JACOBI (A.)

The Production of Diseases by Sewer Air.

BY

A. JACOBI, M. D.,

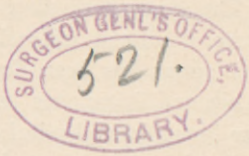
Clinical Professor in the College of Physicians and Surgeons, New York.

REPRINTED FROM THE

New York Medical Journal

for July 28 and August 4, 1894.

Reprinted from the New York Medical Journal for July 28, and August 4, 1894.



THE PRODUCTION OF DISEASES BY SEWER AIR.*

By A. JACOBI, M. D.,
CLINICAL PROFESSOR IN THE COLLEGE OF PHYSICIANS AND SURGEONS, NEW YORK.

The composition of sewer air is at least as variable as that of sewerage. According to Henry R. Kenwood (*Public Health Laboratory Work*, Philadelphia, 1893, p. 232) its reaction is generally alkaline. Oxygen is variously diminished, according to the efficiency of the sewer ventilation; it is sometimes in normal proportions. Carbonic acid is variously increased from the same cause; it probably does not average more than twice the normal amount. Ammonia, sulphureted hydrogen, ammonium sulphide, and carbon bisulphide are present in small quantities. Marsh gas is small in amount or absent. The fœtid and putrid organic vapors of sewage are, according to Odling, allied to the compound ammonias, and are probably carbo-ammoniacal, and contain traces of ptomaines and leucomaines (*i. e.*, animal alkaloids). Molds, fungi, and bacteria (chiefly bacilli) and their spores, together with animal and vegetable *débris*, appear to constitute almost the entire suspended

* Read in the General Session of the Congress of American Physicians and Surgeons, May 30, 1894.

matter. Micro-organisms average about six per litre in the air of a good sewerage system.

The atmospheric air always contains bacteria, mostly, it is true, dead, and mineral parts. The presence of pathogenic germs has been denied; but there *must* be some in the air, and living ones too, for contagion, unless it result from immediate physical contact of the sick and the well, must take place through the air. Tubercle bacilli are found on the walls of rooms; before they enter the lungs of inmates, they must be carried through the air with other dust. It is true, they have been found there but rarely; but von Eiselsberg claims to have seen *Streptococcus erysipelatos* (Langenbeck's *Archiv*, vol. xxxv, 1886) and Pawlowsky *Pneumococcus Friedlander* (*Berl. klin. Woch.*, No. 22, 1885). Indeed, the general statement of Tyndall, not contradicted, always reaffirmed (*Essays on Floating Matter of the Air*, New York, 1882), that the apparently purest air contains dust with micro-organisms, makes the frequent presence of pathogenic organisms at least probable.

But the atmosphere is certainly no favorable medium. Germs are heavy and fall to the ground; thus it is not unreasonable to believe, but it can not be proved, that a walking child of two feet in height may inhale them more readily than an adult whose respiratory inlet is more than five above the surface. The dryness and light of the sun destroy them; even micrococci die in sunlight in a few hours (Duclaux, *Microbes et maladies*, p. 34). It is only when locked up that spores were found normal after many (twenty-five) years. Koch retained virulence in his tubercle bacilli five or seven days in diffused light, but only a few minutes or at most hours under sun rays.*

* The statements occasionally made that *Achorion Schönleini*, plasmodia, erysipelas cocci, also tubercle and typhoid bacilli, and vibrio choleræ may undergo multiplication in the air, lacks confirmation.

Indeed, pathogenic bacteria have a hard time of it. They live in high temperatures only, and die soon in a low one; they are readily destroyed in water containing saprophytes or any other non-pathogenic bacteria. In the thoroughly soiled water of the River Seine, at Paris, which holds no oxygen, there are no pathogenic bacteria; while a few miles farther down, near Meudon, the Seine contains again both oxygen and pathogenic bacteria. Hence, sewage is not a promising place for them to thrive or live in. Great dilution destroys them or renders them innocuous. For two thousand years Rome has emptied all its fæces and other refuse into the Tiber, and no impurities of a dangerous character were detected by Celli and Scala a few miles below the city.

Now, what is valid for air outside a sewer is so for that inside it, with this difference, that there are more germs found in the atmosphere than in sewer air. Billings states emphatically that there are fewer micro-organisms in the air of sewers than in that of the streets. He quotes Carnelly and Haldane (*Proceedings of the Royal Society*, London, 1847, p. 51), who report that the London and Dundee sewers contain twice as much carbonic acid, three times as much organic matter as outside air, and fewer micro organisms, and remarks that this air in the sewers is better than in naturally or even mechanically ventilated schools. It is only when there is splashing in the sewers that (temporarily) there can be more organisms in their air. Otherwise moist surfaces do not give them off. It is only under favorable circumstances that they can be carried off and upward into the houses and escape through ventilating shafts. Into living rooms they could escape only either where there are no traps, or where the traps are empty either from disuse or from being sucked out or from upward pressure. In this way, Billings suggests, pyogenic organ-

isms and Fehleisen's coccus appear to be conveyed through house drains.* At all events the opportunity for microbes to get out of the dwellings is greater than to get into them. When they get into the drains from inside, they are flushed out. It is evident, however, that the flushing out of substances entering the sinks from inside depends on the structure and size of the drain, the nature of the trap, and the amount of the water poured through it, also on the use or non-use of disinfectants employed in the households.†

Less rainfall, and consequently less flushing of sewers, gives rise to accumulation of more filth. Badly constructed brick sewers have the same result. Outfall sewers terminating below water are apt to be choked. Thus, while Russell's analysis yielded a fair standard of purity of sewer air, Parent Duchatelet found only 13·79 per cent. of oxygen and 2·99 per cent. of sulphureted hydrogen. Thus gas is undoubtedly developed to a great extent, bubbles are constantly breaking on the surface (Frankland on

* The epidemic of enteric fever in Croydon, 1875, was attributed by Buchanan to the entry of infected sewer air into houses through untrapped drains and openings into the drains. The pipe sewers were of small size, six or nine inches in diameter, and were ventilated at distances of a hundred and fifty to two hundred and fifty yards by petty openings which were blocked by charcoal trays.

† The quantity of refuse from rooms and houses is very large indeed. Pettenkofer calculates the daily amount of fæces for the average person at 90 grammes, of urine 1,170 grammes; for a thousand persons per annum, fæces, 34,000 kilogrammes; urine, 428,000 litres. If you add to that figure 159 litres of water daily for each individual, the sum total of daily sewage for a thousand persons is 160,000 litres. That explains in part the wrath of Andrew Fergus, M. D. In the *Proceedings of the Medico-Chirurgical Society of Glasgow*, of October 2, 1868, he broadly states that water-closets and canalization are opposed to revelation and Bible, that they are contrary to Nature, inasmuch as they rob the soil, are the sole cause of pollution of rivers, and fill the sewers with noxious gases which enter the houses in spite of traps.

The Transport of Solid and Liquid Particles in Sewer Gases, *Proceedings of the Royal Society*, April, 1877), and may enter houses through *untrapped* drains *whenever they are not permitted to leave the main sewer otherwise.*

Under these circumstances, as the specific germs of infectious diseases may be contained in the liquid disseminated by the bursting of bubbles, sewer air may certainly become specifically infected. Some of the germs may find a favorable medium in the organic material, the ammonia and the phosphates of sewage, while others are more liable to be destroyed by the saprophytes of putrefaction. As to typhoid, the cases are very numerous. In regard to cholera Parkes refers to its introduction into Southampton in 1866, where it was probably due, in his opinion, to the passing of pumped sewage, infected with cholera evacuations, in a frothy and agitated condition along an open conduit. He adds the remark that, as soon as the latter was covered over, the epidemic (or rather endemic) abated. The latter remark is suggestive. A sewer disconnected from houses by good traps is no longer an open conduit; and it appears that *unless sewer air is forced upward*, no amount of cholera bacilli or toxin will annoy the population of houses properly secured by traps and by ventilating shafts both in the houses and in the streets.

But granted that sewers are infested with bacteria, how do they get into the air of sewers, of streets, of houses?

Mr. J. B. Berkart (*British Medical Journal*, November 25, 1893) claims that, in the usual conditions in which defective drainage is supposed to exert its baneful influence, it is impossible that pathogenic micro-organisms which may exist in an untrapped pipe or in a cesspool can escape into the air. The force of evaporation is not enough to lift from a moist surface an organism, however small it may

be; and even powerful ascending currents of air can not convey from a dry and porous soil, much less from a cesspool, any germs. Consequently, from untrapped pipes and cesspools nothing but irritant and toxic gases can escape.

He experimented through six or eight hours with currents of air at a velocity of from twenty-two to forty-five miles an hour. They did not lift into the atmosphere a micro-organism from a putrid solution of extract of meat of not more than a half per cent., or from putrid urine, and were unable to detach a micro-organism from any such putrid solution as may have been allowed to dry on the walls of a glass vessel or on wire gauze.

The question whether any and which diseases can be produced by the inhalation of sewer air has engaged the fears of a great many and the attention of a number of observers. A careful contribution to the literature of the subject is that of H. Hun (*Medical News*, August 20, 1887). He admits the absence of proof of a direct infection by sewer gas, but has quite an array of cases of ailments and diseases attributed to it. Anorexia, constipation, vomiting, diarrhœa, and coated tongue are frequent; prostration, drowsiness, headaches, small pulse, delirium, clonic and tonic spasms, fever, chill, and coma, intercostal neuralgia, Bright's disease (though in a person of sixty-five with arteriosclerosis, and another of sixty years); poliomyelitis in a patient of twenty-nine, who never recovered fully, and of forty-two who recovered after two years; also enlargement of the spleen, with albuminuria, are among the observations made in persons exposed to the exhalations of sewers or cesspools. It will be noted, however, that among all these cases there is not one which can be traced with the knowledge we now possess to a specific germ.

Mark Style (*Lancet*, October 19, 1889) attributes

cases of acute pemphigus to the inhalation of sewer gas. Two children of five and of two years lost color and felt drowsy for a fortnight, then developed blebs on feet and shins; new attacks occurred on other parts of the body (no erythema with it). There were fever and anorexia. The sewers were found to be badly constructed and leaky; when they were mended the children improved.

Hæmoglobinuria in a child of eight years, "probably due to the inhalation of sewer air," was observed by Gordon Sharp and William Summerskill (*Lancet*, December 9, 1893). The girl lived in comfortable circumstances, was previously in good health, fell sick with dyspnœa, puffy appearance, and frequent micturition, which resulted, however, in six ounces daily only of a chocolate-brown urine the sediment of which rose to the top. Guaiacol and ozonic ether gave the characteristic blue color. There were no casts, only a trace of albumin, but few blood cells, much amorphous hæmoglobin. Convalescence began in three days, hæmoglobin disappeared after the fourth day, and anæmia remained behind. In the dwelling the water-closet pipes had been leaking, and the smell had been disagreeable. The pipes were being changed, and the smell was worse when the attack came.

It appears, in the opinion of the authors, that sewer air affects young children quite rapidly, and noxious vapors are known to produce hæmoglobinuria, but it is claimed that no previous case like the above is known.

In the experience of Dr. A. H. Smith, the president of the Climatological Society, in 1881, a large number of the attendants in St. Luke's Hospital, New York, were sick with tonsillitis. Examination showed that the brick sewer which ran beneath the building had fallen in in many places, and the sore throats ceased when iron pipes were substituted for the brick sewer.

The same gentleman communicates to me the following facts:

At Elberon, N. J., in the latter part of August, 1891, occurred a series of eleven cases of sore throat within a period of eight days in the summer residence of one of the most prominent of the cottagers at that place.

The first person attacked was the butler. He complained of great soreness of the throat and severe headache, but continued for two or three days to wait upon the table. When first seen there was intense congestion of the tonsils and fauces, but no membrane, and no exudation at the mouths of the tonsillar follicles. There was little or no swelling of the throat, and no enlargement of the lymphatic glands. The character of the throat lesion remained the same throughout the attack. The temperature never exceeded 103° F. There was extreme lassitude and severe aching of the bones. This, which was the severest case, lasted about ten days, the dysphagia being the most prominent symptom to the last.

In rapid succession ten other inmates of the house, including several guests, exhibited similar symptoms in varying degrees of severity; in two of the cases the throat lesion was that of follicular amygdalitis of a mild type. In the other cases there was simply a dusky redness of the fauces, and some degree of pain in swallowing, lasting from three to six days.

It was discovered, as the result of a sanitary inspection of the dwelling, that a bath-tub on the third floor had been for some time disused, and that the trap had become dry, permitting direct communication with an old cesspool, the existence of which was not known. No other plumbing of the house discharged into this reservoir, and there was no offensive odor from it.

No communication of the butler with any source of

infection could be traced, but the negative evidence on this point was not conclusive, as unconscious exposure could not be wholly excluded.

The bath tub and its connections were removed, and the house has been occupied for two seasons since without the occurrence of further trouble.

Earlier in the same summer a group of four similar cases occurred in a house about half a mile from the one just mentioned. The first patient was a young lady, in whom the throat lesion was similar to that of the butler already referred to, but with the difference that the throat was extremely painful even when at rest, and the dysphagia was so great that the patient could scarcely be prevailed upon to take even the smallest amount of nourishment. The fever in this case was moderate, and there was no aching of the limbs.

Three other cases occurred in the house within a week. One of these showed well-marked follicular inflammation; the other two only engorgement of the mucous membrane, chiefly venous in character.

Examination showed that the main waste pipe, which ran under the house for nearly the whole length of the latter, was of clay, and was broken in numerous places. The soil along the whole length of this pipe was saturated with sewage. An iron pipe was substituted, and the contaminated soil removed and replaced by dry sand. No sickness has occurred in the house during the two seasons that have succeeded.

Owing to special reasons, there was absolutely no intercommunication between the persons constituting these two groups.

One of the latest contributions to the same subject is a book on the combat with infectious diseases by Brix Pfuhl and Nocht (*Die Bekämpfung der Infectionskrank-*

heiten). After discussing the necessity of access of air to a sewer, to prevent it from getting putrid and giving rise to bad odors and dangers, they say on page 310:

"The transmission of infectious diseases by sewer gas has not been proved by past researches and may be considered as out of the question. But bad sewer air can produce nausea, headache, and malaise (when its effect is persistent), and may become one of the causes of other morbid symptoms. To the workmen employed about sewers the preservation of pure air is of paramount importance. Thus successful aeration has a great hygienic importance.

"Investigations referring to the health of men employed in sewers had negative results. They do not suffer more than the average population from infectious diseases.

"Only those employed in the sewers of Wiesbaden suffered from rheumatic complaints more than other public employees. This was due to the fact that the Wiesbaden sewers, carrying off the water of the hot springs, have a constant temperature of 25° C. or more, thus exposing the workmen to frequent colds. Thus their rheumatism depended on circumstances not at all connected with sewers or sewer air."

To my mind the assumption that throat disease and sewer air must be connected with each other is probably due mostly to the irritability of the fauces. Pungent odors and tastes are not tolerated, chloroform can not be administered to a sleeping person because of that circumstance, and strong gases produce cough and discomfort. Hence irritation, hyperæmia, and catarrh may well be explained by the contact of malodorous and sharp gases with the vulnerable mucous membranes of the throat, particularly of children, but specific germs and toxines are, unfortunately, not malodorous, not pungent, and not irri-

tant locally. Indeed, it is in this that lies their principal danger.

Compared with the frequent endemical occurrence of sore throats under the apparent influence of sewer exhalations, which is suggested by some of the reports, I am permitted to make use of a report made to H. M. Biggs, M. D., Chief Inspector of the New York Health Department, by A. Clinton, M. D., Inspector. The report is a very careful one, and the one thousand cases of throat affection detailed under the heading of pseudo diphtheria, which occurred, or rather were reported, from August 1, 1893, to April 1, 1894, in the city of New York from the Battery to East and West One Hundred and Twenty-fifth Street have been accurately located on large city maps. The principal conclusion to be drawn from these two maps, kindly intrusted to me by the Health Department, for whose co-operation in the preparation of this paper I am thus greatly indebted, is this, that to the best knowledge and belief of the experts of the health department the occurrence of throat disease, particularly false diphtheria, is in no way connected with sewers, open sewers, leaky sewers, or outlets of sewers. The same conclusion must be drawn—I may say that just here—from two other maps placed at my disposal which prove that there is no connection in New York city between diphtheria and sewer air in any shape or form. In the latter instance there can be no doubt whatsoever, as the reports of diphtheria cases must be supposed to be correct.

There is, however, some evidence in the practice of every medical man and in public statistics that sickness in general, and fevers—mainly typhoid—coexist with the accumulation of excreta and other refuse material, though no infected water be drank. Definite amelioration has invariably followed their regular removal. The facts carefully collected by Dr. Buchanan in his *Ninth Report of the*

Medical Officer of the Privy Council prove a considerable lowering of the death-rates by such amelioration, particularly in typhoid fever. The same result has been obtained from the same cause (*i. e.*, improved sewerage) in a number of cities—such as Salisbury, Bristol, Carlisle—where the sewers are ample and well ventilated.

He asks: "Why is it that some cities, like Chelmsford, Penzance, Worthing, and Morpeth, with ample sewers, have an increased mortality of typhoid? In one, 'the sewage is delivered into a tank by an outfall sewer which enters some six feet below ground,' with the result that when the engine is not at work or the liquid accumulates in the well, cellars get flooded by the sewage, and sewer gases get forced up into the houses (W. H. Corfield, *The Treatment and Utilization of Sewage*, 3d ed., 1887, page 252). In another one there was no ventilation of the sewers, and sewer gas was forced back through the traps of sinks and water-closets. In another the pipe sewers are below the level of the river, so that in times of flood the sewage is backed up into the main sewer for four or five hundred yards. It is known that outbreaks of typhoid followed times of flood when the outfall sewer had been under water."

The general reduction of mortality can not be said to have extended to infants under a year to the same degree. Typhoid fever is not frequent at that early age, and when it occurs, it is mostly mild, and few deaths occur from that source.

The mortality of infants depends on different circumstances. Diarrhœal diseases do not appear to have been visibly benefited by improved sewerage.

Scarlatina, measles, whooping-cough, croup, and diphtheria were not rendered milder or less fatal through improved sanitation in general, and sewers in particular. On the contrary, both scarlatina and diphtheria were greatly

increased; on the other hand, "cholera epidemics appear to have been practically harmless in the towns examined" (page 47). Even pulmonary phthisis exhibits a great general reduction of its death rate wherever, but only there where pipe sewerage was accompanied with measures taken for the purpose of drying the subsoil generally, such as a special system of deep rain-water culverts.

Stevenson and Murphy, page 11 of their treatise on *Hygiene and Public Health*, refer to the enteric fever in Eastney Barracks, where sewer air was forced back by the tide into the drains, which had no traps but many leaks. When traps were put in and the leaks mended, the fever subsided. Edward Seaton (*British Medical Journal*, December 23, 1893) refers to his experience with dry earth closets. When they were largely introduced after the abolition of privy vaults, the mortality from typhoid fever was greatly reduced. The English generally believe firmly in the dependency of typhoid fever on cesspool and sewer exhalation. It is true that typhoid is apt to be more frequent where there are no sewers but cesspools, but the former are but cesspools rendered entirely or mostly innocuous by their structure and isolation. If the covers were removed from the sewers they would be open conduits, in fact cesspools, and worse than mere privies.

I believe I am correct when I say that the large majority of cases of typhoid fever we observe in New York city in September and October of every year are imported from the country. There a large concourse of people takes place, larger from year to year, in farmhouses, boarding houses, or large hotels. Many of these cases can be traced to the same place, not infrequently big hotels with a good reputation. The cases have become more numerous from year to year, and just at the time when the people thus stricken expected to be benefited by their summer outing.

Cesspool poisoning I know exists. The following case is an instance: A lady who annually took dozens of her boarding pupils to the country, hired for that purpose large farms or country places. During the whole summer not one of the children and young ladies fell sick. One day she happened to come near where workmen were emptying a large cesspool at a great distance from the dwelling and the drinking-water supply. She was exposed to the disgusting odors but a few minutes; but, not being acclimated, within ten days she came down with a very severe typhoid fever, the only case in the whole community. Typhoid fever in dwellings in which the water-closets were in disorder, mainly those located in the interior of houses, I have met with in a number of instances. In the same way, and from the same cause, I have seen dysentery. In several instances I have seen tenement houses full of dysentery, where I could convince myself of the unusual filthiness and offensiveness of the common privy in the rear of the place. In ill kept sick-rooms or hospital wards, where dysenteric stools are not disinfected and removed, dysentery will spread.

There are many authors who go far beyond this. Dr. George Cordwent (*British Medical Journal*, November 25, 1893) is more positive than most of those who like him believe in the direct production of infectious and contagious diseases by defective drainage. He is even anxious to substitute "privy odors" for sewer air, and takes it for granted that bad drainage "frequently evolves gases producing typhus, diarrhœa, etc., often *without* diphtheria; but of forty-three cases of diphtheria—all rural—all occurred in houses pervaded by a strong privy odor. He adds that this is a condition then quite usual in the laborer's cottage, but does not say why there were, in the course of three years, 1858–'60, not more than these forty-three

cases, nor why there were none of them before those years. The real explanation of it all is that there *were* cases of diphtheria when the mucous membrane, affected by the influence of gases, was invaded by diphtheria germs, and there were none, in the same prevailing conditions, when there was no diphtheria about. At all events, however, it is a grave mistake to consider "privy odors" and a specifically infected atmosphere identical. They are far from so being. No specific germ has an odor.

R. W. Parker commits himself unmistakably in favor of sewer-air borne diphtheria. His reasoning is simple. For fifteen years he met with cases in which the infection appeared to come from drains. The special infective material has got into the drainage system. There will be more and more diphtheria, since the main drainage system is now largely ventilated directly into the open streets. The ventilators, while they protect the individual houses, poison the whole atmosphere and spread the disease broadcast. It is this cause to which the increase of diphtheria in London is said to be largely due. So in his opinion the ventilation of the sewers is a great danger. It would be so if the ventilation of a sewer be defective; if, for instance, there were but a single outlet to the subterraneous cesspool, the odors and exhalations would be disagreeable, and possibly harmful. Diarrhœa, nausea, vomiting might be and are produced in those exposed to the odors—children with vulnerable mucous membranes and respiratory organs only two feet above ground would be principally endangered—but unless there were a specific germ, or rather a number of germs, in the exhaled air there would be no specific disease. If there were any admixture of specific germs, they would be, the worse the odors of putrefaction, the sooner destroyed and rendered innocuous.

In the *Lancet* of January 13, 1894, H. Grant Sutton,

M. D., relates the following incident: On March 25, 1892, diphtheria broke out, and afterward spread, one hundred and fifty yards from a quay on which immense masses of decomposing animal and vegetable matter, rags, woolen materials, old chair seats, feather beds, and all kinds of rubbish and filth were burned and lay smoldering for weeks. "Though the gases are volatilized their poisonous properties are not destroyed, and so these noxious fumes are carried in the direction favored by the wind, one of which would probably be over the village where diphtheria did actually occur." Now, the report is not positively clear as to whether the refuse of the city is actually and completely destroyed by burning or not. Even if it be so, depositing and the burning are not simultaneous, and it appears very much more probable that the wind carried diphtheria germs directly from the huge masses piled up. Is that possible or probable? I believe it is. In spite of the great diffusibility of gases, they are liable to remain in a solid mass. Our tornado experience proves that moved air passes through many miles with sharply defined boundaries; and standing on board a steamer we see the masses of smoke and steam cling together, even for miles, in an unbroken column. So it is quite possible for the wind, if it be strong enough, to carry disease germs to a distance. But the co-operating requirements of such a result must be the ample presence of pathogenic germs, the absence of disinfectant sunshine, and wind blowing sufficiently strong in one direction.

Begging the question and absence of logic are great aids in making mistakes and perpetuating popular prejudices. In the coolest manner possible Nicolaus Gerzetic (*On Parasitism and Disease Producers*, 1893, p. 96) delivers himself as follows: "It is well known that sewer air carries pathogenous germs, like those of diphtheria and

gastro-enteritis, even typhus, according to Buchanan and others."

George Carpenter, M. D., of London (*Arch. of Pæd.*, May, 1894), goes further than his predecessors. He attributes a case of diphtheria occurring in an airy house located in a healthy district to the inhalation of the foul air emanating from a putresent placenta which had been left in a night commode at the head of the bed. He means to prove that decomposing animal and vegetable matter can be readily and very reasonably accused of inducing the disease, and besides declares it probable that the diphtheritic virus has found a suitable nidus in these decomposing materials for its growth and propagation, and the engrafted virus is the real cause, though not the apparent one. "In the same way sewer air acts as the vehicle and not the cause." "By a rational process of thought we feel that this must be so, but sometimes a case crops up to which our reasoning does not apply, and we are left wondering as to how a decomposing mass of matter could become infected."

I should say it could not; for if there is a power that destroys pathogenous germs it is putrefaction.

In many instances the reasoning in this matter is simply emotional. Thus, according to the *Massachusetts Association of Boards of Health, Official Journal*, September, 1893, page 23, mention is made in the discussion on a recent law passed by the State Legislature of Massachusetts on the licensing of plumbers of Mr. Roe, of Worcester, who introduced the bill and worked for it. He is mentioned as "a man who had difficulties to encounter in his own house regarding unsanitary conditions. His child died of diphtheria, and the house was examined by an inspector of our board and found to be in an unsanitary condition. At the time he was loath to accept it as the cause of the death of his child,

but eventually he felt convinced. He is an ex-principal of our high school here and a broad-minded man, and is thoroughly convinced of the fact that the child must have died from the effects of the unsanitary conditions." This is the kind of report that will influence public opinion. Emotional reasons in place of scientific reasoning will always carry the day. *Credo quia absurdum est.*

Some of the medical reasoning is not much better. For instance, Barnes (*Brit. Med. Jour.*, July 28, 1888) studied fifty separate outbreaks of diphtheria for the purpose of discovering if diphtheria may not arise from certain combinations of filth and unsanitary conditions independently of a pre-existing case of the disease. According to him the prevalence of diphtheria in rural districts is explained by the want of suitable systems of drainage, combined with filth in the form of decomposing animal matter. In the majority of instances he found no previous case as the starting point of each outbreak. Besides, the author claims that the winter months, when most diphtheria is met with, are unfavorable to the development of low forms of animal or vegetable life—he forgets that the throats and the houses are warm—and believes that because sore throats existed previous to and simultaneously with the outbreaks of diphtheria, it follows that we have to deal not with a specific germ but with a poison gradually developed.

In the *Medical Record* of January 28, 1893, Dr. Louis Fischer approached the subject a little more seriously. He published a very interesting article on The Result of Examinations of Sewer Gas which Escaped in Tenement and Private Houses wherein Cases of Diphtheria Occurred. It is to prove that escaped sewer gas will easily enter houses and poison their inmates. As a single positive proof would prove more than a thousand negative observa-

tions would disprove, I have carefully read and reread the paper. I can not learn, however, that his conclusions are unimpeachable. A child had diphtheria; the house was a tenement, four families on a floor; in the previous winter there had been diphtheria on the floor above and and the floor below on the same side of the house. The doctor says "the disease broke out successively on different floors and was seemingly spread by way of the sewer pipe leading up through the house. On the other side of the hall diphtheria did not break out."

He then describes the deterioration of the air in the room, due to the closing of windows in the narrow quarters and to the proximity of the sink into which sewage and refuse was emptied, and adds that underneath this sink there was a trap which served as a reservoir and to exclude noxious gas coming from the sewer.

He does not say that the trap was defective, nor that there was any reason why the disconnection of room and main sewer should have ceased. He simply assumes that because there was diphtheria above and below in the previous winter, there must be a communication of the germs through the pipes into the intermediate floor, which, however, was protected by a trap a year afterward.

Moreover, he alludes, himself, to the fact that what is thrown down into the sink and the reservoir underneath may be deposited there and, under favorable circumstances, may there find a convenient culture medium. Still more, he reports that he found bacilli in the air of a room where diphtheria existed, and in an adjoining room (not connected by a waste pipe at all); also that he made a series of examinations of air in a number of other houses with the following results: Of eighty five experiments performed, forty-five must be excluded owing to carelessness and breakage of plates. Of the remaining forty, twelve yielded patho-

genic bacteria; eight, different micro organisms (non-pathogenic); and twenty were negative. Thus, in thirty per cent. pathogenic bacteria were found in miscellaneous houses, which merely proves that pathogenic germs are ubiquitous and waiting for chances. These chances are *reduced general health, diminished power of cell resistance, and denuded surfaces.*

After Dr. Louis Fischer had looked for dangers "in the gases arising from sinks," and emphasized that "sewer traps themselves may become, if not properly flushed, breeding grounds for bacteria," Dr. F. W. Koehler claimed at once that "defective sewer pipes, dampness, and lack of cleanliness account for most cases of diphtheria occurring in private practice" (The Prevention of True and False Diphtheria, *Medical Record*, September 30, 1893). The better part of his paper may be repeated here, not because it is new, but because it is true: "The waste pipe of a washstand or sink may be a source of infection. I refer to that part of the pipe between the external part of the external opening and the nearest trap. This section of the sewerage gets the warmth of the house, has quantities of organic matter poured into it, has water more or less constantly running through it, always contains air, and is consequently a most perfect culture ground for many kinds of bacteria. The traps may therefore be in perfect order, and yet we may not be safe. Some device to shut off also this part of the sewerage system from all communication with the atmosphere of the house seems to me badly needed." In reply, I should say disinfect sink and trap once a day.

In all this question of cesspool and privy exhalation, what we know tolerably well is this, that it may result, as it frequently does, in a pharyngitis—the pharyngeal and naso-pharyngeal mucous membrane being exceedingly irritable—and that bacilli, being ubiquitous during the reign

of an epidemic, may find a nest in the sore surface.* The *Bacillus diphtheriæ*, in particular, is not in the cesspit and has not been found there, for putrefaction deals as inclemently with bacilli as with other organic matter.

There is, however, no doubt as to the difficulty encountered when the origin of an individual case of diphtheria is to be explained. The following case will give an instance of the various ways in which diphtheria may arise without sewer gas or spontaneous generation.

Dr. W. W. Ralston, of Horton, Kan., communicated to me the case of a boy who died in a neighborhood where no case of diphtheria had ever been known to exist, who lived under the best possible circumstances—good drainage, good air, no contagion, good health. Two years previously a child died of diphtheria in Chicago, where the family then lived. Afterward they lived in Detroit, later they moved to Kansas, and with them traveled a swab which had been used on the diphtheritic child in Chicago. When the little boy was (in Kansas) taken with a suppurating amygdalitis, the mother bethought herself of her swab, and used it to apply an alum solution. Thus it was that her boy died (*Arch. Ped.*, 1889, p. 131).

In the face of such a fact the weight of such cases as will now be quoted is of not much account.

Dr. Philip Francis Harvey (Fort Keogh, Montana) publishes two cases of diphtheria from "faulty drainage" (*Lancet*, 1892, i, p. 1184).

The first case was that of an officer of the United States army who had not been exposed to any known source of contagion. The case proved to be very malignant, and terminated fatally by heart paralysis after about eight days,

* It is a common experience that in a family of children such as are suffering from a catarrh will be taken with diphtheria, if any of them are.

progress. One week later the patient's wife developed a fatal attack. The disease originated *de novo* at an isolated military post in a new brick building. The location of the post was high and dry on a plateau between the confluence of the Mississippi and Minnesota Rivers.

A thorough sanitary inspection of the house was made, and a faulty drain was found in the basement with some leakage of sewage into the earth at that point. Here, then, was the explanation of the origin of the disease, and a demonstration how rapidly the diphtheritic poison may *be formed* under circumstances *favoring its evolution*, as the cases occurred in January and the premises were first occupied the preceding November.

Another case was reported, under the same heading, by Dr. N. Mallins (*Lancet*, 1892, i, 579). It was that of a boy ten years of age, who was attacked with membranous sore throat, followed in a few weeks by almost universal paralysis, a circumstance that proved its true diphtheritic nature. The boy slept in a small room directly over the scullery, and for weeks past a most unpleasant smell had pervaded this room. The scullery sink was found to communicate by an untrapped—in places broken—pipe with a cesspit situated about twenty-five yards from the house. There was, therefore, every opportunity for the foul air from the cesspit to be siphoned into the house. The patient was carefully isolated, and, though he was one of a very large family of children, no one else caught the infection. As there was not a single case of the disease in the neighborhood, as the boy did not mix with any children except his own brothers and sisters, and lastly, as he was the only one in the family sleeping in the line of escape of foul air, the conclusion seems irresistible that in this case, at all events, the diphtheritic poison was conveyed in the emanations from a foul drain, such emanations polluting the air that was nightly

breathed. How the specific bacillus got into the cesspit is, of course, a very difficult matter to explain.

The possible causes of an invasion of diphtheria are so many that a resort to an autochthonous origin ought to appear superfluous. Perhaps, however, it is the very multiplicity of possibilities which acts confusing and bewildering: the vulnerability of the young mucous membrane, the frequency of nasal and pharyngeal catarrh, the narrowness of the nose, the large size and the softness of the tonsils, the frequent fermentation of food in the mouth, the sucking of the soiled little fingers, together with the influence of family disposition, which is more powerful in the young. Their constant intercourse with each other in large families and in densely populated houses and districts, in schools and on playgrounds, the possibly long period of incubation during which the disease is contagious though giving rise to no symptoms, act as just so many predisposing causes of contagion; and the large number and size of the lymphatics renders every attack so much the more dangerous.

The very fact that diphtheria need not always be of the same type; that many cases of lacunar or follicular amygdalitis ("tonsillitis") are diphtheritic—a fact proclaimed by me dozens of years ago, which I have the satisfaction of seeing more and more, though with great hesitation at first, established even by bacteriologists—that there are as many cases out of bed and out of doors as in bed and indoors; that, particularly in adults, diphtheria may last long and give rise to but few embarrassing symptoms, and that a mild case of diphtheria may produce very serious ones by contagion, renders contagion by nursery maids and other domestics—by teachers, seamstresses, sick-nurses, workmen, factory girls, shopkeepers, barbers, and all other persons mingling with the many extremely easy. The per-

sistent vitality of the diphtheria germs, as is well known, may extend over years. They cling to solid and semi-solid bodies, are imported in milk, cling to walls and floors, to toys, to curtains, towels, clothing, and bedding which is so often kindly donated to the poor by the benevolent well-to-do when they wish to get rid of their dangers. They stick to omnibus and carriage cushions, to rail-car seats, to the either ready or custom made coat on your shoulders near which your baby will nestle—the very coat that is sold in Broadway palaces after it has been made in the pest stricken tenement sweating shop. The very restlessness of our people, the frequency of moving, is another cause of doubling the number of cases. There can be no doubt besides that many animals—horses, chickens, cows—have and spread diphtheria. Thus it appears that we ought to think twice, and indeed many times, before admitting among the causes of diphtheria new factors which can not be proved.

"No contagion could be traced." That is the introduction to every wild and unproved theory of indigenous spontaneous generation. When a case of cholera breaks out in a village a thousand miles away from the coast, is there anybody in our time who looks after chemical poison in a well or for filth on the roofs? You look for direct or indirect contagion from a tangible source. Why not so in diphtheria? In the *New York Medical Journal* of September 27, 1886, I have quoted from Isambert the case of a medical assistant who had nasal diphtheria many months, and then traveled half a year to get rid of the last remnants. He fully recovered; but how many deaths did he spread—from railroad car to railroad car, from stagecoach to stagecoach, from hotel to hotel? How many may have been the physicians who searched in vain for the causes of the sporadic cases suddenly springing up in their places,

and the epidemics generated by them along the roads on which the luckless French wanderer after his own health strew out his curses? Nobody suspected the traveler who left days ago, just as nobody may be able to trace every outbreak of cholera to the unknown person who carried it upon his person or in his bowels. Nor is this an isolated case of a long duration of diphtheria. Cadet de Gassicourt operated for laryngeal diphtheria after eighteen, twenty-three, and forty-three days. Sanné had croup patients who recovered after twenty-seven, thirty-two, and sixty days. I know of many cases of diphtheria protracted into the second or even the third month.

Such facts, pointing as they do to the ready communicability of diphtheria, have influenced my opinion from early times. I can not see anything miraculous in the sudden appearance of a *Bacillus* or a *Streptococcus diphtheriæ* in a person *apparently* not exposed to it. During an epidemic there is *nobody not exposed* to it, and everybody is subject to it under favorable circumstances. The latter mean a fit condition of the human integument, either cutis or mucous membrane, which makes them liable to become a resting place for the germ. That fit condition is a slight or severe wound, abrasion, denudation of the surface. As no healthy surface becomes erysipelatous in spite of erysipelas being epidemic, as Fehleisen's bacillus requires a sore, so diphtheria, being ubiquitous and waiting for a chance, will stick to a cutaneous wound, a stomatitis, a pharyngeal or nasal catarrh, and will rapidly multiply. A resected tonsil will thus be covered with a pseudo-membrane within a day. Only yesterday Dr. Caillé reported in the meeting of the American Pædiatric Society such a case. It terminated in generalized (including laryngeal) diphtheria. Without the operation, that tonsil might not have been affected at all.

In my paper on diphtheria and diphtheritic affections

(*Am. Med. Times*, August 11–18, 1860) I acknowledged contagion only as the cause of the origin of an individual case. In 1861 * Jenner, after an experience of five years among the poor and the rich, maintained the independence of diphtheria from bad hygienic conditions, and stated even a larger mortality among the rich. In a lecture published in *Guy's Hospital Gazette*, 1873, Samuel Wilks reports that it spread from the focus in Folkestone along the eastern counties of England, apparently quite irrespective of soil, impure atmosphere, or drainage. As regards London, it was more frequently met with in the better class of houses in the suburbs than among the lower and dirtier habitations of the poor. These views were not exactly refuted by good observations, but did not strike the fancy of the medical public. Jenner's view was strongly condemned in an otherwise favorable review contained in the *Dublin Quarterly Review*, August, 1861 ; nor was the conviction of the profession in this respect much changed before the appearance last year of Thorne Thorne's book, which again proves, as I tried to do thirty-three years previously, contagion as the ætiological influence, without relation to bad sanitary conditions as regards water supply, sewerage, and drainage.

In the discussion on the same question contained in the *British Medical Journal* of the two last months of 1893 and the beginning of 1894, Dr. Wilks again takes a leading part. His opinions on the same question have not changed. Davis, Priestley, C. M. Jessop, J. Bunting express themselves in the same way. George Johnson, Parker, C. N. Allfrey, H. G. Warrey (who assumes that every "membrane in sore throat is always diphtheritic"), and P. G. Marriott favor the sewer-borne origin of the disease; and George Johnson associates with diphtheria, in this respect, typhoid fever, pneumonia, puerperal fever, and albu-

* *Diphtheria ; its Symptoms and Treatment.*

minuria, which "may have such an origin," and charges that "those who believe in contagiousness only will not look for bad drainage." A few of his cases, which are to prove his point of view to be correct, are the following: In a wealthy house an infant was circumcised for phimosis; the wound became diphtheritic, and did not heal until the patient was removed to another house. Two servants were also affected with diphtheria; after defects in the sewer pipes were found and corrected no other case occurred. Another case is that of a butler in a wealthy and healthy house who contracted diphtheria. An untrapped sink pipe was discovered near his sleeping-room. He recovered, and there was no other case after the defect was mended. More, however, we do not learn, particularly nothing to exclude the hundred possibilities of contracting the disease.

If you will permit a personal remark I should here say that in spite of my positive statements, repeated a dozen of times in writing,* and a hundred times in lectures and discussions, I have personally been claimed as favoring, in the case of diphtheria, the sewer air theory. As late as this year, Emil Feer (*Aetiologische und klinische Beiträge der Diphtherie*, 1894) says (page 67) that "both in England and America there is a prevailing opinion, both among the medical men and the public, that uncleanliness of dwelling and people is a main cause of disease; in these countries diphtheria is often called a filth disease. According to Jacobi the connection between diphtheria and filth has, it is true, not been proved, but the author states as the result of his conclusions that it exists; for there are many reports which exhibit the co-existence of diphtheria and filth." A few moments later he gives me

* With the exception of a careless expression on page 50 of my *Treatise on Diphtheria*, which is quite in contrast to my previous statements in the same chapter.

credit for a teaching which is also opposed to life-long convictions, for he adds: "The injurious influence of sewer gas and cesspools is emphasized by Baginsky, Monti, and English and American authors (Jacobi)." Of my writings, he quotes only my article on Diphtheria in Gerhardt's manual, 2d volume, of 1877. The only allusion to sewer gas contained therein is found on page 703, where I say that the influence of the seasons on the origin and the course of diphtheria is but conditional and indirect, in a similar way as that of "filth," or sewer exhalation.

In the November number, 1888, of the *Archives of Pædiatrics* the late Dr. Charles Warrington Earle published a brief article on "the influence of sewerage and water pollution on the prevalence and severity of diphtheria." He begins by saying that "it has been claimed by many that imperfect sewerage has been the cause of diphtheria, and the people, urged on by the opinion of the doctors, frequently blame a sewer for poisoning a family and producing diphtheria, when the cause should be placed elsewhere. It is much better for us to recognize the true cause, if it is possible to find it, rather than to attack an imaginary one, for it is possible that while we are fighting the supposed gas as the cause, we are losing sight of the real enemy which should engage our attention."

"Jacobi says that cases of diphtheria which are traced to exhalations from sewers, or even to filthy habits of life, are very frequent. This opinion, especially in regard to sewerage, has been reiterated by scores and hundreds of physicians. It represents the prevailing idea of American physicians." Then Dr. Earle prints the opinions of a number of correspondents who deny the origin of diphtheria from sewerage, and shows me the errors of what he believes to be my ways.

Now, as it is both unhistorical and unpleasant to be

charged, after a life in part spent on the study of diphtheria, with the very erroneous views always combated by me, I tried to refute Dr. Earle's allegations in the November number, 1888, of the *Archives of Pœdiatrics* (page 744). As my letter to the editor contains in the briefest possible way a statement of what I believe to be the facts, I beg to here repeat them.

"In my very first paper published on the subject (Diphtheria and Diphtheritic Affections, *Amer. Med. Times*, August 11, 1860, p. 96), I looked for the source and epidemic occurrence of diphtheria in contagion to the exclusion of any and all other alleged causes.

"On page 34 *et seq.* of my *Treatise on Diphtheria* (1880) you may read these remarks: 'Cases of diphtheria which are traced' (I might have said attributed) 'to exhalations from sewers (or even to filthy habits of life) are very frequent. Yet typhoid is attributed to the same causes. So is dysentery. Can these foul exhalations produce alike diphtheria, typhoid, and dysentery? Do these diseases arise from a common poison? Or is the poison of a treble character, so that a part may give origin to diphtheria, the other part to typhoid, the third to dysentery? In a house in West Twenty-second Street, between Eighth and Ninth Avenues, in New York, three children and a female help were taken sick, two with dysentery and two with typhoid, in the course of a month. In the same house, in two of the children diphtheritic sore throats were of frequent occurrence.

"'Have we to deal in such occurrences with special influences, or only with a lowering of the standard of health, thereby affording other morbid influences an opportunity to exercise their power?'

"I then quote (page 35) the results of the researches of the Board of Health of the State of Massachusetts, the third of which reads as follows: 'A positive connection

between diphtheria and filth can not be verified, although the latter adds to the evil influence of moisture.' This statement I call (page 36) 'modest and sensible,' and one 'for which we have to be thankful.'

"In Diphtheria Spread by Adults (*New York Medical Journal*, September 24, 1884) I say: 'No permanent spontaneous generation is claimed or has been proved for cholera, scarlatina, or variola. Nobody looks for their primary cause in moist walls of houses, dry dust of streets, in the prevalence of previous house endemics of typhoid fever, measles, or other eruptive diseases, in bad ventilation, in the odors of hospital wards, in putrefying kitchen refuse, or in the exhalation of sewers. But both medical men and laymen are found to be inexhaustible in accusing and condemning all those detrimental influences, not as being predisposing elements, not because of their injurious influence on health in general and on the condition of the mucous membranes in particular, but as the main and frequently sole causes of diphtheria. In the minds of many physicians, diphtheria is intimately linked with sewage; with them the trap of the water closet and the plumbing of the cellar are the first objects of attention, the patients and their families, fauces and nares coming in for a relatively smaller part of their care. If they would pay more attention to the direct sources of contagion, which is something understood and definite, than to the indefinite and unproved presumption of specific poisons in the outlets of the house or the inlets from the sewers, their ætiology would be something more positive in a great many cases.

"'I do not mean to say that the house hygiene ought not to be looked after by the physician in every case of sickness, but the more I have seen the more it has occurred to me that we may live to reach the conviction that there is but one predisposing element, viz., a sore mucous mem-

brane, and but one cause of an individual attack of diphtheria, viz., direct contagion.'

"In a paper on The Therapeutics of Diphtheria, read before the Medical Society of Philadelphia, May 23, 1888, which has been copied by half a dozen medical journals, I made the following remark (reprint, page 1): 'Diphtheria is a contagious disease. There is probably no spontaneous origin of diphtheria, any more than there is a spontaneous origin of cholera or scarlatina.' And again (page 3): 'When an attack of diphtheria has made its appearance, it is well enough to examine the hygienic condition of the house, with its deteriorating influences on the general health of the inmates, but look after the source of the case in the persons of friends, attendants, and help.'

"In my Remarks on the Nature and Treatment of Diphtheria, made by invitation before the Section of Diseases of Children of the British Medical Association, August, 1888 (*British Medical Journal*, September 22, 1888), there are found the following sentences: 'Foul air and sewer gas do not create diphtheria; they do create dysentery and typhoid, or such a condition of general ill health and malaise as to afford the diphtheritic virus a ready resting place. There were plenty of malodorous privies and foul smells fifty years ago, but no epidemic of diphtheria. Besides, and mainly through the careful observations of English physicians, such as are contained in Dr. George Turner's report on diphtheria in the lower animals and many others, the sources from which diphtheria may come are very many. Pigeons, fowls, turkeys, chickens, pheasants, cats, horses, sheep, cows are just as many sources of diphtheria for man. Foods of all kinds, vegetables and milk, will transmit it. It sticks to furniture, floors, and wall paper, railroad cushions and school desks. No spontaneous generation is required to explain its ravages.'

"These extracts, Mr. Editor, ought to prove that Dr. Earle does not stand alone with his views so ably discussed in your journal. Like him, I have always lamented the disposition of so many of us to look for the cause of an individual case of diphtheria in the wrong quarter. Like him, I have often found a professional brother inspecting traps and cellar floors, while the rest of the children of the family were permitted to play in the rooms and about the beds of those affected with the malady.

"I have never believed, nor do I believe now, that sewer gas *per se* is a cause or the cause of diphtheria. A sewer or a trap can convey diphtheria only when that particular sewer or trap has been infected with diphtheritic poison."

After these quotations and to day's remarks, I hope I shall be counted among those who will rather look for the cause of diphtheria in a germ communicated, directly or indirectly, from a patient or his belongings than from sewer air. The latter can not be made responsible enough in an occasional case where the introduction of germs into the sewer or into the sewer air, and their presence in the pipes, and their introduction into a house and their presence there are proved facts. My convictions tally with the experience of those who have seen much.

In a conversation with Dr. J. D. Bryant, for many years health commissioner of the city of New York, I learned a number of interesting facts. Since 1873 there has been an incessant war against defective plumbing; traps were enforced, and since 1878 roof waste pipes. When Dr. Bryant entered upon his office the earthen or brick connections of house drains with the street sewers were replaced by iron. In reference to every case of infectious or contagious disease a strict inquiry was required, on the part of the medical inspectors, concerning ventilation and sewers, even of the adjoining premises. Many inspectors who did not find

or report actual defects were discharged. The general result of the investigation concerning the coexistence of an infectious disease and defective sewer was, however, negative; the number of cases where defects in joints and waste pipes were met with in such cases was limited. The large majority of diphtheria cases were found in tenement houses. Still, sewer and drain defects were more frequent in private houses containing two or three families than in tenement houses. No special class of people were mainly affected. Diphtheria was alarming in the city of New York before and after the Health Department was established. In answer to my direct question I was told that both diphtheria and typhoid occurred where plumbing was perfect, and were often not found where it was defective. Many typhoid cases were imported from the country in September and October. Dr. Doty related the case, and referred to many similar ones, of a baker who lived in Tenth Avenue with his family over an open earthen and brick sewer into which a privy found its outlet. There was no case of sickness. Physicians always looked for and searched for sewer gas or sewer infection; but the comparative statements of a number of inspectors were negative. Nor could it be said that there were more cases of diphtheria or other infectious fevers near the outlets of sewers or in the immediate proximity of stables.

Dr. William H. Park sends me the following abstract of a paper of his recently read:

"From the reports from a large number of cases of diphtheria it has been shown that bad drainage and bad plumbing have but little noticeable effect upon the spread of diphtheria in New York city. Though we may readily believe that the escape of sewer gas into a room might easily predispose to sore throats, and thus perhaps render persons more susceptible to diphtheria, the Health Depart-

ment inspectors have not been able to find any cases where the infection with diphtheria came through bad sewer connections.

"The maps which we have in our possession show well how all the tenement districts of New York are infected, and not certain ones over old sewers or streams; also diphtheria is found about as frequently in the garret as in the basement."

Mr. Archibald Montgomery, a very intelligent master plumber of more than twenty years' experience, gives the following as the result of his observations:*

"Plumbers do not lose more time from work on account of sickness than do mechanics in general.

"Emanations from decomposing night soil, etc., may cause vomiting, but not diarrhœa. The effect is only transient.

"Typhoid or other fevers are not more common among plumbers than among other workmen.

"The accidents arising from entering sewers are the result of the presence of either illuminating gas which has leaked into the sewer from the gas mains, or of carbon dioxide formed from the decomposition of sewage.

"In places where the level of the sewer is below the general line, carbon dioxide is liable to form in large quantity.

"The inoculation of an abraded surface with sewage often leads to great local swelling, with implication of *lymphatic* glands and general symptoms of 'blood poisoning.'

"There is no discrimination against plumbers by life insurance companies."

I may be finally permitted to add the oral testimony of

* Communicated to me by Dr. A. H. Smith, the president of the Climatological Society.

more than a dozen European medical men, and dozens of Americans. Every one was asked by me: What do you know of the production of a specific germ disease out of, or through, sewer air? The uniform answer was: There is a general vague impression among the public, but I never saw a case, or could prove one.

Some of the conclusions to be drawn from this paper would be as follows:

The atmosphere contains some specific disease germs, both living and dead.

They are frequently found in places which were infected with specific disease.

In sewer air fewer such germs have been found than in the air of houses and schoolrooms.

Moist surfaces—that is, the contents of cesspools and sewers and the walls of sewers—while emitting odors do not give off specific germs, even in a moderate current of wind.

Splashing of the sewer contents may separate some germs and then the air of the sewer may become temporarily infected, but the germ will sink to the ground again.

Choking of the sewer, introduction of hot factory refuse, leaky house drains and absence of traps may be the causes of sewer air ascending or forced back into the houses. But the occurrence of this complication of circumstances is certain to be rare.

Whatever rises from the sewer under these circumstances is offensive and irritating. A number of ailments, inclusive, perhaps, of sore throats, may originate from these causes. But no specific diseases will be generated by them except in the rarest of conditions. For specific germs are destroyed by the process of putrefaction in the sewers, and the worse the odor the less is the danger, particularly from diphtheria.

The causes of the latter disease are very numerous, and the search for the origin of an individual case is often unsuccessful.

Irritation of the throat and naso-pharynx is a frequent source of local catarrh; this creates a resting place for diphtheria germs, which are ubiquitous during an epidemic, and thus an opportunity for diphtheria is furnished.

Of the specific germs, those of typhoid and dysentery appear to be the least subject to destruction by cesspools and sewers. These diseases appear to be sometimes referable to direct exhalation from privies and cesspools. Very few cases, if any, are attributable to sewer air.

A single outlet from a sewer would be dangerous to general health because of the density of odors (not germs) arising therefrom. Therefore a very thorough and multiple ventilation is required.*

The impossibility or great improbability of specific diseases rising from sewers into our houses, protected as they are, or ought to be, by good drains and efficient traps, must, however, not lull our citizens and authorities into indolence and carelessness. For the general health is suffering from chemical exhalations, and the vitality of cell life and the power of resistance are undermined by them.

* The sidewalk ventilators in New York city are almost always obstructed.

The New York Medical Journal.

A WEEKLY REVIEW OF MEDICINE.

EDITED BY

FRANK P. FOSTER, M.D.

THE PHYSICIAN who would keep abreast with the advances in medical science must read a *live* weekly medical journal, in which scientific facts are presented in a clear manner; one for which the articles are written by men of learning, and by those who are good and accurate observers; a journal that is stripped of every feature irrelevant to medical science, and gives evidence of being carefully and conscientiously edited; one that bears upon every page the stamp of desire to elevate the standard of the profession of medicine. Such a journal fulfills its mission—that of educator—to the highest degree, for not only does it inform its readers of all that is new in theory and practice, but, by means of its correct editing, instructs them in the very important yet much-neglected art of expressing their thoughts and ideas in a clear and correct manner. Too much stress can not be laid upon this feature, so utterly ignored by the "average" medical periodical.

Without making invidious comparisons, it can be truthfully stated that no medical journal in this country occupies the place, in these particulars, that is held by THE NEW YORK MEDICAL JOURNAL. No other journal is edited with the care that is bestowed on this; none contains articles of such high scientific value, coming as they do from the pens of the brightest and most learned medical men of America. A glance at the list of contributors to any volume, or an examination of any issue of the JOURNAL, will attest the truth of these statements. It is a journal for the masses of the profession, for the country as well as for the city practitioner; it covers the entire range of medicine and surgery. A very important feature of the JOURNAL is the number and character of its illustrations, which are unequaled by those of any other journal in the world. They appear in frequent issues, whenever called for by the article which they accompany, and no expense is spared to make them of superior excellence.

Subscription price, $5.00 per annum. Volumes begin in January and July.

PUBLISHED BY

D. APPLETON & CO., 72 Fifth Avenue, New York.