely so; not a relative inquiry.

Therefore, whether there are any other substances which are equally or more efficacious for this purpose, you have no means, from any experiments of your own, of knowing?—As far as this; since making that

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Report, I have witnessed experiments performed with the liquid of Sir William Burnett, and with the liquid of Mr. Ellerman. I was invited to attend some experiments which were made with those two fluids.

What were the results in those instances. In what way did they vary from the results as to this fluid?—The experiments with reference to Sir William Burnett's fluid, were upon night-soil exclusively, and the result was to take away the offensive odour; but whether as efficiently, with reference to the quantity used, as when the fluid of M. Ledoyen was applied, I cannot say. The experiments which I saw performed with Mr. Ellerman's fluid upon night-soil, seemed to me to be very effective in removing the offensive odour, but it left a smell that I considered unpleasant, and that smell was a circumstance which seemed to me to render it objectionable upon that score for use in private families, and in the interior of dwellings, or hospitals; but, out of doors, I should think it would be very efficient.

Was Sir William Burnett's, without any peculiar odour?—It has no odour.

Have you tried sulphate of iron?—No.

Nor any of the other metallic compounds which are said to be deodorising?—I have not tried them by my own experiments or observations.

Are you to be understood as assuming, when you speak of the purification of gas, that the diminution of offensive smell is its purification?—Not necessarily so; but if we know the nature of the agent which is to be applied, and of the matter to be operated upon, we have the two conditions for knowing whether the poisonous gas will be decomposed or not. And in the present case we have the necessary conditions for arriving at a right conclusion.

Then you consider that the destruction of the smell is the destruction of the poisonous gas?—With reference to certain known gases operated upon by certain known agents we can then predict, and affirm that the poisonous gas may, if the agent is fit, become decomposed, which in this case was so.

You say that you would remove from the neighbourhood of dwellings all decomposing substances. Now, destroying smell as you do by this substance, according to your reasoning you destroy the poisonous gas. Then why should you remove all decomposing substances?—I think there appear to be various obvious reasons:—First of all, the difficulty of insuring the immediate application of the correcting agent. Secondly, that if the decomposing matter is in any considerable bulk, unless care is taken on the part of the person who applies the liquid, and that he applies a sufficient quantity, the remaining portion of matter not affected by the liquid will still undergo decomposition.

But where the bulk of the *faeces* is not very considerable, if care is taken by the use of the liquid to extinguish the smell, why should the *faeces* be removed; in a hospital for instance?—In answer to that, I should first of all repeat what I have already said. And secondarily, that in the Report upon M. Ledoyen's fluid it is not stated that every smell, or that every gas connected with feculent and decomposing matter, is removed. And until we know what is the efficient cause of fever, no pathologist can undertake to say, but that certain gases that still remain, or certain subtle matters which remain, may, although per-

fectly inodorous and altogether inappreciable by the senses, be either the efficient cause of fever or a cause of its spreading.

Were you and your colleagues in perfect correspondence with respect to what was the effect of the liquid upon the smell. Were your perceptions the same upon that point?—I believe I may affirm that the reporters were all satisfied that the peculiar and offensive odour, the penetrating and offensive factor connected with decomposing matter, was removed. No dissent was expressed to me at the time, nor have I heard of it since from either of my colleagues.

You say that the offensive smell was removed. Was there not a distinct faint smell left, a smell very different from that of perfect freshness?—I carefully examined with this express view highly putrid fish which had been acted upon by the liquid, particularly mackerel, and I found after the application of the liquid, that it had precisely, as far as I could judge, the smell of fresh boiled mackerel. The smell of the flesh of other animals and of human flesh, was of an oily character, a faint oily smell, and it was pronounced by those who were accustomed to anatomical processes, to be the smell of adipocire. The smell of putrid fæces became, again, precisely as if they had been fresh discharged, which is, of course, an offensive smell, but in this case the smell was not diffusible, and it was of a different character from that of decomposition.

Not penetrating so far?—No.

And not noticeable to the same extent?—Certainly not. At Highgate a large privy containing nearly a wagon-load of nightsoil, was operated upon by this liquid; effectively stirred up and a sufficient quantity applied; that was done in the middle of the day, and within two or three doors lived a pork butcher, whose wife told me that she should not have known what was being done, unless she had been informed of it, and she wished very much that they could have this liquid applied to their privy to have it emptied; whereas, if this nightsoil had been removed in the ordinary way, she said it would have been, as it always had been before, a great nuisance.

There was no case in which it did destroy all smell?—I believe not.

Then, any smell being disagreeable and improper for a hospital or a sick chamber, does not that afford a clear reason why all those matters should be removed as completely and as quickly as possible?—One reason, in addition to the others that I have stated.

Is not the offensiveness of smell somewhat of a warning as to the presence of an agent that is not compatible with health. Though the nose does not always afford warning, yet, whenever the nose is offended, is not it a warning?—Seeing the perfect adjustment of all the works of nature, I have always myself been of opinion, as a physiologist, that our senses are never intended to convey to us any disagreeable or painful sensation, except for an object of preservation, or of safety of some kind; and, therefore, my general conclusion is, that all matters that have a noxious smell are injurious to the human being.

Is not it perfectly well known, with respect to the propagation of disease, that many diseases are propagated where that warning fails, or, at least, is not perceived?—I have no doubt that there are many noxious agents, probably in minute quantity, which might produce most deadly results. Seeing that the more subtle powers of nature are gene-

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rally the most active, I think it is probable that there are matters highly noxious which are not accompanied by smell, or, if they be accompanied by smell, it cannot be perceived under ordinary circumstances, being so minute.

Do you think, from what you have seen with relation to Sir William Burnett's fluid, the chloride of zinc, that it was, *pro tanto*, as efficacious as the nitrate of lead?—I may mention that I was merely present by invitation, at certain experiments, where the liquid of Sir William Burnett, M. Ledoyen, and that of Mr. Ellerman were tested, but I had no means of making comparative experiments, and therefore I am not prepared to pronounce any opinion upon that point.

Without making comparative experiments with perfect accuracy, what was your impression, or what was the impression of the observers, as to the relative strength of the two fluids when applied in anything like the same proportions?—No observation came to my ears, that I can remember as to the relative merits of the two fluids. The great object seemed to me to be to test the efficacy of Mr. Ellerman's fluid, who was the performer of the experiments.

Ought not you, before giving an opinion decidedly in favour of any one substance, to have made similar experiments as to the relative strength of others, which might, for ought you know, be more powerful, and possess other advantages?—If the question which was referred to us had been to ascertain the relative merits of Monsieur Ledoyen's fluid as compared with others, it would have been a very desirable thing.

Would it not have been, quite irrespective of any reference, a desirable thing, as a matter of science, on a subject so important as you consider this to be to public health?—Certainly. I conceive the subject to be by no means closed. The investigation of decomposing agents has only begun; and I, for one, think that the greater the number of these agents, and the greater the variety of them which may be discovered to be efficacious, the better, inasmuch as they may be applied under various circumstances. It is a most desirable thing to multiply their number and to test their qualities.

If Sir William Burnett's fluid destroyed smell, *pro tanto*, to the extent to which it did, so far you would say that it had the same properties as this fluid, the nitrate of lead?—It would depend upon the chemical constitution of Sir William Burnett's fluid and on its chemical action upon the matter to which it is applied.

Did you observe any effect of this nitrate of lead on the chemical constitution of the matter to which you applied it; did you perceive anything more than that the amount of the offensive smell diminished?—More than that, the appearance of the parts acted upon indicated the presence of lead; the matters were changed in colour, particularly night soil, and, as I stated before, as the chemical composition of this liquid is known, and the chemical composition of the matters to which it was applied was known, we see perfectly what it would decompose. For instance, sulphuretted hydrogen.

Though it might arrest, it did not prevent, the decomposition of animal matter?—In the cases in which it was tried it did not prevent it, but it retarded the progress.

In the progress of decomposition, would not gases be evolved?—Yes.

Are you not aware that in the case of persons who are exposed to the influence of decomposing substances there is a very deleterious effect upon their health?—Certainly; nothing can be more noxious.

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Then this fluid may destroy smell, but not destroying the decomposition, or the gases evolved by decomposition, it may, for any proof you have yet to the contrary, fail to destroy the noxious qualities hitherto observed in gases evolved from the decomposition of animal matter?—On the contrary, I contend, that in this case, it cannot destroy the smell in any other manner than by decomposing the gas on which the smell depends. In this particular instance we know for certain that it does destroy the smell of one noxious gas by decomposing, and not merely masking, the gas, namely, sulphuretted hydrogen. I think, therefore, the term, “deodorising,” is misleading; for it assumes, that the substance, to which the word is applied, does nothing but remove the smell; whereas, in the case of sulphuretted hydrogen, we know that it removes the smell, because it decomposes the gas. If all the gases, the product of decomposition, be known, they can be entirely decomposed by appropriate chemical agents. Whether something remains behind with which we are not acquainted no person at present is in a position to pronounce, because that involves a fundamental question which the progress of science has not yet answered, namely, what is the efficient cause of typhoid and other fevers of that class.

With relation to the cause of fever, are you not aware that a person may be placed under such circumstances as will be certain to produce a fever; could not you yourself place a person under such circumstances as to produce a fever?—The only evidence that we have of the kind is from experience; and I will mention one fact illustrative of the influence of circumstances producing fever, that if a house is either built over a privy, or close to the side of it, so that there is a constant evaporation of the gases from the night soil given off in that house, it matters not how often the inhabitants are changed, it is known to medical practitioners that different families going into houses so situated will again and again be attacked by typhus fever. But I should say as I did before, that, not knowing the efficient cause of fever, all these observations are, after all, but an approximation to the truth.

Is not an immediate and invariable antecedent to be deemed a cause? Supposing, for instance, a certain number of individuals were shut up in a close and ill-ventilated room, surrounded with night soil or with gases evolved from decomposition of various kinds, might you not be quite certain what would be the result upon them sooner or later?—Experience has shown that when those conditions are present, typhus and typhoid fevers generally follow; but this is to us, at present, the ultimate fact.

Has not experience equally well shown that in places where those agents are removed; for instance, in places kept particularly clean, free from decomposing matters, with a pure air, typhus fever is effectually kept out?—Unquestionably experience does show that.

Can you have any better proof of cause and effect than what is afforded by the effect following the presence and not following the absence of those things?—That there is an aggregation of circumstances, for the most part known, which produce fever, and that the absence of those aggregated circumstances will prevent its appearance, is perfectly true,

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and a most important truth, in which I entirely concur. But inasmuch as when those circumstances are present they are numerous, and their isolated action has not hitherto been detected, and the exact character of some of them not even known, all that is quite consistent with what I have stated, that we do not know enough of the efficient cause of fever to enable any one to say that he has or can have a preventive of it.

From the practical knowledge you have obtained in the examination of different towns, could not you undertake to say that in particular districts it would be perfectly certain that during certain periods of time typhus fever and other epidemics would prevail there?—Unquestionably.

Have you not a perfect confidence that the removal of those circumstances, from which you infer disease, will be attended with the absence of disease?—Certainly. My opinion is, that as much might be done for the prevention of the generation of typhoid fever by the removal of the aggregate known causes, as has been done for the removal of intermittent fever, by removing the known aggregate causes leading to ague, and that when all those causes are known, as at the present time most of them are, we may hope entirely to eradicate typhoid fevers.

The following passage is contained in a letter from a medical practitioner, "I was passing the drain grating at the corner of Union-street, Bond-street, when I perceived a most faint and disagreeable smell arising from it. Being immediately attacked with nausea and an indescribable sensation of illness, I at once returned home and drank half a wine-glassful of brandy. After a short time the indisposition appeared to pass away, but the peculiar smell of the drain still remained in my nostrils. I had to visit a patient, near Manchester-square, that evening, and whilst in his house, I felt so ill that I immediately returned home and went to bed. At that time my head ached violently. I had nausea, pain in my back, and an unpleasant taste in my mouth." It would be easy to multiply such instances. Is not that specific evidence of the operation of cause and effect with reference to the form of disease which you call typhus?—Yes, I think that that has all the appearance of cause and effect. My conviction is entirely to that effect; but there is no positive evidence, as the germs of the disease might have been in the system previously.

Are not you aware that till very recently, it was the opinion of a very large portion of the medical schools, decidedly, that such agencies as these had no effect at all upon typhus?—That is an opinion which not only has been entertained very generally, but is still by many persons. But on the whole of this subject there are most conflicting opinions. Thus it has been very strongly advocated by Professor Gardner, of Hampden Sidney College, in the United States, that the active principle of malaria, in a general sense, is sulphuretted hydrogen, and he brings forward a number of facts in support of that opinion. With reference to the remittent African fever of the Niger, it is, on the contrary, the opinion of Dr. Pritchett, that sulphuretted hydrogen had nothing to do with it; and Dr. McWilliam also denies the existence of sulphuretted hydrogen in the waters of the Niger, and believes that it was not the cause of fever. These conflicting opinions always have existed, and will for some time doubtless exist.

Are not the opinions which you have stated to prevail, mere hypotheses, without any experience or proof?—My opinion is, that at present no one is in a position to affirm what is the real and efficient cause of typhus fever. I have mentioned Professor Chomel as an example of the prevailing opinions. He says that there are two opinions, one, that the noxious agent acts upon the nervous system, and another, that it acts by poisoning the blood. Now it is quite possible, though I do not myself believe this to be the cause of the disease, that some electric state or subtle change of the atmosphere may be induced, and that this is the efficient cause of disease, and not the production of poisonous gases. I believe, that at the present day, science does not afford sufficient data for an answer to the question, as to what is the real and efficient cause under which typhus fever will arise.

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You mean that the aggregation of causes, supposing that aggregation always to occur, has always the same result, but that the present state of knowledge does not enable you to pick out of that aggregation the exact agent which produces disease?—Certainly. We know that a certain aggregation of circumstances will cause typhus fever, and that the prevention of that aggregation of circumstances will prevent its occurring; but we do not know which is the efficient agent among those numerous causes. I may also observe, that in the works of nature generally, the most obvious phenomenon to human observation, that which most commonly strikes a person amongst a number or series of phenomena, is not generally the real and efficient cause of what results—that is generally concealed, a circumstance increasing the difficulty in the present case.

Is it not sufficient that we know the force of the aggregation of causes, without pretending to know the efficient cause. For example, we know that by the combination of sulphur, and carbon, and nitre, in certain proportions, and an application of heat, we get the explosive force of gunpowder. Why should practical applications be stayed, by speculative hypotheses,—without trial—as to what is the efficient cause of the explosive force of gunpowder, the nitre, the carbon, the sulphur or the heat?—I would not stay any practical application. It is with aggregates we have to deal; and, fortunately, we know practically, to some extent, how to deal with them. Because in the present state of our knowledge, we cannot single out from the aggregate the immediate disease-producing agent, that is no reason why we should not do all we can to act upon the disease-producing aggregate. To illustrate my meaning, I should choose the example of the composition of the atmosphere rather than that of gunpowder. It has always been known, that atmospheric air sustains combustion and life; but until the several principles which enter into the composition of the atmosphere were discovered, and obtained in a separate form, the particular principle which sustains combustion and life could not be known. Now we know, that among the aggregate principles contained in atmospheric air, the life-sustaining principle is oxygen. What the disease-producing principle, which is to typhus fever and other maladies, what oxygen is to healthy existence, we do not yet know; and I think it is wrong to speak as if we did know. But when true disinfectants are talked of as contradistinguished from deodorizers, the possession of this knowledge is assumed; and this, I think, the present state of science does not warrant.

Does not that amount to an express statement that this particular

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fluid has not the quality of disinfection?—In the present state of knowledge, I should say, we cannot answer whether it has the power of preventing infection, or not.

You stated that it purified the atmosphere. Of course the best test of the purity of the atmosphere is its effects on the health. Now, taking a ward crowded with typhus cases, are there not the ready means of proving the matter experimentally, by seeing whether, by the use of this fluid, and the abolition of the fœtid smell, the general symptoms of disease abate when it is used, and increase when it is not used. What evidence have you that it has an effect upon the health of the patients?—The evidence is of this kind. It has never been affirmed by me or by my colleagues in that Report, that the fluid of Monsieur Ledoyen had any other direct action than that of decomposing, for example, sulphuretted hydrogen. Then knowing that sulphuretted hydrogen is a very deadly poison, and that an atmosphere mixed with considerable quantities of it has a most injurious effect upon the health, I consider that the fluid purifies the atmosphere as far as it removes the sulphuretted hydrogen, but I have never affirmed that this liquid produces perfect purity of atmosphere.

It is well known that persons recover more quickly, and that altogether, the symptoms go on better in a pure country atmosphere, than they do in an impure town atmosphere. Now if you purify the atmosphere have not you the power immediately of observing its effect in the progress of the people in the hospitals?—Yes. I have the strongest conviction, that by purifying the air as far as you can purify it (which is a conditional term), you will immensely improve the condition of all persons labouring under disease.

Ought we not to have something more than that conviction, that is to say, some positive evidence as to the effect on the sensitive people who ought to be immediately influenced by the purification of the air that they breathe, namely, the sick?—I believe that evidence of that kind which has not been controverted, has been afforded in the brief space of time since this liquid has been applied. It has tended to improve the condition of the patients in the dysentery ward of the Fever Hospital in Dublin. It is testified by the resident physician, that the condition of the sick labouring under dysentery was much improved.

Have you not seen contradictions of those statements with relation to the Dublin Hospital, by Mr. Wylde, one of the surgeons there?—I have not seen any contradiction of the fact, that in the dysentery ward, of which a report was published in the General Report upon M. Ledoyen's fluid, after the application of the liquid, the mortality was considerably diminished.

Have you not seen it stated in the testimonials to Sir William Burnett's fluid, that the fluid did not prevent the spread of disease?—I have seen testimonials in favour of Sir William Burnett's fluid; but I do not, at this moment, remember their precise bearing on the point you mention. I should mention that the only part of the Report for which I and my colleagues must be held responsible, is the part to which our names are appended. This Report contains a number of other letters and statements for which I and my colleagues are in no degree responsible.

Ought there to remain a doubt as to the effect of this fluid in purifying the air, when it may be tested by its perceptible effect upon the

condition of patients?—I am not aware of experiments having been tried sufficient to determine to what extent there is a diminution of disease, in consequence of the application of this fluid. It would require an extended series of experiments, occupying considerable time, before a physician would be able to pronounce that any particular agent had greatly improved the condition of patients labouring under disease. All that is affirmed in this paper is, that it holds out a promise of benefit with reference to the purification of the wards of hospitals. But I consider that one very important object of this liquid is, its application to the case of night soils and water-closets, and all contrivances of that kind, where we prove positively, that it has a most important and beneficial influence.

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That it diminishes the offensive smell is clear; but where is there any evidence as to the effect on health, except inferentially, and that inference founded exclusively on the unproved assumption that offensive smells alone are the efficient causes of disease?—It is founded upon this evidence, that this agent clearly has the power of decomposing what is known to all medical men, and particularly to those who have been engaged in sanitary inquiries, as a most noxious poison, the sulphuretted hydrogen.

You consider that you cannot destroy that smell, without destroying that poison; that the destruction of the smell is in fact the decomposition of the agent upon which the smell depends?—It is the result of the decomposition of the sulphuretted hydrogen.

Where is the evidence, in the course of sanitary inquiries, as to the specific effect of sulphuretted hydrogen?—I must again observe, that all these opinions, with regard to the cause of disease, are most unsatisfactory, for the whole inquiry is uncertain. Nobody can say whether you have an agent which will prevent the generation or even the spread of infectious or epidemic diseases. But there are many important indications that sulphuretted hydrogen is most noxious, either in the production or in the spread of disease; there are numerous experiments to show that it is a poison.

Will you refer to them?—There have been experiments performed upon animals, which have been compelled to breathe an atmosphere in which a certain quantity of sulphuretted hydrogen was mixed, and which have perished. Sulphuretted hydrogen, in combination particularly with ammonia, is evolved in privies, and knowing that this is a noxious agent, by experiment, and it being known by physiologists that it is one of the most deadly poisons in nature, inferentially, it has been presumed, that where it is present, it must have an influence either in the origination of disease, or in the propagation of it.

If you remove from the atmosphere that agent, do not you *pro tanto* purify the air?—Unquestionably, *pro tanto*, and no further.

You have spoken of a long series of experiments, as being necessary to prove the effect of pure air. If you take either a sick person or a person in moderate health, from a town, and put him on the top of a hill in a dry situation, will not the effect be manifest in a day or in a week?—In some cases it will be so, and in many instances very speedily, the improvement is striking and remarkable.

Is it not a matter of common experience that the going out of a

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crowded town even for a day into a pure air is immediately perceived, at all events by the appetite?—In some cases it is; not necessarily so.

If a number of persons are taken out for a day into pure air, will not the effect be perceived by the increase of appetite in the class?—If you mean by that to attribute it to the influence of breathing the pure air, exclusively, there is no proof of it. Another obvious explanation would be the taking exercise.

Supposing you take them out in a carriage without a motion in the way of exercise, or riding on the top of a coach, will not such an effect be produced?—Besides exercise, there is another circumstance which also occasions the waste of the body—when a person passes from a warm temperature into a cold one. If a person is on the top of a coach, and passing through cold air, there is a loss in the body which must be supplied by food.

Do you mean to say that taking an hour's walk in St. Giles's, and taking an hour's exercise in pure country air, will produce the same effect?—Unquestionably exercise in the pure air will be more beneficial, but I am not aware that the effects are so immediately produced. And I must also say, with reference to any experiments upon this fluid of M. Ledoyen, that it has never been applied under those circumstances in which you could exclude, or pretend to exclude, the whole noxious atmosphere. That is nowhere affirmed in the report for which I and my colleagues are responsible; nor do I think that this point has ever yet been accomplished in the impure air of cities, hospitals, privies, &c. But our opinion was, seeing the decided advantage that it would be to the comfort of persons with reference to the emptying of privies, and in various applications in which the most offensive smells can be instantly removed in a sick chamber, it had altogether such advantages that it would be of great utility to the public to have it in general and common use, in combination with other fluids of a similar character, invented by various persons.

Have any suggestions occurred to you relative to the employment of any of these fluids in preventing smells arising from drains?—Yes. It appears to me, having lately had occasion to direct my attention to the construction of house drains, and the contrivances used to prevent the escape of foul air from those house-drains through the sinks and gratings, by the bell-trap particularly, and the syphon-trap, and other traps, that the construction of those bell-traps might be greatly improved by their being made to contain, without increasing their size, more water, and that at night particularly, when the water is to remain in the trap perhaps for 12 hours during the night; by a discharge of fluid like M. Ledoyen's, or any other having the proper chemical properties, being made into the bell-trap and syphon, you would prevent the passage of sulphuretted hydrogen (which is the cause of the smell of a common foul drain) into the house; the gas would be decomposed in its transit.

But inasmuch as, according to your evidence, the fluid does not prevent the decomposition of animal matters where animal matters are carried into the drains, but only prevents the smell, and as, therefore, you do not prevent the evolution of gases arising from decomposition, will you undertake to say that, by stripping them of that which gives warning of their existence, namely, the smell, you do not mask the

dangerous element, namely, the gas, which is the result of the decomposition that goes on without smell?—We have no proof that this liquid, if it could be applied as fully as it was required, might not entirely prevent decomposition. In the experiment to which I referred, where it was tried upon portions of the human body, the application was of such a character that there was no certainty that it reached every part of the body. Therefore, there is no proof that, if applied to a sufficient extent, it does not entirely prevent, as it certainly does check, decomposition.

Could you practically have done that without disintegrating the whole?—It is impracticable.

You have no substance, even if it were efficacious to the extent you have described, which would entirely prevent decomposition?—I am not aware that we have. But if it be considered an objection to any agent which takes away offensive smells, that it leaves no warning of the presence of that which caused the smell, then no agents will ever be used to prevent foul smells, arising from the present construction of dwellings, and which are likely to continue, under the most favourable circumstances, for a considerable period. The efficient mode of preserving health will be, of course, to prevent, by proper precautions, decomposition taking place.

With respect to this agent itself, the nitrate of lead, have you tried it sufficiently to be quite sure that in itself it has no injurious effects?—That has not been tried, but from the form in which it is used, and the changes which afterwards take place when it is applied, when it becomes converted into insoluble sulphuret of lead, it is not likely to lead to mischief at all.

Being a liquid it cannot attack the gases?—I am speaking of it after it is decomposed.

Are you not aware of the known effects produced by emanations from lead, such as *colica pictorum*?—Yes; but in this case after the nitrate of lead has been applied to the night-soil, or other decomposing matter it becomes converted into insoluble sulphuret of lead. I do not see that any danger would follow the application of it.

Have you read Dr. Lyon Playfair's evidence on this subject?—I have.

Wherein do you dissent from that, or wherein do you challenge any of his facts?—It struck me on reading Dr. Playfair's evidence, that it is likely to lead to disappointment, or even something worse by speaking of true disinfecting substances. I think it is objectionable to class them as *disinfectants*, *decay preventers*, and *deodorizers*, inasmuch as no pathologist, I believe, presumes to say, what is the efficient cause of typhoid fevers to which these agents more particularly refer. And therefore, to speak of a certain class of agents, such as chlorine, being true disinfectants, is not in my opinion in keeping with the present state of knowledge. Moreover, in the above classification, those substances, such as certain metallic salts, which, although they may not be true disinfectants, are, by the decomposition they effect in certain noxious gases, much more than mere deodorizers, would find no proper place.

You think that the efficient cause of fever is not known?—I am perfectly convinced that typhus fever occurs under certain conditions in their aggregation, but that the operations of living bodies are so subtle,

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that nobody in the present state of knowledge can say what is the effective cause of typhus fever, and that he can therefore, remove it.

Not being able to say what may be the efficient cause, you cannot tell whether an agent of this kind will grapple with it?—In saying that we cannot remove it, I should still say, that I believe we have the perfect power of removing the aggregate causes, and amongst the aggregated causes the efficient cause, but no physiologist knows what the efficient cause of typhoid fever is, and therefore, to speak of true disinfectants, is likely to lead to disappointment.

Then you dispute the statement that we must attack the gaseous emanations with another gas?—That is not a necessary part of this question. We have no evidence that the cause of typhus is a gas; it may be some peculiar condition of the atmosphere induced by certain circumstances. We cannot tell what we have to attack.

You spoke of the purity of the atmospheric air as being affected by these impure substances, of course the air is a gas?—I make a most important distinction between the efficient cause of typhus fever and the spread of typhus fever. The efficient cause of typhus fever may be present when a large number of persons are aggregated together; out of those persons a certain number will become the subject of typhus; the efficient cause will take effect upon them, others among them will escape; but if the health of those who have escaped becomes deteriorated, the efficient cause may then produce typhus fever in them, and therefore, anything which tends to lower the stamina of the constitution, (and I consider noxious gases, particularly sulphuretted hydrogen, and carburetted hydrogen, to be of this class,) will not directly produce fever, but will indirectly produce that condition of the body, which fits it to receive the impression of the cause of fever, and in that way purifying the air is a most important safeguard to prevent the spread of fever notwithstanding the cause of fever is not known.

You still think that this fluid, inasmuch as it purifies the atmosphere does affect the spread of fever?—Yes; because taking certain actual known poisons, as syphilis, which requires for its effect upon the human body a certain condition; if a number of persons are exposed to the poison of syphilis, some will be affected, and some will escape. And so it seems to be with respect to all causes of disease. A cause may be present, but that is not sufficient, it will not act upon the living body unless it is in a state fit to receive the impression. This susceptibility to disease would, I believe, be lessened by this and similar liquids.

If you crowd people together under almost any disease, will not the effect of crowding them together be to spread the disease and aggravate its intensity?—If you speak of typhoid fevers, I should say, Yes; and more or less as regards all other kinds of disease.

Puerperal fever?—The evidence about that will not enable me to form a general conclusion; it often does become epidemic and infectious; so that the germs of it, whatever these may be, may, for example, be carried by the medical attendant from a patient labouring under the disease, to another patient till then free from it.

Are not you aware that it is found, that upon separating the patients the amount of fever diminishes?—Certainly.

During the late severe visitation of fever there has been an oppor-

tunity of trying the effect of this fluid in the crowded fever wards. What evidence have you as to its effect in preventing the evils usually resulting from over crowding the wards, or in preventing the spread of fever?—I merely regard the fluid of Monsieur Ledoyen, and all of the same class at present, as tending to prevent the spread of epidemic diseases, by purifying the atmosphere.

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You think that if the smell is put an end to, or diminished, there is, *pro tanto*, a purification?—I think, when we know the gases which cause foul smells, which we ascertain by observation and experience to be poisonous, if you remove or decompose those gases you so far purify the atmosphere, with reference to the extension of disease.

Has not carbonic acid gas, in some of its modifications, a less offensive smell than sulphuretted hydrogen, and yet is it not attended with as great or even greater mortality?—The action of carbonic acid is of course that of a deadly poison, if it is sufficiently concentrated. But that does not appear to me to touch the question. Certain noxious gases have smells, and certain noxious gases have not smells. I believe that when those which have smells are removed from the atmosphere, you, *pro tanto*, purify the atmosphere, with reference to the spreading of disease.

For anything that you have shewn to the contrary, may not the smell belong to the sulphuretted hydrogen, and the efficient cause of disease be carburetted hydrogen, or some other modification of gas without smell, which this deodorizer does not touch?—It certainly may be so, but we have no proof for or against that opinion. I would observe, that many of the attempts that have been made to determine the cause of fever of late years, have given sulphuretted hydrogen as the cause; but I place no reliance upon those inquiries at the present time.

May not those statements, with respect to the effect of sulphuretted hydrogen, be of as good authority as the statements of those who see no efficient cause of disease in the assemblage or aggregation of filth, and all the excretæ of a city?—Indeed, much more so, inasmuch as we know that sulphuretted hydrogen is a deadly poison to animal life. Therefore, we have that in favour of that opinion, while the other opinion is opposed to every kind of evidence.

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You are teacher of chemistry and forensic medicine in St. Thomas's Hospital?—I am; and one of the physicians, thereto.

Have you, as a chemist and physician, paid special attention to the subject of noxious gases and emanations, and the means of decomposing them?—I have had my attention particularly directed to the subject on many occasions, not only as a physician, but also as having been very frequently engaged in various indictments for nuisance and otherwise.

Will you state what are the peculiar compounds which occasion the fœtid and dangerous gases that arise from the decomposition of

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vegetable and animal matters?—The foetid ones are generally sulphuretted hydrogen, sometimes termed hydro-sulphuric acid, phosphuretted hydrogen, cyanogen, hydro-sulphuret of ammonia, and ammonia, the most foetid being sulphuretted hydrogen and phosphuretted hydrogen. Carburetted hydrogen, carbonic oxide, and carbonic acid in excess, may be enumerated as dangerous, but comparatively inodorous gases. In a sanitary point of view the amount of watery vapour is also important.

Which are the most dangerous?—That is rather a large question. I should attribute the most deleterious influences to the sulphuretted and phosphuretted hydrogen, the cyanogen, and the hydro-sulphuret of ammonia.

That is, of those gases with smell?—Yes.

The vegetable and the animal emanations are commonly conceived to give rise to different classes of diseases, are they not?—It is generally supposed, and, in fact, coincides with observation and experience, that where you have a large quantity of decomposing vegetable matter, there fevers of a remittent type are most prevalent; where, on the contrary, the decomposing matter is of animal origin, there fevers of a typhoid character are most prevalent.

Are not typhoid fevers observable in places where there is no decomposition of animal matter?—If you have reference to the origin of the disease, I think it is difficult to say that they do exist, or do originate, where animal matter has not been in a decomposing state. But I am rather doubtful of the decomposition of animal matter being absolutely essential to the generation of the miasma, whatever it may be, of typhus.

You are aware that typhus fever prevails extensively in portions of Ireland, are you aware of there being evidence that there is a coincident prevalence of animal decomposition?—There is no ditch, or other reservoir of stagnant water, in which a large quantity of animal matter does not also exist, arising from animalcules and a number of little insects, continually dying and putrefying. The bog country of Ireland has, however, been considered as remarkably free from paludal miasmata, and I should be rather disposed to attribute the present prevalence of fever to the diminished capability of resistance to disease arising from famine and destitution.

When the prevalent character of a great mass of decomposition is vegetable, why should you ascribe the main cause of the prevalence of fever to the smaller portion, namely, the animal?—I am not prepared to ascribe it to either the one or the other. I can only speak to facts; as to the more general prevalence of remittent fever in those places where there is a large quantity of decomposing vegetable matter; and as to the general prevalence of typhoid fever where animal matter is in a decomposing state.

You would include in the category of animal matter human fæces?—Yes.

Even when they come from a population who do not eat animal food in any considerable proportion?—Yes.

Will you state the composition of the principal foetid and dangerous gases?—The composition of the sulphuretted hydrogen consists of sulphur and hydrogen, phosphuretted hydrogen of phosphorus and hy-

drogen, carburetted hydrogen of carbon and hydrogen, ammonia of nitrogen and hydrogen, carbonic acid and carbonic oxide of oxygen and carbon, cyanogen of carbon and nitrogen. The composition of the hydro-sulphuret of ammonia (or, as sometimes termed, the hydro-sulphate of ammonia) is a compound of what is termed sulphuretted hydrogen and ammonia, the sulphuretted hydrogen being considered as an acid, and termed hydro-sulphuric acid.

So that they are, in fact, combinations of hydrogen with sulphur and phosphorus, and so on?—Yes; with the exception of carbonic acid and carbonic oxide, hydrogen is a constant constituent. In cyanogen it does not exist but is commonly combined with it, forming hydrocyanic or prussic acid.

Have you paid any attention to the means by which those compounds may be destroyed?—Yes; they may be destroyed in various ways. They may either be removed from the atmosphere by what is termed fixation, or destroyed by entering into new combinations. Sulphuretted hydrogen might be entirely removed from the atmosphere, for instance, by substances capable of forming combinations with its elements, as, for instance, the metallic salts. Then again, sulphuretted hydrogen might be destroyed by the action of chlorine, in which case another gas, the muriatic acid, would result from the decomposition of the sulphuretted hydrogen, and there would merely be the substitution of muriatic acid gas. The action of chlorine upon the sulphuretted hydrogen would be to combine with its hydrogen, forming hydrochloric or muriatic acid gas. The action of a metallic salt capable of fixing the gas would consist in the combination of its metal with the sulphur to form a metallic sulphuret, whilst the hydrogen would be united to the oxygen of the metallic oxide (the basis of the salt) forming water.

So that, by one method the decomposition is effected by changing some of the elements and making a new combination, and the other is by fixing the elements of the noxious gases?—Yes. In one case the contaminating gas is absolutely removed from the air, and the air is purified, in the other case you substitute one deleterious gas for another.

What is the chief agent in changing the composition of those gases by altering the component elements?—Chlorine is one of the most efficacious.

What is it that gives to the chlorine its peculiar efficiency?—It has a very great affinity for hydrogen, forming with it hydro-chloric or muriatic acid. It may also decompose water and thus set oxygen at liberty.

Is there any particular inconvenience in using that as a decomposer?—We have found, as far as our experience in St. Thomas's hospital is concerned, very little benefit, in fact no benefit, from the use of chlorine, because the irritant effects of the gas generated, the irritant effects of the chlorine itself, are so deleterious that we find the mischief resulting from the use of chlorine too great to be compensated for by any disinfecting properties it may probably possess. Its corrosive properties are also a serious inconvenience.

What are the agents chiefly used for the purpose of fixing certain of the elements of noxious gases, so as to render the objects no longer volatile and neither odorous nor noxious?—Metallic salts chiefly, but

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You witnessed the experiments with Monsieur Ledoyen's disinfecting fluid at St. Thomas's Hospital?—I did.

Did you detect at once what the particular substance employed was?—Yes.

How did you arrive at that knowledge?—From observing the effect of the liquid upon the various substances to which it was applied. I observed a slight white precipitate when it was mixed with water, which I attributed to the production of sulphate or chloride of lead. I also observed a blackening, which induced me to believe that it contained one of those metals which most readily combine with the sulphuretted hydrogen, and form with [it a black compound, which I judged in all probability to be a sulphuret of lead. I arrived at that conclusion because lead is one of the cheapest metals that could be employed. A similar appearance could be produced with nitrate of silver; but I was aware that they would not be likely to use nitrate of silver for such a purpose, and, therefore, considering those metals which were most suitable for such a purpose, I naturally fixed upon lead as the probable basis of the compound. I had, subsequently, an opportunity of examining some of the material to which it had been applied, and from that I satisfied myself that I was correct. The acid with which the oxide of lead was united, I knew could not be the acetic from the absence of its peculiar odour, and I therefore presumed that the solution must contain either the chloride or nitrate of lead, the latter being the more soluble.

You obtained the metal?—Yes, and the nitric acid with which it was combined.

What is the conclusion to which you came as to the efficiency of its action upon the substances to which it was applied?—That it was very useful in removing the sulphuretted hydrogen; that it would decompose the hydro-sulphate of ammonia, and fix any free ammonia that might be present.

So that it would remove the sulphuretted hydrogen, one of the most fœtid substances to which the unpleasant smell of decomposing animal matter is to be attributed, and also the hydro-sulphate of ammonia, which is another extremely fœtid substance?—Precisely so.

With regard to some of the other gases which are also fœtid, and which are given off from decomposing animal substances, I believe it has no effect upon them?—It has not.

Did it act upon phosphuretted hydrogen?—Not upon phosphuretted hydrogen; the phosphuretted hydrogen still remains.

Do you think that the remaining odour in the night-soil, for example, which there is after the application of this substance to night-soil, is owing to the phosphuretted hydrogen still remaining?—That was my opinion.

You think that that is mainly what gives the natural odour to such matter?—That is a very peculiar smell; it is a smell that is not disseminated to the same distance as is the sulphuretted hydrogen; it is a smell that you would more particularly perceive on applying your nose closely after the liquid had been applied, and that, I believe gives that peculiar odour which is common to animal matter not in an advanced state of decomposition.

That is not the first smell that one would perceive, provided the disinfectant had not been applied?—No; it is not.

Because the sulphuretted hydrogen being the strongest odour overpowers the other?—Yes.

Did you observe any experiments made with this fluid in relation to the preservation of bodies for dissection?—I did.

What is, in your opinion, the extent of its preservative effect?—I think it has very little preservative effect. As long as there is any free nitrate of lead remaining it will go on absorbing the sulphuretted hydrogen which may be generated in the act of decomposition. But, beyond that, I think it has little preservative effect.

The decomposition may go on and evolve not only sulphuretted hydrogen but other gases incident to decomposition?—Yes.

What is the quality of those other gases in a sanitary point of view?—I believe that they are injurious. My own belief is that any gas existing in an atmosphere which is foreign to its proper constitution is injurious, only that the gases act in different ways.

Have you given any written opinion or expression of your view as to the application of this substance?—I have furnished Dr. Southwood Smith and Messrs. Grainger and Toynbee with a written statement of my opinions generally upon the subject, without going particularly into the sanitary question.

In the decomposition, other injurious gases will be evolved, and the application of this fluid only decomposes the sulphuretted hydrogen, and prevents the smell arising from that one gas?—That and the hydro-sulphate of ammonia and the ammonia.

The hydro-sulphate of ammonia is a very important one, is it not?—I believe that they are both very important. My own impression is that the existence of those gases has a much more important part in the production of typhus disease than is generally supposed. I rather think, myself, that those gases, with the existence of which we are positively acquainted, do exercise a deleterious influence beyond what is generally supposed. It would be desirable before ascribing so much to unknown and hypothetic agents, to observe and study the action of those gases which have been actually proved to contaminate the atmosphere.

Will you state any exemplifications of fact upon which that belief is founded with respect to either of those gases?—In the first place, the general effects of the gases themselves. I have had frequent occasions to observe them, having experienced them not only in my own person, but also having noticed their effects on other individuals. The general effects of sulphuretted hydrogen are highly depressing to the animal powers; its action upon the human blood is most injurious, it not only arrests its function of absorbing and conveying oxygen, or in other words, prevents the conversion of venous into arterial blood, but also tends to promote the decomposition of the blood itself. Cyanogen, carbonic oxide, and carburetted hydrogen, also act most injuriously on the blood, preventing its oxygenation; so also with carbonic acid, if too largely respired. It is well known that venous blood which is returned into the system without undergoing the oxygenating process, acts as a poison, more particularly destroying the irritability of the nerves, on the due stimulus of which, health is absolutely dependent. In Dr. Christison's work on poisons, p. 809, he observes, "At one time while

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No. 9. in the practice of not using any precautions against inhaling the gas, (sulphuretted hydrogen) in chemical researches, I used to remark that daily exposure to it in minute quantity, caused in a few weeks, an extraordinary lassitude, languor of the pulse, and defective appetite. Strohmeyer in the like circumstances, was liable to severe headache. Mr. Taylor says that the workmen in the Thames Tunnel, suffered severely for some time from a similar exposure : many of them became affected with giddiness, sickness, general debility, and emaciation, then with a low fever attended with delirium, and in the course of a few months several died. No cause could be discovered for their illness except the frequent escape of sulphuretted hydrogen from the roof. The affection only disappeared when the communication from bank to bank was completed, so that the tunnel could be thoroughly ventilated."

Subsequently, at p. 810, Dr. Christison relates that "in August, 1831, 22 boys living at a boarding-school at Clapham, were seized in the course of three or four hours with alarming symptoms of violent irritation in the stomach and bowels, subsultus of the muscles of the arms, and excessive prostration of strength. Another had been similarly attacked three days before : this child died in 25, and one of the others in 23 hours. On examination after death, the Peyerian glands of the intestines were found in the former case enlarged, and as it were, tuberculated ; in the other there were also ulcers of the mucous coat of the small intestines, and softening of that coat in the colon. A suspicion of accidental poisoning having naturally arisen, the various utensils and articles of food used by the family were examined, but without success. And the only circumstance which appeared to explain the accident was, that two days before the first child took ill, a foul cesspool had been opened, and the materials diffused over a garden adjoining to the children's play-ground. This was considered a sufficient cause of the disease by Dr. Spurgin and Messrs. Angus and Saunders of Clapham, as well as by Drs. Latham and Chambers, and Mr. Pearson of London, who personally examined the whole particulars."

My own observations would induce me to concur in the explanation thus given, it is, however, proper to add the conclusion of the paragraph, in which Dr. Christison observes, that "Their explanation may be the only rational account that can be given of the matter ; but as no detail of their chemical inquiries was ever published, their opinion cannot be received with confidence by the medical jurist and the physician, since it is not supported by any previous accounts of the effect of hydro-sulphuric acid gas," (sulphuretted hydrogen). Whether the disease in question arose from the evolution of sulphuretted hydrogen alone, or, as is most probable, from a combination of several deleterious gases, still as a case of disease evidently produced from fœtid exhalations arising from the emptying of a cesspool, it presents so much matter of interesting consideration that I hope to be allowed to place before the Commissioners the reply of Dr. Spurgin to inquiries made by myself in reference thereto.

Copy of Dr. Spurgin's Letter.

"MY DEAR DR. LEESON,

"THERE are some inaccuracies in Dr. Christison's report, to wit, the date of the occurrence was in August 1829, not 1831. The first child I was called to was seized with violent abdominal pains, on the night of Thursday the 13th of August, accom-

panied by great prostration of strength, ending rapidly in death, for he had expired before my arrival at the house, which was about 6 o'clock on Friday morning. The death was ascribed to severe inflammation of the bowels. You may judge of my surprise on being called to the same house on the following Sunday morning, under precisely similar circumstances, excepting that the second boy died about two hours after my arrival. To all appearance he was quite well the preceding evening. About 8 o'clock in the morning another boy was reported sick, in pain, and prostrate; then another and another, until I believe every boy in the school, with but one exception, was attacked before 9 o'clock. The alarm became very great, and extended to all the neighbourhood. I was unremittingly engaged in directing the measures that were pursued to combat the sickness, diarrhoea, and faintness. No description can convey an idea of the scene. The parents of the children that could be summoned to the spot, the friends of others, and several female assistants, were rendering such aid as they could, but under great agitation and alarm, which it was extremely difficult to control. By 1 o'clock the state of the children was such that it was thought desirable to send specially for Drs. Latham and Chambers, who arrived about 3 o'clock, and after their examination of the children, they gave it as their opinion that there was but little hope for the recovery of *thirteen* of the number; and indeed such was the degree of prostration, with an absence of pulsation at the wrist, coldness of extremities, and sinking and pallor of countenance, that no other conclusion could be formed. However, by our perseverance in restorative measures, by the exhibition of calomel and opium, by hot fomentations and poultices applied to the abdomen, by mustard cataplasms to the feet, re-action was at length established, and a rapid recovery ensued to all, excepting the two patients before mentioned, who happened to be the sons of the master of the school.

"The *post mortem* examination was of course a matter of great interest to every medical man present, and particularly to myself, who never could assign all the importance to inflamed patches of the lining of the alimentary canal which has been the fashion in my day; for I regard them as effects rather than causes. The interior surface of the intestines presented here and there an *irritated* condition, but not so the stomach; and consequently I could not conceive that there had been any deleterious mixture with the food.

"As I had the immediate professional charge of the school, it was to my great satisfaction that I was able to disperse the children to their respective homes by nine o'clock on the following morning. Several of the patients remained under my care for several days afterwards; and it was this that afforded me the opportunity of tracing back to the most probable cause of the mischief, by questioning one of the most intelligent of the boys to this end; from whom I learned that on the Tuesday preceding, viz. August the 11th, an old drain was accidentally discovered on some workmen digging near the house; and as the inmates had often been annoyed by noxious smells, it was at once determined to have the drain emptied, and the contents of it spread over a part of the garden, for the sake of manuring it. In this operation the boys were engaged for that afternoon, in common with the workmen; and though the stench was bad enough, yet none were deterred by it from lending a helping hand. One of the ushers of the school was affected on the Sunday for several hours, but not so grievously as were the children. The common workmen escaped the mischief; but the two little boys who fell victims to the noxious exhalation were observed to be particularly busy in the work of removal.

"That this exhalation from the drain was the cause of the so-called cholera I cannot entertain the slightest doubt; but what the nature of the exhalation was, whether sulphuretted hydrogen gas, or any to us unknown gaseous agent, I cannot say. A remarkable circumstance to be noted is, the length of time it lay dormant in the system, answering, as it did in this respect, to the malaria, whence come remittent and intermittent fevers; but whether sulphuretted hydrogen gas, as such, can, on its tainting the animal economy, present this singular phenomenon, is more within your power than in mine to determine. To me it is a question whether its effects are not more immediate and determinable. The instance in question presented no positively *typhoid* feature; the darkened tongue, the trembling limb, the suffused and heavy eye, the oppressed brain, the muttering, the delirium, the *subsultus*, were wanting. The disorder had more the character of a virulent English cholera, and as bearing upon the circumstances likely to favour the spread of the Asiatic form of cholera, I think the instance here presented is one of weighty consideration, because, tainted as the *animal fluids* may become by exhalations from drains and various filthy accumulations, they may be rendered less able to resist a more virulent taint, like that which visited Europe in 1832-3. In conclusion, allow me to observe, that the sanitary regulations now con-

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 H.B. Leeson, yet lose much of their power, if unaccompanied by careful efforts on the part of every
 Esq., M.D. individual of the community to be *themselves* cleanly in their persons and habits, and
 especially in attending to all those rules of diet, regimen, and exercise, which are
 necessary to the maintenance of a healthy condition of body.

“You may, my dear Sir, make what use you please of the above observations, or of any portion of them. We cannot but have one object in view in this most important inquiry, and this object is in faithful hands with yourself, as can at all times be testified by,

“Yours with respect and regard,

“To Dr. Leeson.”

(Signed) “JOHN SPURGIN.”

Paludal miasmata have been observed in Italy and the shores of the Mediterranean as well as in the West Indies, to occupy the lower portions of the air; a very few feet in height is found to make considerable difference in the salubrity of the air. In the parts alluded to, the ground-floors are never occupied by those who can avoid so living, and are commonly appropriated to the cattle. In some parts of the West Indies the houses are built upon columns by way of avoiding the poison. This and many other facts which might be adduced, would point to the conclusion that the miasma consisted partly of a heavy gas, and that gas very probably, the carbonic acid given off from the surface of the earth in those localities where the nature of the soil is suitable to its production. Wherever paludal miasmata abound, fog or vapour is commonly observed, and probably contribute greatly to aggravate the mischief by condensing, and as it were concentrating the deleterious gases; the upper strata of the air being purified by the vapour condensing and as it were, washing out the deleterious gases. The remarkable manner in which drainage improves the healthiness of such neighbourhoods depends, probably, partly on the lessened amount of vapour in consequence of a dryer soil, and the greater dilution of the deleterious gases with pure air, and partly by affording a conduit or passage by which the heavy vapours or gases are themselves removed, such removal being greatly facilitated by the presence of water to condense and combine with the gases. I have never met with any position where typhus fever was very rife where it was not accompanied by the co-existence of deleterious gases. I am rather disposed to doubt the commonly received opinion as to the production of the typhoid miasma, as it is called. The commonly received opinion with regard to miasma is, that it is animal matter, particularly gelatine, in a state of decomposition floating in the atmosphere, which when inhaled communicates a similar state of decomposition to the fluids of the human body, and that putrefactive decomposition is set up in the same manner as fermentation is excited by yeast. That is Liebig's opinion with regard to the nature of this miasma. If you were to ask me what is the prevailing opinion as to the nature of what is termed typhoid miasma, I should answer, that it is supposed to be animal matter in a state of putrefactive decomposition floating in the atmosphere, which communicates a similar condition to the animal fluids with which it is brought into contact. Now it would be very difficult to demonstrate the actual existence of those matters floating in the atmosphere in this peculiar state of decomposition. I am aware that certain experiments have been made with that view. Rain water, and water or ice, which has been exposed to the air, have been analysed, and have subsequently

yielded ammonia, which has been supposed to be due to animal matter. The actual existence of animalcules in the atmosphere as well as of vegetable seeds, seems at first sight evidenced by the fact, that whenever you provide a suitable nidus, as for instance, when you allow rain-water to stand in a tub, or substances to become mouldy, there animalcules or fungi make their appearance: but this by no means proves that the animalcules or fungi were absolutely derived from the atmosphere, and certainly does not consist with the supposition that such animal or vegetable matter was in a putrescent condition. It might, however, be matter of speculation how far the contamination of the atmosphere by poisonous gases, might destroy animal and vegetable life, and thus originate putrescent animal and vegetable impurities, and in a similar manner, we might account for the putrescent condition of water condensed from, or ice exposed to a contaminated atmosphere. With regard to the mere supposition of a certain quantity of animal matter in a putrefactive state producing typhoid fever, I think the fact is contradicted by this circumstance, that you can scarcely take any individual who would not occasionally have about his teeth, or about his tongue, or in the intestinal canal, a certain portion of animal matter actually in a putrefactive state. That is an every-day occurrence, yet we know that such condition exists without producing any typhoid symptoms.

May not a poisonous substance be so diluted as to lose its power? We know, for instance, that arsenic is a deadly poison taken in certain proportions, but we know that it may be so diluted as to produce no such effect, but that it may be taken with impunity, depending on the extent of the dilution?—Therefore the argument, *à fortiori*, applies in the present case. I am to suppose that that, of which I can obtain a quantity, is to produce less effect than that, the existence of which is so evanescent, so slight and subtle, that I can only infer its existence from the effects produced.

You mention that you found always the co-existence of typhus with the existence of those gases, were those gases always present in combination, or would you give any separate account of the gases?—I am speaking of neighbourhoods in which typhoid fever originated. The localities are generally close, ill-ventilated places, in which localities we find the existence of those gases on analysing the air. The gases to which I more particularly refer are sulphuretted hydrogen, an increased amount of carbonic acid, and ammonia.

Are you not aware that analyses are reported to have been made of the atmosphere of the most crowded portions of towns, which we know are the seats of typhus and other epidemics, and that yet chemists have not been able to detect any difference between the gases in those places and the gases on the mountain tops, where the air is the purest?—That is a current opinion, but which is really untrue, because I have no doubt that if I were to analyse the air of this room, I should be able to point out to the Commissioners differences in its constitution from that of the air in the fields at some distance from town. The opinion in question is based upon the observation that the relative proportion of oxygen in a given amount of air has not been found to vary. But the small quantity of air usually employed for analysis, and the methods in use for estimating the quantity of oxygen, are insufficient to discover the very minute amount of per centage variation which

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results from the existence of other impurities. Saussure (*Annales de Chemie et Ph.* xxxviii. 411, XLIV. 5) observes, that the proportion of carbonic acid gas varies at the same place within short intervals of time, being greater at night than in the day, and more abundant in gloomy than in bright weather. He found that 10,000 parts of air contained at the least 3·7 parts, and at the maximum 6·2 parts of carbonic acid. Of course, if Saussure's experiments are correct, they establish the incorrectness of the statement in question, that there is no variation in the composition of the atmosphere. The admitted constant variation in the amount of watery vapour might also be cited to the same effect; and if it be objected that these are abnormal or accidental impurities, we may reply that such are evidently the most important to be considered in a sanitary point of view. The fact is that the air, especially of a crowded city, is constantly contaminated, and it is by no means difficult to prove the existence of such contamination. The very circumstance of the frequent existence of the sulphuretted hydrogen is shown by the discolouration of paint, just as it was shown by hanging up linen dipped in M. Ledoyen's liquid. It will be found to be stated by Liebig, that he had frequently analysed water which had been exposed to the air, and that he had found variable quantities of ammonia, more abundant in cities than in the country.

Was not that put forward as a discovery of Liebig's, that the analysis of water which had fallen through the air, was to be considered as a proximate analysis of the air itself?—The attention of the public was more particularly directed to the subject by Liebig, although it was well known previously, not only that there frequently existed ammonia in the air, but also various other substances besides oxygen and nitrogen.

The particular gases to which you refer are gases offensive to the smell, are they not?—You are now speaking of gases which are really deleterious; I should not confine it to those gases. I believe that carbonic acid gas, which is a gas not offensive to the smell, is also one of the gases by which the air is greatly vitiated, and rendered injurious to human life. There is also an admixture with the air of solid matter or small impalpable dust, derived from coal smoke and other sources, which is more abundant in crowded cities where coal is consumed, and which I believe to be a fertile source of pulmonary affections, although such dust is destitute of smell.

Is it not a matter of frequent experience that typhus exists without any perceptible smell which strikes the observation of persons in the neighbourhood?—It has been stated that the miasma of typhus cannot be smelt; but before that statement can be borne out it must be determined what that miasma is. By some parties, again, it has been stated that typhus excites a very strong smell, which is absorbed by means of water.

But in those instances in which fever exists with no perceptible smell, the operation of those gases which have a smell is excluded?—There is scarcely any gas, however offensive, but if largely diluted in the atmosphere, will elude the ordinary sense of smell. If you diluted even the most deleterious gases very largely an ordinary person would be unable to detect them. I believe myself, having had my attention frequently directed to the subject, that I can, when coming fresh to a

locality, detect smells where another person living on the spot would not notice smells in any way. Persons who live or remain long in places where the air is constantly vitiated by any peculiar gas become altogether insensible to its presence, whereas another person, coming from a fresh atmosphere immediately into that vitiated atmosphere, would at once detect the close smell with which we are familiar in localities of the description I am speaking of.

The question is, whether by abating obnoxious smells which render certain gases offensive, you abate proportionally the obnoxious effects of those gases?—Unquestionably you abate proportionally the obnoxious effects, because to that extent you purify the air; the air is purer than before.

Do you think that you would be safe from disease in a hospital or any other place where there was no appreciable smell?—No, that I would not undertake to say, because we do not know at the present time, with any amount of certainty, what peculiar combination or proportion of noxious gases is essential to the production of any particular disease; it is completely surmise what proportion of disease originates from other gases which are destitute of smell.

Is it not a matter well known that disease has obtained in places where decomposition has been going on, though there is no perceptible or appreciable smell at the time to enable you to detect the presence of any one gas?—That could only take place where the products of decomposition were largely diluted with the air; and I think it is possible, as I before said, that they might be so largely diluted with the air as not to be ordinarily observed, and still exist in sufficient quantity to generate disease. You may prove the existence of sulphuretted hydrogen and ammonia in the atmosphere where the smell will scarcely enable you to detect it. The sense of taste is sometimes more acute than the sense of smell. Corrosive sublimate may be detected by the tongue in calomel where the ordinary chemical tests would fail, that is, with an equally minute quantity.

Practically, if you, *pro tanto*, diminish the impurity of the air, or increase its purity, which are convertible terms, by suppressing the smell in a hospital, ought you not to see the effect of that in the increased rate of convalescence of the inmates, or in some other way have an effect marked distinctly upon the patients?—I think we do so. Our present practice, contrary to that of former years, is to place our typhoid cases indiscriminately among the other patients, and we then depend upon good ventilation for the protection of the other patients. We introduce so much pure air into the wards that we largely dilute, and thus pass off those noxious exhalations, whatever they may be, which, in the close crowded chamber, would no doubt have been the occasion of spreading the disease. We found that when we concentrated the patients in one ward, the air was rendered so impure that it spread the disease, and that it was more fatal than when we disseminated the cases amongst the other patients. Now we very seldom find it spread; and our mortality, as compared with former years, is very much diminished.

That is by dilution with the external, or with purer air?—Exactly, and by increased ventilation, constantly removing the vitiated atmosphere.

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And increased ventilation alone?—Yes.

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Would you say that, by increased ventilation, you put an end to the smell by extending the dilution?—In a great measure.

And you trust to that alone?—I believe myself that is the most effectual method that can be adopted.

If you could not have ventilation, do you believe that, if you introduced some disinfectant substance which your medical knowledge has placed within your reach, you would produce the same effect as is now produced by fresh air?—We should not produce the same effect, but only purify the air to a certain extent; because I have already stated my belief, that what vitiates the atmosphere is not one gas only, but a combination of several gases. I think it is difficult at the present moment to say what may be due to particular gases, and what may be the result of all the gases which are the products of putrefaction; but to the extent that you remove any of those deleterious gases, for instance, in the removal of sulphuretted hydrogen and hydro-sulphate of ammonia, you would remove two of the most deleterious gases, and, in my opinion, to that extent you would decidedly purify the air, and compensate, in some measure, for the deficiency of ventilation.

Have you made the experiment of using nitrate of lead, or any other substance, for that purpose; and marked the consequence on the health of the patients, as improving them to the extent to which you succeeded in subduing the sulphuretted hydrogen?—We have such excellent ventilation in our hospital, and we have paid so much attention to the ventilation, that we have not thought it necessary to have recourse to any of those disinfectant fluids; therefore, I cannot speak to that.

All you have to say upon the disinfectant fluids is, then, hypothetical; you having no evidence in support of your view?—I have this evidence; in several localities where, I believe, disease has been the consequence of the exhalations of those gases, there I have known considerable improvement effected by using some method by which those gases should be got rid of, as, for example, in some localities in Deptford.

What materials were used?—We used sugar of lead, that is acetate of lead.

Then the use of lead for those purposes was familiar to you before you made these experiments?—Yes, for the purpose of removing the sulphuretted hydrogen. I am not speaking of nitrate of lead, but of acetate of lead.

Have you used any of the other substances which are said to produce the same effect, such as sulphate of iron, or salt of zinc?—I have used sulphate of iron. I cannot say that I have used salt of zinc. Neither of them are so useful for the purpose as salt of lead; for this reason, they do not act upon the sulphuretted hydrogen unless there is an alkali present; you require to have the presence of ammonia, or some alkaline substance, to enable the sulphuretted hydrogen to combine with the sulphate of iron; if you were to pass sulphuretted hydrogen through a solution of common sulphate of iron, it would not fix the sulphuretted hydrogen. The same may be said of the salt of zinc, unless neutral; but if you first of all render them alkaline, or add something to subdue the acid action of the salts themselves, they will decompose the gas.

Take a practical case: suppose the case of a hospital, or a ward of

fever patients, or a single room with fever patients, and that they are obliged to have recourse to the nightstool, would you think it perfectly safe, after using nitrate of lead, or any of those deodorizers which put an end to the smell, to let the fæces remain, or would you think it a safer course to remove them immediately?—I should decidedly remove them immediately; there is no question that they might remain a very much greater length of time without producing ill effects, but, as I have observed, the phosphuretted hydrogen would still remain.

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Although, when you get rid of the smell, you proportionally purify the air, do you not in fact remove one source only of impurity by the use of those means, and permit other dangerous sources to remain, sources even more dangerous, from their being less offensive, and equal care not being taken to remove them?—I should say, looking to what would be the general conduct of persons, that there would be no very great danger of their being thereby led to expose fæces so as to produce mischief, more than they do at present, whilst the actual removal of a very considerable portion of the deleterious exhalation would be a positive advantage. I think the benefit resulting from the removal of a certain and very dangerous portion of the exhalation would be a much greater good obtained than any chance of increased exposure resulting from the idea that all danger was removed.

But you think that, in any case, the preferable course would be the removal of the fæces themselves?—Decidedly.

And practically in your own hospital, instead of using any means of purification, you think the most effectual purification is ventilation by common air?—Decidedly, and using plenty of water in cleansing the wards, &c.

Do not you think that by placing some of this deodorizing substance in the soil pans, and so on, the removal of the impurity would be effected more safely?—Decidedly more safely; it is a benefit as far as it goes. And in emptying cesspools, a still more important benefit.

When you destroy the smell of sulphuretted hydrogen, and gases of that kind, can you do that without decomposing the gas?—Certainly not.

In all these cases, in so far as you destroy the smell, *pro tanto*, you destroy the poison?—Decidedly.

With respect to chlorine gas, it is given as an example of what is called a true gaseous disinfectant, does it effect anything more than a decomposition of the noxious gas upon which it acts?—That is the way in which it acts.

It does no more than that?—It does more than nitrate of lead, because it substitutes one irritant gas for another; it substitutes muriatic acid gas for sulphuretted hydrogen.

When chlorine gas acts upon any matter, which it is supposed to disinfect, it does so by decomposing the substance on which it acts?—It does so, forming a new combination; muriatic, that is hydrochloric acid, a volatile or gaseous substance.

When lead acts on sulphuretted hydrogen, for example, does it not act in precisely the same way?—It acts by decomposing the gas; it forms a new combination; it forms sulphuret of lead, which is an insoluble substance, the metallic base of the nitrate of lead, that is,

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the oxide of lead is separated from the nitric acid, which remains in solution. The metal of the base combines with the sulphur of the gas to form a sulphuret, whilst the oxygen of the base combines with the hydrogen of the gas to form water, and thus all the elements would be fixed, and would be no longer in a volatile condition.

But in both cases the noxious agent is removed by those elements being made to enter into new combinations?—I would rather draw a distinction, in one case it is altogether removed from the atmosphere, in the other it enters into new combinations, and a noxious gas still remains in the air.

Do you think that there is ground, in a scientific point of view, for the distinction which has been drawn between true disinfectants and true deodorizers?—Until we are all agreed as to what this miasma or infecting material is, it is impossible to speak of anything as a true disinfectant. Here is a passage in Liebig, in which you will find that he says, “Carbonic acid and sulphuretted hydrogen, which are frequently evolved from the earth in cellars, mines, sewers, and other places, are amongst the most pernicious miasms.”

Is Liebig a practical physician?—I do not think he practises, but he is an “M.D.”

So that until you can decide what the miasm is, you cannot recognise the distinction as a scientific one between a true disinfectant and a true deodorizer?—If we coincide with Liebig, that sulphuretted hydrogen and carbonic acid are amongst the most pernicious miasms, then anything that would decompose sulphuretted hydrogen or carbonic acid, would be a disinfectant.

Have you read Dr. Playfair’s evidence given before this Commission?—I have.

He states, “In cases of hospitals where night-stools have to be used in crowded wards, deodorizers are useful, but I speak of the subject generally without reference to such exceptions. People are at all times by custom too apt to neglect the warning of smell, and therefore, if it were thus artificially prevented, carelessness of decaying emanations would be still greater.” And Professor Graham says, “I concur with Dr. Playfair entirely in that conclusion.” Do you dissent from them?—I do. I dissent from them, because I must in giving an opinion take an enlarged view of the subject. I must look at what is the general practice at the present time, and what is likely to be the practice, supposing the use of this or any other similar material to become common, and I believe, as I said before, that the danger of deleterious gases being evolved at present existing, is so great and so common, that anything which would contribute to the removal of such gases would be a benefit, *pro tanto*, and I believe the hypothetical observation that it would induce general carelessness, is not correct. I do not think that the general carelessness which would be thereby induced would be to any great extent. Common decency would in great measure prevent it; and I think that even if there were a little more carelessness than there is at the present moment, it would be by no means so injurious. I do not think that the amount of that carelessness would be at all comparable to the benefit arising from the getting rid of those noxious gases. At the same time, I should wish it

to be understood that I attach more importance to any means of rendering cesspools innocuous, than I do to the deodorizing of night-stools.

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Still you believe, and your opinion in that respect is in conformity with your practice, that ventilation, &c., and cleanliness and the removal of these decomposing matters themselves, is preferable?—I do. It is, however, to be remembered that even good ventilation only improves the immediate locality, by removing from it into the atmosphere at large any noxious exhalations; and although by dilution they are rendered comparatively harmless, it would nevertheless be preferable, if possible, altogether to destroy and remove such contaminating influences from the air, especially in a crowded city, where such sources of contamination must be so much more numerous than in a country village.

Do you think that everything which has an offensive smell is liable to injure the human frame; in fact, that the nose was given us as an organ by which warning was to be conveyed to man, that danger was in the neighbourhood?—The nose seems to have a double office, for it contributes to our pleasure as well as to our warning; at the same time, with respect to any substances in the air foreign to its normal constitution, I believe that even pleasant odours, if constantly present in the atmosphere, would be productive of disease; the purer the atmosphere, (it is generally admitted), the greater would be the sanitary condition of the persons living in it.

Do not you think that the warning of the nose against substances and emanations which give it offence ought to be obeyed?—I think so.

Either by the removal of the substance or of the person?—Decidedly.

The nose will equally give warning of too much of pleasant smell?—The nose, as it is ordinarily constituted, is by no means sufficient to warn us of danger; in fact, it only warns us when the excess is very great. It is also matter of daily experience that a *short* exposure to a very impure and *fœtid* atmosphere is not so frequently injurious as a *longer* exposure to an atmosphere less obviously tainted.

It is supposed that many trades, emitting offensive smells, are not injurious to health, what is your opinion upon that?—There is a great mistake upon that subject. I believe myself, from very extensive observations in that respect, that they will all be found more or less to shorten the duration of human existence.

Do you conceive the smell from a tallow-chandler's to be offensive?—Yes.

Are you at all aware of the duration of life among tallow-chandlers?—I cannot say that I have gone into it with sufficient statistical accuracy to enable me to form an idea. I have known cases of illness in the neighbourhood of a tallow-chandler's, and yet I know individuals employed in the tallow-chandler's shop who have for many years existed in the midst of it without any apparent injury to their health. We find generally, that when a constitution becomes inured to a particular poison, its endurance of that poison is extraordinary; that is the case remarkably in opium, and it has also been proved to be the case with regard to corrosive sublimate, which is a very active poison, and we know that many poisonous substances are good for medicine. We

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begin with a small dose, and are gradually enabled to increase that dose—the constitution endures it after a time, and seems to habituate itself to the new state of circumstances.

That endurance of constitution which is found in some particular cases, will not give such an indication of health, as the ruddy complexion, the bright eye, and the clear skin will give?—In the case of opium, decidedly not, but in some other cases it would be difficult to say.

Take the case of opium eaters, though as a class, they endure the practice, cannot you pronounce upon the class of opium eaters, that the practice of opium eating diminishes the duration of life?—Undoubtedly.

And so with other classes?—Most probably. I believe it is difficult to say with regard to the butchers or the tallow-chandlers, that their actual term of existence is not shortened. With regard to particular works, there is an observation in Dr. Playfair's evidence to which I might, perhaps, be allowed to advert, and that is, with regard to gas manufactories, where a large quantity of sulphuretted hydrogen is constantly being given off, I observe that Professor Playfair repeats a common opinion among persons connected with those works, that typhoid fever and other fevers are not so rife in their neighbourhood as they are elsewhere. I have been several times engaged in prosecutions against gas works, and I have been also engaged in defending them, and, on one occasion in which I was engaged in defending gas works, I was very anxious to show this fact from statistical details. I, therefore, extracted from the returns of the Registrar General the mortality in the neighbourhood of all the gas works around London, and I went on extremely well whilst I was in comparatively healthy districts, and I fancied that I should be able to prove my position. I was anxious then to prove that the generally received opinion was correct; but as soon as I came into unhealthy districts, when I came into those districts where, from the general dampness and lowness of the districts, disease abounded, I found that the mortality in the neighbourhood of the gas works was increased beyond the mortality of the parts of the district lying equally low.

Chlorine is a deodorizer, is it not?—I should not call it a deodorizer, I should rather call it a decomposer.

Do you think it has the chemical effects which are ascribed to it, of neutralizing noxious gases?—It will decidedly decompose them; it has a decided tendency to decompose all compounds of hydrogen, and sulphuretted hydrogen would be decomposed by it.

Being in a gaseous form it ought to be particularly efficient, according to Dr. Playfair's evidence?—Yes; but I do not quite agree with his conclusions.

But still it has an effect in that way?—It decomposes the gases, but with regard to the substance operating differently whether it is in a gaseous state or in a liquid condition a few observations are necessary, chlorine itself will not bleach unless moisture is also present; if you were to put a piece of dry cloth into chlorine it would not bleach it, but if you were to moisten the cloth you would bleach it. The manner in which a liquid substance acts is not in consequence of its being volatilized, but in consequence of its removing the gas, with which its base combines, from the air with which it is immediately in contact,

this air thus purified will immediately take up a fresh portion of the contaminating gas, and thus the whole of the air will be purified, if there is a sufficient quantity of material to purify it, by a sort of chemical process, dependent upon the principle which is termed diffusion. The diffusion of gases, or their readiness to flow into and mix with one another, it is, on which depends the general effect in reaching any particular part of the air. Chlorine gas will not reach the cavities of an apartment readily, that I have proved myself. I once had occasion to destroy some vermin in a wall, and I generated a large quantity of chlorine in order to get rid of them; but I could not do so, and I was obliged to strip the wall to accomplish my object. Chlorine is a heavy gas; the diffusion of a gas takes place in inverse relation to its specific gravity. The heavier gases, therefore, are less readily diffused than the lighter gases. The action of chlorine gas in destroying anything contained in the air must be by means of its diffusion in the air. If by means of rags moistened with a solution of nitrate of lead, you remove sulphuretted hydrogen from the air of a room, and there is a further supply of sulphuretted hydrogen present, it will immediately take the place of that which has been removed, and thus the air becomes the carrier carrying the impure air to the moistened rags from every recess and crevice of the apartment which are thus as it were exhausted. So that the actual facility with which the impurity will be removed is entirely dependent upon the relative specific gravity of the gases and the air.

If it is applied directly to the substance, for instance, if the chloride of lime were applied to *fæces*, you would expect as strong an action upon the sulphuretted hydrogen, or other compounds of hydrogen, as if nitrate of lead were applied?—I should not think the chloride of lime at all equal to the nitrate of lead, for this reason, the nitrate of lead would fix the sulphuretted hydrogen and would remove it entirely away, nor would any excess of the nitrate of lead occasion any smell, whilst chloride of lime not only smells disagreeably itself, but the reaction of the muriatic acid generated by the decomposition, or any acid existing in the material, would liberate chlorine gas, which is still more offensive and deleterious. Actual experiment with the two substances would convince any person that the nitrate of lead is much the most effectual deodorizer, at the same time it is proper to observe that chlorine will act upon phosphuretted hydrogen, which nitrate of lead will not decompose.

One physician says, "As to chloride of lime I attach but little value to its power of preventing either fever or cholera, for before the outbreak of fever in Globe-street, Wapping, in 1831, (described in my evidence), and during its continuance, the wards were frequently sprinkled with a solution of the chloride during the day, and fumigated by means of the gas every morning. If ever it ought to have succeeded it was there, for it smelt throughout the whole building, and had every chance of having a fair trial, every officer of the asylum placing the greatest faith in its efficacy. It likewise failed in my own house, although used so plentifully as to destroy a few flowers in our upper rooms, some of which we had preserved for years. And I have smelt it in vessels where it had been used to prevent cholera whilst attending patients in that disease on board of them?"—I quite agree in that evidence. I

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H. B. Leeson,
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do not attach any efficacy to chloride of lime, because although it has been occasionally found useful in the case of some offensive sores; the annoyance and unpleasant smell arising from the material itself is so great that having failed to observe any great effect from it, as a disinfecter, it was considered useless to persevere in its employment for that purpose. Liebig states that "chlorine is a substance which destroys ammonia and organic bodies with much facility; but it exerts such an injurious and prejudicial influence upon the lungs, that it may be classed amongst the most *poisonous* bodies known, and should never be employed in places in which men breathe." I may, perhaps, here be allowed to refer to the use of this substance in the expedition up the Quorra, in 1841, which, notwithstanding, terminated so disastrously to the health of those engaged in it. In consequence, as I believe, of the opinion of the late Professor Daniell, in common with other scientific individuals, that the unhealthiness of the African coast is to be attributed, in a great degree, to the constant exhalation of sulphuretted hydrogen, the vessels then employed were fitted by Dr. Reid with a ventilating apparatus and what he termed a Medicator, containing chloride of lime, from which chlorine was to be evolved for the express purpose of destroying the sulphuretted hydrogen and other noxious miasmata. The result is well known, and although corroborating the opinion, that sulphuretted hydrogen is to be reckoned, as before stated, amongst the most noxious of miasmata, it cannot be wondered at, that the substitution for it of another poisonous gas, viz., the muriatic acid, proved neither palatable or sanitary to the unfortunate crew.

Nitrate of lead has been applied, under your own observation, to sores?—Yes.

With what efficacy?—It removed all the offensive odour, and so far was beneficial. We constantly use for dressings, preparations of lead. The common goulard, with which we are all familiar, is an instance of the application of lead, and a common application. I think nitrate of lead is rather preferable, because it has not the same faint odour which is attached to sugar of lead, and the nitric acid contains a large quantity of oxygen; the oxygen which enters into the composition may have a good effect, it may assist in the curative process. Diluted nitric acid is a well known beneficial application to ill conditioned sores, greatly promoting the healing process.

Did you observe the cholera when it was in this country?—Yes; I attended several cases, and I am disposed to believe that it was not contagious from observing the crowds of people who came into the houses from mere curiosity, and I never heard of its spreading amongst the people who visited the houses in that way.

Then you coincide with the view that we have taken in our Report?—Entirely; had it been contagious, in even a moderate degree, it must have spread rapidly from the numbers that resorted to the houses in which it was.

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Remarks on Disinfection, by Dr. Robert Angus Smith.

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Generally what we call an antiseptic will be a disinfectant. The prevention of infection will depend upon the prevention of putrefaction. I believe we know of no infection without the presence of a putrefying body. The origin and continuation of all plagues point to this fully and satisfactorily, and the only difference of opinion seems to be whether gases can do it, or organic decomposing vapours only. I know of no case of disease produced from chemical compounds in a permanent condition; no disease produced by the constant exposure to them; concentrated at times, and dilute at others. I know, on the contrary, cases of long life and health under exposure to them. We cannot imagine a state of the atmosphere in which there is no organic matter floating; that is to say, not ammonia, or other permanent gases, but organic matter, which leaves charcoal on burning. Organic matter is given out by all animals, and it is probable, that being a necessary state of things, and not removed by health, it is also conducive in like degree to health. But when it collects it is very injurious. In a crowded room it may be gathered, and its concentrated qualities be observed, but even here it is not a pestilence; it becomes so only after the time necessary for decomposition to set in.

This matter will of course act on the nose and the lungs chiefly, if not entirely. On the nose first. This organ can tell at once when we are getting into impure air, but it ceases after a while to be aware of it, and we are referred then to the general feeling of the whole body, and to the state of the system, for a true answer to the question, where are we? Odour, then, becomes a comparative thing, but its first occurrence should be noted; we cannot smell what we are continually exposed to, and we cannot smell what we never pay any attention to; it is a sense capable of education, but much neglected. A man in health has a certain odour about him, he cannot be aware of it, but some persons, and many animals, can; also persons in certain peculiar and diseased conditions are aware of it. Health has, then, an odour, and this odour is connected with organic decomposable matter; much more has disease an odour, and much less likely to be free from decomposable matter.

The action of substances giving odours is very various; it is as various probably as the other senses, and capable of throwing us into as various states of mind. The quantities used are small, and our general use of them has sanctioned the conclusion that powerful effects are produced by odours given in the most minute quantities; and also that even in imperceptible quantities they are operative. We know that there may be an action before it becomes a distinct sensation; there may be a change produced before we are so far aware of it as to express it; and we have a right to conclude that if a small quantity produce a sensible effect, a smaller may produce an efficient, although insensible effect.

This action on the system may well be called an inner sense, it often changes one state of feelings instantly, and we wonder why. Its continued action produces disease. I have made these remarks, because some persons are unwilling to believe in the great power of forces,

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which they neither see nor feel, not considering that such are of all others the most dangerous.

I shall mention first a few of the methods by which the atmosphere is disinfected by nature, and then a few artificial ones.

Air I consider the great disinfecter, partly by its removal of matter and partly by its oxidating powers. Its mechanical properties are more under due management than its chemical. The source of miasm is in the ground; this arises from the consideration that it is gaseous in its emanation. If on the ground, then, it would be at least advisable that our houses should not be ventilated from the lowest stratum of air; why not go a few feet higher, from 10 to 15 feet? The lowest stratum must be the worst, and any summer evening will tell one that the vapours condense there, and probably the greater part of the miasm. In cases of yellow fever and ague it is notoriously so, and often confined to the lower stories of houses. Ventilation, then, especially ventilating a house with a pure air, not from a cellar, is a most important permanent disinfectant; perhaps not in the most rigorous sense of the word, but nevertheless in a useful and practical sense.

Water is the next agent extensively used by nature. Although moist and drying bodies decompose in the most dangerous way, bodies wholly immersed in water undergo a different and, it would seem, less noxious decomposition. Water also acts from being a conveyor of air, by which means the organic matter is oxidized, forming various products, and among others nitric acid. Water also is a valuable agent in washing the air, throwing down immense quantities of organic matter as food for vegetables. Lakes, rivers, and seas are healthy, and springs and rivulets also, but stagnant water, marshes, and mixed water and plants, do not make wholesome climates. If heaps of rubbish are completely covered with water they become far less injurious, as the rising and falling tide shew us clearly; this is particularly the case when the water is cold; if it be warmed, the effluvia comes off with the vapour of the water. This is a case which may sometimes occur in towns or houses. One evil is, the amount that penetrates into the soil; this, if wells are not near, is not a great evil, as it is so rapidly converted, especially in porous soil, into an inorganic substance.

Soil is the next largest natural disinfectant, and in conjunction with air and water is the most efficient of all. The organic matter is quickly rendered innocuous or inorganic, especially if the land be drained; if it be not drained, the matter will then pass into a decomposition to be allied to putrefaction, instead of an oxidation. The same may be said of all porous bodies, not merely that they absorb the organic matter, but decompose it.

The drainage of a country is therefore an antiseptic and disinfectant.

The great remedial measures are therefore to provide air, water, and land drainage.

But when these things are not done and disease does enter, a state of things has arisen, which has to be destroyed as quickly as possible. For this, there are two agents which are partly natural, partly artificial. Heat is a powerful agent of infection and disinfection. Like many other changes, infectious matter does not decompose, except under degrees of heat which may be called temperate and warm. In the hottest tro-

pical season of Egypt plague disappears. Dryness has probably a great deal to do with this, in a climate, too, where mummies have lain under ground so long. At the same time, heat and dryness have been always recommended in ague districts; the great point so often insisted on is not to sleep in the open air, and probably there is more than one cause for this. Hot water suddenly stops many kinds of decomposition, probably all, although it is not capable of removing some compounds not gaseous which may be found. This I find has been stated by Dr. Playfair in his evidence. That violent organic power which has killed so many in Germany, sausage poison, is destroyed by hot water. Although perhaps we do not boil or heat meat at all times to the temperature necessary, the uneven part of a piece of beef is frequently red, a colour which is removed according to Liebig at a temperature so low as 140° Fahr. This is the temperature at which, if I recollect, Dr. Henry said that pestilential matter was removed, shewing that about this point a change occurs in organised matter, making it incapable of its former decompositions.

Cold is another disinfectant, and of all antiseptics the most powerful, preventing decomposition for an indefinite, if not an infinite period. The iced up animals in the north are an example. It is however the one which is least easily applied to ourselves; the system does not feel invigorated by much cold, although braced by a little; we do however apply it, and perhaps might apply it still more to substances which we wish to preserve. Anything liable to decompose or give out disagreeable odours should never be kept warm. This is an ordinary occurrence with beer, wine, milk and meat. It may be extended to putrid matter of all kinds, which in many places is exposed to the rays of the sun, and also spread over a large surface, as if to let the air act more rapidly on it. It is true this causes more rapid decomposition, but it also yields more volatile matter. It is used by medical men. In seeking powerful artificial antiseptics and disinfectants for violent and extreme cases, we are obliged, as in cases of disease, to administer what is of itself to some extent hurtful to the body. It is important as much as possible to avoid this. But the first consideration is with what are we to deal. If it be a substance analogous to flesh, then have we a difficult body to deal with, for flesh is not easily decomposed. Chlorine does decompose it and give off nitrogen, keeping the rest, the fat excepted, in solution. There is no doubt of its power to decompose all infectious matter and uninfected also. Sulphurous acid gas will also destroy it, but both are violent remedies, and all hopes of destroying infection are small, unless a more easily-managed substance is to be dealt with. Decomposing matter gives out gases and volatile matter. This matter has always ammonia with it: it comes off alkaline; and we probably destroy the one by destroying the other. If it be in conjunction with ammonia that the miasm comes, then will an acid remove it; if it be in a state of an organic alkali, containing nitrogen, then will an acid combine with it. Chemical action, by elementary substances, is not so rapid, although often more violent; if electric affinity be allowed to act in decomposing, it is better.

Chlorine must act in somewhat the same manner, in order to combine; and it even decomposes ammonia, an action not causing any evil, but requiring, I imagine, strong gas. Chlorine acts on all

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metals, and not agreeably on the lungs. It rots the wood in bleaching houses, and is generally mischievous. The wood of the dye-houses, and the beams of print-works, are not subject to rot, although with an equal amount of moisture. It acts violently on the mucous membrane of the nose, producing rapidly a catarrh when weak. Chloride of lime is very different, and decomposes ammonia and many other compounds of nitrogen with ease, by interchanging on double decomposition. It is a pity that it cannot be introduced into the atmosphere. I believe if it could be it would be found efficacious. I do not know whether it gives out pure chlorine only; I am inclined to doubt it. Its action on bleachers is to make them appear a ruddy, healthy set of men; but, at the same time, I think it acts better as a solid in solution; and as liquids will penetrate all places with ease, it may be used as a liquid with great advantage. I fear it cannot be introduced into the air well. If it is decomposed, it rapidly gives out chlorine only; and it is, as far as I know, only its long and gentle action that can be trusted to. I agree, however, with those chemists who recommend it, and would recommend chlorine also, where, especially, people are not living, in fact as a fumigator.

I would say almost the same of sulphurous acid. It is a violent agent, but its action on the system is proverbially deleterious. I think it must make a valuable fumigator, and a most efficient washer. If houses were washed with it it would go into the pores of wood, which it is most difficult to enter by any of the ordinary methods. It is valuable as being gaseous also, by which means it acts as a bleach in the works of woollen bleachers, and is very penetrating.

In purifying sources of bad odour these agents are all valuable.

If however chlorine acts as I suppose, I think any acid will act as well. Acetic acid is a useful and powerful antiseptic; it is mild and agreeable, and can be conveyed in any shape whatever into all places. Pyro-ligneous acid is perhaps the best form of it. I am not aware of this being tried to any great extent; certainly if we may judge of its results in many cases of putrefaction, we should ascribe a great deal to it. It could often be innocently used about the sick. All metallic salts are more or less (disinfectant or) antiseptic: chiefly because they contain acids which, in one form or other, combine with the nitrogen, and prevents its escape. The metal combines with the sulphur, which also prevents the formation of sulphuretted hydrogen. Any metallic salt which is sanctioned by use, may be employed for this purpose.

I have shown in the Mem. Chem. Soc., 1847 (and I am told Boussingault has since obtained the same results), that the salts of magnesia, including the flocculent carbonate, are capable of fixing both the ammonia and the phosphorus of organic matter, leaving a crystalline compound, clear and transparent, of phosphate of magnesia and ammonia. This is valuable, because it preserves the ingredients most valuable for farmers, and gives the magnesia in a state in which it is an excellent manure; but it does not keep the sulphur, and may therefore be considered as imperfect; it will however arrest the evolution of it to a great extent. I would not give it as a perfect body, however, without the addition of a little metallic salt, such as I use to prevent sulphuretted hydrogen, which is a bad gas although by no means the worst. It prevents the formation of phosphuretted hydrogen, although I cannot

attribute any extraordinary effects to this gas. It does not merely act as an antiseptic, but I think one of its valuable properties consists in breaking up the compounds quietly, and making them inorganic, retaining them at the same time for further use. Muriatic acid thrown on magnesian limestone is enough; it acts especially well on urine and liquid manures. It is chiefly for the farmer and the manufacturer, not so much for the house or hospital.

Any slight acid is a great preserver. The acid peat-bogs preserve substances in them a long time. I am not aware as to the alkaline peat-bogs, but I think preservation will probably not occur with them, as they are not alkaline to any depth. Tannin is another substance which is a valuable antiseptic, acting little on the organism, but in a length of time doing its work efficiently. Tan-yards have a great deal of filthy matter about them, but the tanners are reckoned healthy men; whether there be anything here on which we might lay useful hold is a question worth answering.

The infectious matter of plague, cholera, and yellow fever is probably not a true gas; it does not diffuse. Plague and cholera run up one side of a street: and have been found not to enter a house till the door was opened. Yellow fever can be shut out by protecting the side from which the miasma is blown. Yellow fever may be blown away by a wind. Other pestilences have also disappeared by wind (Hecker). There are cases in which gases do not diffuse readily: what causes are in operation I do not know; some may combine more readily with water, and thus be prevented from acting as true gases. It is very probable that emanations from organic matter combine with water also. Organic matter of animal origin may be detected abundantly in the air. In a crowded room it is got in large quantities, and fatty bodies and nitrogenous bodies may be recognized separately; when burnt, charcoal is left, in quantities by no means microscopic. I cannot agree with those who attribute the unwholesomeness of crowded rooms to carbonic acid. Experiments with the pure substance have been contradictory in their statements. The animal matter has far more power to act, and, like other animal poisons, does not require to be given in large doses to produce bad effects. These vapours may then lie for a considerable time full of the worst qualities, and we cannot calculate to what place any amount of vapour will go, the circumstances of the ground and the atmosphere are so numerous.

When we say remove the cause and the disease will disappear, we are right—both are the cause, want of purity is want of health. At the same time, let us not forget that there may be extraneous agencies to act on us, which make more impure that which is impure among ourselves, and that to whatever pitch of cleanness we may ever arrive, as long as any one nation in the world is not so, we are subject to the seeds of a pestilence, as we have, from sad experience, in all ages learnt; and that, also, in whatever state our lands may be, until the land of other countries is also removed from the state of producing pestilence, we also are subject to be threatened with its seeds, and the lesson we must learn is, to be doubly careful that when it does come, it may die out from the excellency of our arrangements, which should leave nothing on which it can feed; however, I am not aware that miasma from land has ever been found infectious.

State of the Suburbs of the Metropolis.

MY LORD AND GENTLEMEN,

PURSUANT to your instructions I have perambulated, and taken an eye survey of the suburb and districts around the metropolis, and I beg to lay before you the following remarks thereon; commencing at Fulham, and going round the northern side by Hampstead towards Hackney, and from Battersea to Lewisham and Deptford, and then over the marshes.

About Fulham, and up the river side towards Hammersmith, the land is mostly occupied as market-garden ground, and in a high state of cultivation. The soil is a free loam; the subsoil gravelly, and charged with water, to within from 8 to 10 feet of the surface of the land.

On inquiry I was told, that the London fogs do not often go so far up the river, but that there is sometimes light fog, which, appearing towards evening, is generally all gone off by next morning. The district lies very open, a few hedges for shelter and ornament would be an improvement.

About Earl's-court, Walham-green, and Little Chelsea, the soil is of a more retentive nature, rather wet, and capable of improvement by better drainage, at a cost of about 4*l.* per acre, which would effect an improvement in the annual value of the land of 25*s.* per acre. Liquid manure might then be applied to the land with advantage.

Along the river side, to the distance of about half a mile from the river, the land, though very nearly of the same soil, is much drier than that farther from the river.

Between Hammersmith and Shepherd's-bush, the surface of the land is very flat, and much in want of better drainage. Upon a number of fields the earth, to the depth of from 4 to 6 feet, has been removed for brickmaking; and the ground being left in a rough and undrained state has become quite a swamp.

Several acres of it have all the appearance of a bog, being covered with reeds, flags, and other aquatic plants common to such places. A great part of it has been converted into ozier-beds of 12 or 15 feet width, with trenches filled with water between.

I estimate the whole extent of these artificial swamps at about 70 acres; about one-fifth of it being either so wet as to be worse than useless, or entirely covered with water. The whole extent of it is very wet, producing a rank coarse vegetation; great quantities of which is allowed to rot where it grows, producing unwholesome exhalations, such as occasion ague and rheumatic affections; and along the south side of the Uxbridge-road, the process of excavation and brick-making is still in progress. It would be well, if the owners or persons conducting such works, could be called upon to provide sufficient drainage for such places to prevent their becoming a nuisance to the neighbourhood. Cases of ague are of frequent occurrence in the district, and rheumatic complaints are very prevalent.

By the roadsides, between Shepherd's-bush and Hammersmith, a number of houses have lately been built, and some are in course of

building; but no proper ~~sewage~~^{sewerage} is provided for any of them. The ditch, which answers the purpose of a common sewer, is so shallow as not to admit of the house drains being made more than a foot under the surface of the ground.

On the north side of the Uxbridge-road, near to Old Oak Farm, there is a row of houses and cottages, about 20 in number; the sewage from which is collected into a very shallow ditch, between the houses and the adjoining field, which has a very unsightly appearance. It was pointed out to me as a nuisance to the neighbourhood by Mr. Norton, a market-gardener there, who states, that in consequence of the ditches, which are intended to serve as common sewers, not being kept clear and deep enough, much of his land is kept injuriously wet.

A better outfall for drainage may be obtained. The nature of the soil is well adapted for draining, and appears to be injured for want of drainage, which might be effected at a moderate expense.

I am of opinion, that an outfall may be got sufficiently low for draining even these old claypit swamps, so that they might be again brought into cultivation.

There is a piece of land, about 50 acres in extent, between Acton and Turnham-green, apparently rather under the general level and very wet, so much so, as to be unfit for pasture; a great part of it is in ozier-beds. Some of the drier parts of it are in pasture, and produce a very coarse herbage of little value. If drained, it would be a piece of the best land in the district, and it might very well be drained. In its present state it is hurtful to the neighbourhood. The brook, which is the common sewer for the drainage of the district, runs by a very circuitous course through lands belonging to various proprietors, and through Hammersmith into the river by the Hammersmith creek; a more direct main sewer with a better outfall, may easily be obtained. The labourers throughout the district state, that their cottages are very damp in winter, and that they suffer very much from rheumatism.

I was surprised to find the village of Chiswick one of the worst conditioned I have seen, with respect to roads and drainage; the roads or streets having never been made or paved in any way, but just so much of the natural surface of the ground left for the purpose of a street. They are much cut up with carting, &c., and covered with mud. The village is well situated for drainage, but is sadly neglected.

I was there informed that small-pox has been very prevalent there, and that sixteen children had died of it in one week lately.

North of Acton is a ridge of higher ground by Hanger's-hill, Old Oak-common, and Wormwood-scrubbs, towards Kensall-green; a cold poor soil, with many springs of water. The water from these springs is diffused throughout the gravelly subsoil of the level district between that and the river, and keeps the whole district wet and cold. By a few drains well placed, a great extent of this land might be laid dry, and thereby much improved at very little expense.

Respecting the roads, lanes, and byeways, to which you directed my attention, I have to remark, that with a few exceptions, they admit of much improvement. The water in the ditches keep the roads wet and soft; and they are cut up with the cartage of garden stuffs and manure. If better drained, they would be less expensive to keep in order. The ditches by roadsides, though very common, are of very little use. They become a general receptacle for all sorts of light

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rubbish, which obstructs the water in them, which stagnating soon becomes offensive, and keeps both the road and the adjoining lands more wet than they would be without a ditch at all. By the substitution of agricultural drains, instead of the ditches, a greater breadth of roadway may be obtained by filling up the ditches, and the roads be much better drained.

These drains would dry a considerable extent of the land on each side of the road, and would also serve as main drains or outfalls for the drainage of a great extent of the land on either or both sides of the road wherever draining is requisite, and there is very little in the suburban districts which may not be improved by drainage; one of the greatest obstacles to this being the want of a proper outfall.

In the neighbourhood of Hampstead, there are several hundred acres of unenclosed land, which by drainage may be made very good market-garden ground. There are many springs of water upon it, from some of which water is carried to Hampstead and sold at a penny per pail-full. The sewer water from Hampstead, streams of which are running to waste in the ditches, might be advantageously applied to some of the lands adjoining by gravitation.

The ponds near Hampstead—constructed I believe for collecting water for the Hampstead water-works, appear to me objectionable, receiving as they do a great amount of impurities washed into them by rainwater from the surface of the commons. The ponds near Highgate are surrounded mostly with meadow and pasture land, a part of which had recently been manured with dung. It had rained heavily for some hours, and I observed that the rain-water carried a good deal of colouring matter from the newly manured field into the pond. I was rather particular in noticing this, as it occurred to me that probably if it were proposed to apply liquid manure to these fields, objections would be raised against it, lest it should injure the purity of the water in the ponds.

I was upon the low wet land between Highgate and Kentish town, at sunset (on the 7th January.) It had rained nearly all day till within half an hour of sunset, with a rather brisk wind, and the atmosphere tolerably clear. Very soon after sunset the ground became covered with mist, rising gradually higher, and in half an hour the low wet fields were covered with it, to the height of 6 or 8 feet, where it had all the appearance of a thick fog, while the drier land had none of it.

The whole of the low lands about Kentish-town, and between Camden-town and Holloway requires draining, if not for the improvement of the land (and it would be much improved thereby) yet for the salubrity of the district, which is one of the worst for damp and fogs in the suburbs.

About Highbury, Ball's-pond, Dalston, Hackney, and Homerton, the land is of a gravelly nature, and dry enough if the field and roadside ditches were kept clear and clean. The lanes and byeroads are badly drained, and not kept in good order.

The district about Battersea is in a state which admits of much improvement. The soil is a dark-coloured loam on a gravelly subsoil. The surface drainage is apparently much neglected. The ditches by the roadsides, filled with stagnant water, and made a receptacle for all sorts of rubbish, are very unsightly. On the Battersea-fields are a

number of old brick clay pits filled with water, and numerous other ponds and ditches, and something like the course of a brook, all filled with stagnant water, smelling offensively, and in one of the lower parts of the fields there is a piece of bog. The drainage of all these, would tend to improve the salubrity of the district. There is a flat low piece of ground, south of Battersea, through which a sluggish stream of water stagnates, nearly on a level with the surface of the land. It is known by the name of Latchmore. It is let in allotments to the poor of the parish, under the management of the parish overseers. Some poor men at work on the ground, told me that influenza had been very prevalent among them, and that the ground is very useful to them, but would be a great deal more so if it were so dry that they could dig it during winter. The drain from this piece of land passes under the South Western railway, where the culvert is hardly low enough to admit of draining the land properly. I traced the course of the sewer along towards Lambeth. It is a sluggish stream of impure water, smelling disagreeably.

The water-course may be traced through the marsh to near Lambeth, stagnating and emitting offensive effluvia; the land along its whole length is flat, wet, and unwholesome. The workmen in this district suffer severely from rheumatism. From South-ville towards Camberwell, the land, from its lying higher, and having a subsoil of sandy gravel, needs little draining; but the lanes and by-roads are in very bad order; and in various places sewage water runs into the ditches, and reduces them to a very filthy state.

From Camberwell southwards, from the high ground about Herne-hill and Champion-hill, commences the plastic clay surcharged with water; towards Forest-hill the soil is poor, cold, and wet, but capable of much improvement; the water runs in streams from every field; hedges and belts, or clumps of plantation for shelter, and a thorough drainage are the means by which it is to be effected. South of these hills about Sydenham, and from thence down the valley of the Ravensbourne by Lewisham, the land is of excellent quality, but all more or less charged with water; the southern part of Lewisham has a clean healthy appearance, but near the bridge where the Kent-road crosses the river, there is some land injuriously wet; apparently owing to a mill weir which there keeps the water above its natural level; but it might be drained without interfering with the mill by a main drain clear of the river to below the mill.

Some of the back streets near the bridge are in a very unsatisfactory state, I could see no street-drainage there, the houses were of a humble description, and such of the inhabitants as I saw about their doors, bore in their sallow shrunken countenances witness to the unwholesome state of the place; the place I speak of, is on the west side of the river, and south of the London road. Between Deptford and New Cross the land appears very wet, but of a good quality, and mostly occupied as market-garden ground. Between Deptford and Peckham New Town, and Rotherhithe, there appear to be nearly a thousand acres mostly cultivated as market-garden ground, a great part of which has been a peat bog; the surface soil being an alluvial deposit, on a subsoil of peat moss varying in depth, from 3 or 4, to 8 or 10 feet; this district appears to have been brought into cultivation without being sufficiently drained, retaining the ditches or water trenches, common on marsh districts, instead

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of fences. The occupants admit that a better drainage would be beneficial to their grounds in winter, and would enable them to bring forward their spring crops earlier, but they are afraid lest it should make the ground too dry in summer. But of this there is no danger, unless the land be drained to an improper depth. Land that is kept dry and in a pulverized state, during winter, is much more retentive of moisture during summer than lands kept too wet in the winter.

Wherever such ground remains in a very wet state for two or three months, the air is expelled from the soil, and it becomes solid and compact, after which one season's cultivation is not sufficient to pulverize it sufficiently for the purposes of vegetation.

It is not generally till after the second year, after land has been drained and properly cultivated, that it becomes sufficiently pulverized, and till then the beneficial effects of drainage are not apparent.

By proper drainage and the substitution of hedges instead of these unsightly and unprofitable ditches, nearly all the lands in this district, now cultivated as market-garden ground, but which are so wet as to be fit only for summer crops, may be rendered quite fit for the growth of winter and spring crops also, and thereby nearly doubled in value; and the agues and rheumatic complaints of the labourers, would be removed with the superfluous moisture which occasions them.

Mr. Morris very obligingly accompanied me over the Isle of Dogs, and shewed me the system of sewerage there, the mode of flushing them with water from the river, and supplying the land-ditches with water. And he introduced me to Mr. Lambert and Mr. Bradshaw, two gentlemen long resident, and occupiers of land in that district.

The open sewers which receive the sewage from the buildings and factories about Blackwall, are in a much less offensive state than the land-ditches, but yet a more frequent and copious use of water in flushing them, would have a good effect. The roads about Blackwall are in a very neglected state, and much complained of by the inhabitants.

There is no apparent obstacle to a complete sewerage of the district, and the facility with which water is got from the river, renders it easy to keep the sewers clear and clean.

The Isle of Dogs is considered to be one of the richest, if not the richest piece of marsh pasture land in England.

Its soil contains the elements of fertility in abundance; and the pasture is luxuriant where the soil is dry enough to let it grow; and having been long in a state of pasture, there has accumulated upon its surface a mass of vegetable mould, and vegetable matter in a state of decomposition, till by its excess the land is rendered less valuable. It is intersected by numerous ditches or trenches, partly filled with water, intended to answer the purpose of fences and supply the cattle with water. And the ground not being quite level, makes it necessary to dam up the water in the ditches on the higher ground, and not being allowed to run off, it becomes stagnant, and unfit for the use of the cattle. These ditches are in a very foul condition, with the water dammed up in them, full of weeds and filth, stagnant and stinking abominably.

Some of the lower parts of the grounds have the appearance of peat moss; which, however, is not peat, but a mass of decayed grasses, reeds, rushes, and other vegetable matter, almost resembling a dung heap. The margins of many of the ditches are without grass, and

What is this but normal peat?

trampled like a road by the horses and cattle, impelled by thirst, yet loath to drink, traversing the sides of the ditch in search of purer water.

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Mr. Bradshaw, jun., informed me that these ditches are cleaned out generally once in six years, at an expense of 2s. 6d. a rod of 16½ feet.

Horses pasturing there during the heat of summer are affected with the staggers. Mr. Williams, a veterinary surgeon in Poplar, says it is from drinking the impure water from the ditches. Mr. Lambert and Mr. Bradshaw, who have long been occupiers of land there, attribute it to an effluvia emanating in hot weather from the soil, and breathed by the horses while depasturing thereon. They say it is common to all rich marsh pastures, and worst where the grass is kept bare.

Whichever of these may be the more correct opinion, the primary cause of the disease is the same, for the impurities of the water, and the unwholesome effluvia from the soil, are owing to the decomposition of the vegetable matter in excess, upon the marshes. These gentlemen also state, that the land is now less valuable than formerly, as pasture; and that, consequently, the rent of it has been lowered 20s. an acre. It now lets at from 4l. to 4l. 10s. an acre.

This deterioration in value of the pasturage is attributed to a concurrence of various causes, viz., the smoke from the numerous steamboats on the river, and factories lately built in the vicinity, injuring the grass; the supply of water in the ditches being less pure, and less in quantity than formerly; and the great number of people and dogs about the fields disturbing the cattle; and each of these causes may have some effect, but the principal cause is to be found in the state of the land, its surface being crusted over with decomposed vegetable matter, which prevents the roots of the grass from entering sufficiently deep into the soil to produce herbage of a nutritious quality. I cannot better explain this than by stating a remark of Mr. Lambert's relative to turning the land into arable or garden ground.

When I asked him whether it would be valuable as arable land, he replied, "If it were broken up and sown with corn, it would grow nothing but straw, you would have no corn. But if you would first take two or three crops of cabbages, mangel wurzel, or potatoes, then it would grow corn very well." Now land that will grow straw only, and no corn, cannot be expected to produce grass of a very fattening quality. And a remark of Mr. Bradshaw's corroborates this opinion; he stated that the grass upon the marsh did not answer well for hay; that it contained too much water, was tedious and expensive to make, and when made into hay, had very much the appearance of wool; soft and light, producing but a small quantity of hay from a great deal of grass.

Mr. Lambert stated that the land would be very valuable as market-garden ground. These gentlemen state that cattle and sheep are very healthy on the marsh, if brought there in a healthy state; but if they have any unsoundness about them when brought there, it is soon found out, but not cured; and that butchers will not purchase sheep or cattle that have been only a short time on the marsh, nor till they have been a full season there.

I do not suppose that the pasture land in the Isle of Dogs affords employment for ten labourers during the year. But if cultivated as market-garden ground, it would give employment to 1000 persons, at the rate of only two persons per acre. Those parts of the marsh

But ground as good can be had at 30/- per acre (and a railway into market distance of London) instead of £10. per acre

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severed from the Isle of Dogs by the West India Docks, and which are now cultivated as market gardens, and for which a rent of 10*l.* per acre is paid, are sufficient evidence that the land may be profitably so cultivated.

On the Bromley marsh, where the land is mostly garden ground, much of it is so wet, that surface drains, or water-furrows, are made on purpose to drain away the surface water; drainage there would be a profitable improvement, and one of the Poplar sewers runs through it, affording a good outfall.

Some of the ditches there are in a bad state, particularly along the side of a bye-road on the west side of the field.

Upon the Tottenham marshes, and those down the river towards Lea-bridge, the soil is of a free gravelly nature, on a gravelly subsoil, and needs little drainage, other than a free outfall for the surface water.

But the river is so obstructed with canal locks and mill weirs, that the water is kept above its natural level, and thereby all adjoining flat land kept injuriously wet, injurious not merely as affecting the land, but also as affecting the house-drainage about Tottenham and elsewhere, and the general salubrity of the district.

On the Hackney-marshes the soil is of a more retentive nature, and the injury done by superfluous moisture proportionably greater; with the water standing in the numerous ditches nearly level with the land, the whole of the mass of the soil is kept constantly surcharged with moisture. From such land I believe there is a very much greater amount of evaporation than from an equal area of water surface. Every particle of the surface soil, every blade of grass presents a wet evaporating surface to the atmosphere; so that one acre of very wet land presents to the atmosphere a greater extent of evaporating surface than ten acres of water; which in some measure accounts for the fogs generated by emanation from the marshes.

From the great number of mill dams, canals, reservoirs, ponds, and ditches, about Stratford, half the surface of the district seems nearly covered with water and the other half is kept in a state of saturation. If a few spadefulls of earth be dug up anywhere, in half an hour the place stands full of water—ditches dividing the fields—ditches meant for house drainage are all from one end to the other filled with water—not running water, but stagnant; some of the ditches near Bow-bridge receiving house sewage, are in a most unsightly state, and much complained of. One ditch east of the river and south of the high road, commencing at Abbey-lane, receives the sewage and exuviae of a row of houses, (about 40); their privies are all placed over the ditch, which is broad and shallow, half filled with stagnant water, not enough to cover the stercoraceous matter, and all open to view from the Abbey-road.

It is very unsightly and unwholesome, and is much complained of. I called on Mr. Bullock, a baker, who is the owner of two of these houses, and occupies one of them; he told me that they are made to pay sewer-rates, and that ditch is all the sewer they have for these buildings; and he told me where I might see (and I went and did see) several other sewage ditches in a similar state.

From Stratford to the Thames, the land on both sides of the river Lea is of an excellent quality, either for cultivation or pasture, but a great part of it is, like the rest of the marshes, very wet; some of the drier parts of it are cultivated as market-gardens. The whole of it,

and about half of the Plaistow Level, comprising together about 1600 acres, might be more than doubled in value by drainage; and as market-garden ground, would give employment to twenty persons for one at present.

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The roads about Stratford, Bow, and West Ham Abbey, are many of them not in good order, kept ever wet with the great ditches filled with water on each side of them.

I measured some of them. Abbey-lane is 15 feet wide, with a ditch 12 feet wide on each side, containing 9 feet in width of water in each ditch, and every furrow in the adjoining fields was standing full of water. West Ham Abbey marsh road is 21 feet wide, with a 12 feet ditch on each side; farther southwards this road is 15 feet wide, with a 12 feet ditch on either side, and the water in these ditches within 2 feet of the surface of the land.

I estimate the proportion of land occupied by these ditches on this marsh, at 1 acre in 20. The marsh called Plaistow Level, is still more wet than the last, with the ditches in a worse neglected state.

I measured some of these ditches; they are 18 feet wide, grown full of weeds, and the water in them covered with a whitish frothy bubbling scum, produced from the decomposing vegetable matter in the water; I estimate the proportion of ditches to the land, at one acre in 25. That half of the Plaistow Level adjoining to East Ham Level, containing about 800 acres, and the whole of East Ham Level, containing about 1700 acres, may by drainage be very much improved for pasture; or rendered fit for cultivation. As pasture land, its value would be increased 20s. an acre.

The East Ham marsh is not so wet as the others, nor the land so good; about a third part of it needs thorough draining. Near the river, where the ditches are deep, the land is tolerably dry. The half of the marsh farthest from the river is much the wettest, partly owing to the water coming in the gravelly subsoil from the higher lands to the north of the marshes; and the ditches are not so deep as they are nearer the river. A few well placed drains would dry a great extent of this marsh, and greatly improve its value.

It seems to me, that a great improvement may be effected at Bow Creek, by straightening the course of the river Lea, by a short cut either at the iron-bridge or a little lower down, and by which about 20 acres of valuable ground would be gained.

The distance from Bow Creek, following the windings of the valley to Tottenham Marsh-lane, is about seven miles and a half; and one direct cut for the river course for that distance, would occupy about 60 acres, and by means of it, the whole of the marsh land along its course could be laid perfectly dry.

The lineal extent of the several branches of the river with its crooks, windings, and canals, is upwards of 19 miles, occupying upwards of 150 acres, and keeping some 2000 acres of land in such a wet state, that it is not now worth one-half of what it would be if well drained, even for agricultural purposes; but, if it were once well drained, some part of it would become building ground, and as such, worth 10 or 20 times its present value; and all the property in buildings within a mile of the river Lea, on either side, would become more valuable from the improved salubrity of the district.

Mr. Smith being at the time engaged himself, sent the wall reeve to show me their system of drainage upon the Greenwich marsh, a

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system which has been in use for a great many years, who told me that ague is now less prevalent than formerly, owing to a better drainage of the marshes; and that it prevailed, not so much on the low ground, as on the brow of the rising ground along the margin of the marshes.

Fogs are frequent, brought by easterly winds from the marshes farther down the river, and by the south-easterly wind from the Lewisham district. The Greenwich marsh is divided into fields by ditches filled with water drawn from the river at high-water, and returned by means of a common sewer or main drain to the river at low water. The outlet sluices of these common sewers might be lowered 5 or 6 feet, and the drainage thereby improved. I have made a rough estimate of the ditches upon these marshes, taking care that my statement shall be within the actual measurement. I find upon an area of 450 acres of land, that there are 13 miles of ditches. The surface of the water in these averages 9 feet in width. The entire water surface is, therefore, 15 acres. The average of the entire width of the ditches is 11 to 12 feet; there is thus $18\frac{1}{2}$ acres of land occupied with ditches out of 450, or one acre of ditch to 24 acres of land. To make them answer the purpose of fences, the occupiers of the land dam up the water in the ditches as high as possible, till it becomes stagnant and impure; although by the system of inlet and outlet sluices it is intended to be kept in a constant current from and back to the river, but owing to the great extent of the ditches and the numerous obstructions to the flow of the water in them, some of those farthest from the common sewer are hardly ever freed from their stagnant water.

I looked at these ditches; it was half an hour past ebb tide when I was there, and in the ditches near the common sewer, the water had run off to the depth of 15 inches; in others farther off it had fallen 9 inches; in others 6 inches; in others 4; in others 2. And in some of those ditches farthest from the common sewer, it did not appear that any portion of the water had been drawn away in them, the water being quite stagnant; and some of these ditches receive the house-sewage from East Greenwich, and are in a very bad state.

The marsh land east of Greenwich is divided into fields by ditches filled with water let in from the river by small sluices under the care of the wall-reeve. These ditches are on an average 9 or 10 feet in width, and about 3 feet deep of water. They answer the purpose of fences, as well as watering places for cattle, and serve in some degree for drainage.

Some of the workmen upon the marsh attending to cattle, &c., stated that in some states of the weather, where the ditches are not kept well scoured, they smell very much, or in their own words, 'stink terribly,' when the water is low. The smell arises from the rotten weeds about the sides of the ditch. They stated that at this season there is little or no smell from the ditches, but to me it was quite perceptible at the time I was speaking to them, although they seemed unconscious of it.

These ditches are a bad substitute for fences. Neat hedges would take much less land, and they would give shelter, which is much wanted. For the purpose of providing water for cattle, not one-fourth of these ditches are necessary. The drainage could be much better effected in a different manner.

There is an extensive area of high dry ground south of Greenwich, from which a large quantity of water must be discharged somewhere.

I am of opinion that much of it flows through the substratum of the marsh to the river; and on inquiry, I was informed that several wells have been dug on the rising ground near East Greenwich, and that plenty of water was got in a vein of land about 18 feet under the surface.

It is probable that the railway-tunnel now being made through Greenwich Hill will tap these springs, and collect a stream of water which might be made useful about Greenwich.

On inquiry, I was informed that ague has been more prevalent about Plumsted this winter than for many years; and that as the drainage of the marshes have been better attended to, ague and other ailments have abated.

Generally speaking the Plumsted marsh is a very wet one, although various parts of it have been partially drained with good effect. Mr. Russell of Plumsted showed me several fields on his farm which he had lately drained, which presented a marked contrast to the adjoining undrained land. Mr. Russell stated, that the drainage had more than doubled the value of the land, and that he is prevented from draining more of his land by want of outfall, owing to others not keeping the ditches through their lands deep and clean.

A great many of the main ditches are well cleared, with a goodly current of water in them, but the minor ditches are not in good order, and a great many acres are so wet as to be worse than an equal area water surface for evaporation. At least half of the marsh requires thorough draining.

A great part, if not all the water which keeps this marsh so wet, appears to come from the high grounds on the south of it, and might be intercepted on the margin of the level ground, and conveyed direct to the river.

I was on the marsh near the river till after sunset, to observe the state of the atmosphere in the cool of the evening. Shortly after sunset, the very wet parts of the marsh became covered about knee-deep with a whitish mist, and the course of the ditches on the drier parts were indicated by a streak of mist gradually increasing. I walked over some of the wet misty fields; there the air had a chilling coldness and a peculiar odour, which produced a sensation of languid weariness, which soon passed off when I got upon drier ground; the effect, I believe, of breathing the gases distilled by the evaporation from decomposing vegetable matter in the ditches, and upon the wet surface of the land.

The Plumsted and Erith marshes, containing upwards of three square miles of land, or nearly two thousand acres, rich in the elements of fertility, under a defective system of drainage and cultivation, are by their very richness a source of miasma and disease. These lands are well adapted for a high state of cultivation, and under good management, would become the gardens of the metropolis.

I would not hesitate to undertake the drainage (substituting hedges instead of ditches) of the Essex, Plumsted and Erith, and Greenwich-marshes; those along the river Lea, the Isle of Dogs, and also the wet lands about Shepherd's-bush, Acton, and Turnham-green, and to make them over their whole extent as dry as any market-garden ground need be, under the condition, that within seven years the improvement in their annual value would pay 20 per cent. upon the whole expense of the improvements.

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And with such a thorough drainage of these districts the marsh fogs, agues, and other marsh diseases, would be entirely removed, as they have been from other districts by similar means.

By cultivation as market-garden ground a great extent of the marsh land would be worth a rent of 10*l.* an acre, and would give employment to at least twenty individuals for every one now employed upon it. Some of the occupiers of marsh land are of opinion that if it were drained it would produce less grass; and probably it would produce a less *weight* of grass in its green state. The grass on the dry land would contain less water; but it would be more nutritious. It would make a greater weight of hay, and of better quality.

Another and a very important advantage to be derived from the drainage of the marshes is, that sheep and cattle half-fed or two-thirds fat, might be brought there for a month or two, and made completely fat, near to the London market, which cannot be now done; for the London butchers will not buy those that have been only for a short time on the marshes. The rich succulent marsh grass has a stimulating effect upon them, which for a while at first renders them feverish and unfit for the shambles. They must be kept on the marshes for a whole season; a month or six weeks is required to season them, after which they fatten very well.

Another advantage derivable from the drainage would be found in the marsh grass being rendered fit for making into hay, and by taking occasionally a crop of hay from the ground, a portion of the decomposing vegetable matter would be removed, and the pasture kept in a more wholesome condition.

Subjoined is a tabular statement of several matters relative to the present state of the marshes.

With reference to the annexed plans, I beg to state in explanation, that I take as a sample a bye-road of average width, with twelve feet of roadway between the ditches, the ditches being supposed to be $2\frac{1}{2}$ feet in width, at the surface, and two feet deep. Such ditches are of no use for drainage, they soon become partially filled up with rubbish, which obstructs the flow of water in them and thereby keeps the adjoining land wet.

Instead of these ditches I propose to substitute a pipe tile drain of $4\frac{1}{2}$ feet depth with pipes of 3 or 4 inches bore, jointed with collars, which secures a perfect junction of the pipes.

And I propose to have along the roadside, just over the drains a channel of 10 inches width and 12 inches deep, filled with gravel; with gully-shoots of 12 inches square from that channel down to the drain pipe, and also filled with gravel. One such gully-shoot for each five yards along the channel as shown on the plan, and by these channels and gully-shoots the surface-water will percolate freely into the drain. The roadway being rounded a little, the rain-water falling on it will run off to the side channels and sink into the gravel, with which they are filled, and through the gravel into the drain.

The roadside fences being mostly of posts and rails, I should place them near the channels, leaving for the roadway a width of $15\frac{1}{2}$ feet instead of 12 feet as before, and the extra $3\frac{1}{2}$ feet of width, occupied by the ditches, may be laid to the adjoining fields; by this the land-owners will gain 1*r.* 31*q.* per mile of roadway.

The annual cost of cleaning the ditches by the roadsides is not

less than one penny per rod, of $5\frac{1}{2}$ yards; or 53s. 4d. per mile per annum, which valued so low as ten years' purchase, amounts to 26*l.* 13s. 4d.

Upon level land with a gravelly subsoil, such as the district about Hammersmith, Walham Green, Little Chelsea, Earl's Court, and Battersea, the road drains will effect the drainage of the adjoining lands to the distance of 100 or 120 yards on each side of the road; that is, allowing a fall of 3 feet in 100 yards, for the water percolating through the gravel towards the drain, and I am of opinion that less fall would be found sufficient.

At this rate, each mile of the road drains will effect the drainage of 80 acres of land, which, at the low estimate of 5s. per acre, of improved annual value, makes for the whole 20*l.* a year, amounting, at 25 years' purchase, to 500*l.*

These items may be set against the cost of the road drainage.—The cost of the road-drains will necessarily vary a little in different districts, with varying distances of cartage, &c. I estimate the probable cost per mile of a single drain, as follows:—

	£.	s.	d.
To cutting and filling drains, 320 rods, at 9d.	12	0	0
5280 pipe-tiles, at 90s. per thousand	23	15	0
5280 ditto collars, at 30s. ditto	7	16	8
250 cubic yards of screened gravel, including cartage, at 4s. 6d. per yard	56	5	0
	<hr/>		
	£99	16	8
	<hr/>		
Or per mile of double drain	£199	13	4

In comparing the cost and benefit of such drainage, the amount will stand thus per mile,—

To land reclaimed from ditches 1R. 31 $\frac{1}{4}$ P., at 4 <i>l.</i> rental, 30 years' purchase	£.	s.	d.
	53	8	6
To purchase value of the annual cost of ditches	26	13	4
To improved value of 40 acres (taking that on one side of the road only) drained	250	0	0
	<hr/>		
	330	1	10
By cost of drainage as above	199	13	4
	<hr/>		
Profit	£130	8	6

Upon soils of a more retentive nature, where the extent of the land drained would not be so great, the road drains would serve as main drains for the drainage of the adjoining lands, to the extent of 220 yards on each side of the road on level land, or on one side of the road on a declivity; and serve further as an outfall, for the drainage of land to a much greater distance.

The average proportion per acre, of the cost of main drains is about 12s. Therefore, on level land, where the road drains will answer to

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drain on both sides, they will serve as main drains for the drainage of 160 acres per mile, which at 12s. per acre amounts to 96*l.*, and on such lands the account will stand thus:—

	£.	s.	d.
By cost of road drains as above	199	13	4
To land reclaimed	£53	8	6
To cost of ditches	26	13	4
To value of drainage to the adjoining land.	96	0	0
	<hr/>		
	176	1	10
	<hr/>		
Balance	£22	11	6
	<hr/>		

In this case, the actual outlay for better roads, a facility for drainage, and getting quit of the offensive and unwholesome ditches, is only 22*l.* 11s. 6*d.* per mile. But over the greater part of the land in the suburbs where such drainage is most required, the soil is of that gravelly porous nature, which, as above, shows a positive profit to the landowners from the road drainage.

I have the honour to be,

My Lord and Gentlemen,

Your most obedient, humble Servant,

G. DONALDSON.

LOCALITIES.	Estimated Extent.	Estimated Proportion requiring Drainage.	Estimated Proportion of Ditches to the Extent of Land.	Estimated Extent, requiring through Drainage.	REMARKS.
The Marshes from Tottenham down to Lea Bridge.	Acres. 960	One-fifth . . .	One acre in 50 . . .	Acres. 192	Below the mills, &c., where the river takes its natural level, the land is tolerably dry. Above the mills there is not a sufficient outfall for drainage.
Hackney Marshes	650	One-half . . .	One acre in 40 . . .	325	A good drainage would double the value of the land.
Marsh land in the neighbourhood of Stratford.	240	All	One acre in 20 . . .	240	Good land, but much hurt by too much wet.
West Ham Marsh	660	Nine-tenths . . .	One acre in 20 . . .	594	Excellent land, but very wet.
Plastow Level	1,760	Nine-tenths . . .	One acre in 25 . . .	1,584	A good drainage would double the value of the land. The ditches are in a bad condition.
Bromley Marsh	120	Eight-tenths . . .	One acre in 20 . . .	96	Market-garden ground; very wet; with numerous very foul ditches.
East Ham Marsh	1,700	One-third	One acre in 40 . . .	566	Part of the land nearest the river is tolerably dry; the northern half is very wet, with shallow, ill-kept ditches.
Isle of Dogs	500	Three-fourths.	One acre in 25 . . .	375	A rich soil, but wet. The ditches in bad order.
Greenwich Marsh	450	Three-fourths.	One acre in 24 . . .	340	Very good land. The ditches in bad order.
Erith and Plumsted Marshes	2,000	Half	Not known	1,000	An excellent soil, half destroyed with the wet.
	9,040			5,312	

There is about 300 acres upon these marshes occupied with ditches, which would be gained by the drainage proposed. And taking the whole extent of the marshes into the account, it would effect an improvement of about 20 per cent. on the present rent value.

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NOTE.

Since the publication of the folio edition of this Report, advices have been received at the Council Office, the following extracts from which are worthy of notice.

Extract from Remarks on the Cholera, furnished by Dr. Mackenzie, Staff-Surgeon at Archangel, at the request of Her Majesty's Consul there.

The majority of facts collected during the present visitation of the cholera, confirm the opinion that the disease spreads from person to person, through the medium of the air, and there is every probability that the principle of infection finds its way into the system through three different mediums, namely:—

- a, the respiratory organs,
- b, the digestive organs, and
- c, the skin.

In order to guard against the ingress of the disease, it is necessary to preserve these organs in a state of health and integrity, that being the best prophylactic.

1. *The Lungs* apparently suffer little at the commencement, nevertheless many cases tend to prove that they constitute one of the mediums through which the disease enters the system; the susceptibility of the organs to the disease may be diminished by observing the following rules:—

1. To keep the air pure in the rooms.
2. To use no pungent or acrid substance for fumigations, which tend to suppress the bronchial secretions, as chlorine, vinegar, &c.

Resinous substances may be allowed with more propriety, inasmuch as they promote the secretion of mucus from the lungs. On the same principle smoking tobacco may be allowed. It is worthy of remark, that in cholera, the lungs are affected more frequently in those who do not smoke tobacco.

2. *The Digestive Organs* must be considered as the most frequent medium through which the disease enters the system, because in almost all cases the disease manifests itself by derangement of these organs; constituting the premonitory symptoms which give us timely intelligence, and thereby enable us to apply our preventive measures in due season. Of 320 sick of cholera in the Military Hospital at Tiflis, 280 declared that they had been troubled with frequent stools, two or three days previous to the seizure, sometimes even a week: a Russian soldier considers himself well, so long as he feels no pain, and has an appetite for food; and this deceptive conviction is the more dangerous, as very frequently the appetite continues good up to the time of seizure. Though the stomach may be free from disease, still it is more susceptible of impressions and less equal to its task than in health; this is more particularly the case with the intestines. If during this state, heavy indigestible food be used, or very cold drinks, the disease will not be slow in developing itself.

In private practice where patients pay more attention to their condition than soldiers do, it was a rare occurrence to meet with one who did not feel some gastric derangement and suppression of urine several hours before the attack. It is necessary to pay particular attention to these precursory symptoms, as presenting a possibility of warding off the disease; in these cases, attention to the state of the digestive organs, and a judicious selection of diet are of the greatest importance. The diet ought to be exclusively of animal food, the necessity of this is forcibly illustrated by the following: there were two companies of soldiers, consisting of an equal

number of men, and placed under similar conditions; the one made use of animal food, the other of fast-diet. In the former there was not a single seizure, whilst in the latter there occurred 35 cases of cholera.

The diet should be of easy digestion, using salt in moderation; boiled or raw vegetables, such as cabbage, turnips, peas, fruit, &c., are to be eschewed as decidedly noxious; causing similar derangement of the digestive organs to those observed in the precursory signs of cholera. Beef soup with a piece of roast beef, constitute the best diet during the prevalence of the epidemic. To the best of our knowledge, all those families who had used animal diet, and avoided vegetables, escaped. A light diet is best suited to the condition of individuals during the epidemic, as the digestive organs are much weaker than at any other period. Indeed three-fourths, and sometimes even a larger proportion of individuals suffer from indigestion, or derangement of the stomach. Spirits may be allowed in great moderation, say a glass before dinner and before supper; used in excess, it powerfully predisposes to the disease. Cholera seizures, have been frequently observed after intoxication.

The soldiers should be examined morning and evening, those being the periods at which patients are generally attacked by the disease: seizures take place incomparably more rarely during the day. It happens however, that patients are seized apparently about 10, 11, and 12 o'clock in the day, but on enquiry it will generally be found, that they have been taken ill on the previous evening. The most frequent period of seizure is in the evening, or after midnight, or towards day-break.

The precursory symptoms, or prodrome, are of three kinds:—

- a*, the inflammatory variety,
- b*, the gastric variety, and
- c*, the rheumatic variety.

This classification is of much practical importance, as it regulates the treatment of each variety. It is proved by experience, that in some cases a general or local bleeding does good; whilst in others an emetic is required, and in a third class of cases, a bath, together with such other means as restore and promote the functions of the skin, are called for. Experience has also shown that it is needless to look for an universal remedy, or a specific in this disease, and that we must be guided by general principles.

THE INFLAMMATORY VARIETY is known by signs of irritation of the intestinal canal, which sometimes amounts to actual inflammation of these parts. In these cases, dissection has discovered a rose coloured blush of the intestines, with the usual morbid appearance of cholera cases.

Symptoms of the Inflammatory Variety.—The patient feels a slight febrile attack, some dryness of the mouth, thirst, and sometimes nausea; the tongue is rather white, but without bluish margins, is not pale, but on the contrary redder than usual, the pulse is weaker but not accelerated; frequent motions, accompanied by pain, which is increased by pressure, especially in the umbilical region; urine scanty, of a pale straw colour; all these symptoms however may not hinder the men from going about their work.

The Treatment of the Inflammatory Variety must be antiphlogistic; in plethoric subjects or such as differ from viscous congestions, bleeding must be had recourse to, to the extent of ʒviii . In those who are not accustomed to bleeding from the arm, and who are not plethoric, it will be sufficient to take away blood topically by means of leeches and cupping to the abdomen over the hypogastric region: the ilium being the part soonest affected of the whole intestinal tract. Internally, calomel in 2 grain doses. Externally, frictions with mercurial ointment, warm poultices, sinapisms, &c., are generally sufficient to put a stop to the disease. It is seldom that a second dose of calomel is required; next day, should the purging continue, mucilaginous drinks, or small doses of ipecacuhana are suitable and adequate means. Naphtha, creosote, &c., &c., are decidedly injurious in this variety.

GASTRIC VARIETY.—*The Symptoms* of this variety are those indicating gastric derangement; such as loss of appetite; bad taste in the mouth; dryness of the mouth without thirst; nausea; eructations; flatulency; the tongue is covered with a white coating which is easily removed; pulse natural, a sense of weight at the pit of the stomach, observable principally in those who pay particular attention to their condition and sensations; urine scanty but clear, evacuations voided without pain or griping or tenesmus. These symptoms are more frequently observed during a second return of the epidemic, and also towards the decline of the disease.

Treatment of the Gastric Variety.—It is evident that neither antiphlogistics nor diaphoretics are applicable in this variety. An emetic is of the greatest benefit. This remedy was used in the Caucasus with decided advantage, and when given early was found to put a stop to the disease.

At Tiflis, emetics were not prescribed, at least rarely; instead, a dose of castor oil or carbonate of potass ℥j—ʒss in ʒiv of liquid was used. Soda powders, ungt. epispasticum applied to the abdomen, sinapisms to the belly, loins, and extremities were in use there; half a table spoonful of ashes (wood ashes, no doubt) well sifted, given in a little water, and immediately after it a small quantity of lemon juice, was found of benefit. In this form volatile oils, as peppermints, &c. were prescribed.

RHEUMATIC VARIETY.—This form of the disease was observed towards the close of the epidemic.

Symptoms are, insipid, grassy taste in the mouth: sometimes an acid taste, tongue white, loaded with a closely adhering coating; a copious flow of saliva; itchings of the gums, a feeling sometimes of dryness in the throat; pulse natural or a little accelerated. The most striking signs however of this variety, are transient pains in the belly, back and extremities, especially the lower.

Treatment of the Rheumatic Variety.—Naphtha, creosote, &c., diaphoretics, the elixir of Vorouège were found advantageous in this variety (the last mentioned medicament is a heterogeneous compound of incompatibles, as naphtha, saltpetre, oil of turpentine, ammonia, nitric acid, common oil, &c., &c., &c. Hot fomentations by means of bags filled with ashes, and culinary salt, in the proportion of one-third of the latter, applied to the abdomen, were found of service, as also ordinary and vapour baths.

Cholera diarrhœa.—There is a species of diarrhœa which prevails at the same time with the epidemic cholera, and which may be regarded as its satellite. It is accompanied by some febrile action, which continues through the whole day, and sometimes also during the evening: the fever sets in with a slight rigor, alternated with flushes of heat, the patient complains of weight in the head, or of headache; he has a bad taste in the mouth, especially in the morning; tongue covered and rather dry: pulse at times accelerated, and at times of the natural speed; the conjunctiva becomes tinged of a slight yellow: at the pit of the stomach and towards the right side a pain is complained of: pain in the belly during a motion, or slight griping in the lower part of the belly; these after a day or two pass off, the purging still continuing, whilst the surface is observed to assume a yellow colour: the stools are observed to be bilious, and the urine of a very high colour, yet of the usual quantity.

The course and duration of this diarrhœa varies: sometimes it lasts a week, sometimes two weeks; with due care, however, as to diet and regimen it is not dangerous. Coldness of the surface, which sometimes takes place, is never considerable, it never lasts more than 24 hours, nor ever terminates in typhoid fever.

The treatment is simple: calomel, cupping, or leeching to the pit of the stomach, or region of the liver, constitute the best means of removing the disease, and when the pain has ceased, Dover's powder is applicable to stop the purging.

In the course of the epidemic, it has been observed, that those addicted to

drinking, especially in excess, are peculiarly liable to this disease, and that when attacked they seem to be labouring under two diseases at the same time, the symptoms of cholera being blended with those of delirium tremens.

With respect to frictions, they have been found useful in all stages, and in all varieties of the premonitory symptoms, when these were attended with pain and spasms, as well as with coldness of the surface. Shampooing, however, is more beneficial than plain rubbing, and the oleaginous seem preferable to the spirituous liniments.

Extract from Copy of a Dispatch from Mr. Vice Consul Bassam, to Lord Cowley, dated Moossul, January 20th, 1848.—Answering a series of questions on Cholera sent from the Foreign Office.

“From what I have seen of this disease, it does not appear to be in the least degree contagious, and scarcely if at all infectious, unless perhaps where many sick are congregated together, as in the wards of a hospital. Two cases in one house were of rare occurrence, and then they clearly arose from the misery of the inhabitants. And it must be borne in mind that the people are not afraid to carefully attend their sick. In the cases of my canvass and the doctor of the Nizam, at least thirteen persons, European and Natives, men and women, were constantly assisting them in every possible way, and liable to both contagion and infection, did they exist, in every stage of the disease, and yet not one of them caught it. Nor did the professional washers of the dead take it. In fact, I should consider it as an almost pure epidemic, such as the influenza, which has prevailed here since the last cholera disappeared.”

From documents of a still more recent date received at the Foreign Office, it appears that the cases of cholera reported to the Russian Government, during last year, amounted to about 300,000, and the deaths to about 100,000.

It is also stated that all the reports from the interior of the empire tend to establish the belief that the disease is not contagious.

The following extract, from a report drawn up by the chief officer of the Medical Board in St. Petersburg, charged to investigate the character of the disease, states the experience in regard to the two stages of cholera.

“The curability of each case of cholera is found to be in inverse proportion to its violence. *At the premonitory period of the disease, that is the derangement of the action of the digestive functions, indicated generally by a slight diarrhœa, which continues sometimes for a week, medical aid almost always proves effectual. The success of medical measures is incomparably less in the ensuing stage of the disease when besides evacuations upwards and downwards, the cholera is attended with cramps in the extremities, langour, prostration of strength, failure of pulse, and a gradual diminution of temperature of the whole body.*”

The following Table has also been received, which contains the comparison of the prevalence of the cholera in 1847 with that of 1830-1.

COMPARATIVE STATEMENT of the effects of the CHOLERA EPIDEMICS of 1847 and of 1830-31, in certain TOWNS of RUSSIA.

Names of Places.	The Epidemic of 1847.						The Epidemic of 1830-31.					
	Population	Sick.	Died.	Proportion.		Period of the Prevalence of the Epidemic.	Population.	Sick.	Died.	Proportion.		Period of the Prevalence of the Epidemic.
				Number of Sick to the Population.	Number who died to the Population.					Number of Sick to the Population.	Number who died to the Population.	
Astrachan	45,938	2,455	1,433	1 to 18.7	1 to 1.7	4 July to 19 Sept.	30,770	3,633	2,550	1 to 8.4	1 to 1.4	20 July to 25 Aug.
Savatov	50,486	5,071	3,084	1 to 9.9	1 to 1.6	11 Aug. to 23 Sept.	33,641	3,016	2,165	1 to 11.2	1 to 1.4	7 Aug. to 10 Sept.
Charkov	29,395	1,332	446	1 to 22	1 to 3	30 July to 4 Nov.	32,847	898	497	1 to 37	1 to 1.8	11 Sept. to 15 Nov.
Penza	23,298	189	97	1 to 123	1 to 2	23 Aug. to 26 Nov.	14,944	549	319	1 to 27.2	1 to 1.7	17 Aug. to 29 Sept.
Simferopol	13,768	190	62	1 to 72	1 to 3.1	25 Sept. to 20 Nov.	6,010	215	195	1 to 28	1 to 1.1	6 Nov. to 24 Dec. 1831.
Orel	32,600	2,177	1,063	1 to 15	1 to 2	1 Sept. to 23 Nov.	23,737	776	374	1 to 30	1 to 2.1	26 July to 2 Aug.
Kazau	61,104	2,481	1,274	1 to 25	1 to 2	5 Sept. to 13 Nov.	52,245	964	435	1 to 54	1 to 2.2	9 Sept. to 1 Nov. 1831
Kiev	47,424	1,680	990	1 to 28	1 to 1.7	23 Sept. to 17 Nov.	37,760	455	286	1 to 83	1 to 1.5	17 Dec. to 8 Feb. 1831
Novocherkassk	18,157	1,957	715	1 to 9.3	1 to 2.7	18 July to 20 Sept.	13,187	614	418	1 to 21	1 to 1.4	18 Aug. to 20 Sept. 1831
Koursk	24,539	1,684	1,096	1 to 14.5	1 to 1.5	11 Aug. to 22 Oct.	20,050	1,981	1,055	1 to 10.1	1 to 1.9	19 May to 3 July
Ekaterinoslavl	9,706	404	108	1 to 24	1 to 3.8	5 Sept. to 2 Dec.	11,648	645	144	1 to 18	1 to 4.4	10 June to ? Sept.
Samara	14,825	985	672	1 to 15	1 to 1.5	8 Sept. to 25 Oct.	5,648	571	271	1 to 9.9	1 to 2	25 Aug. to ? Sept.
Taganrog	22,472	260	135	1 to 56	1 to 2	21 July to 13 Sept.	12,023	888	105	1 to 13.5	1 to 8.4	7 Sept. to 12 Oct. 1831
Kremeuchoug	17,533	430	206	1 to 40	1 to 2.1	7 Sept. to 13 Dec.	10,819	345	200	1 to 31	1 to 1.7	18 Nov. to 12 Jan. 1831
	411,245	21,295	11,361	1 to 19.5	1 to 1.8		305,329	15,550	9,018	1 to 19.6	1 to 1.7	

