

SEWER-AIR POISONING.¹

By F. W. BURTON-FANNING, M.D. CANTAB.,
M.R.C.P. LOND.,

PHYSICIAN TO THE NORFOLK AND NORWICH HOSPITAL, AND TO THE
JENNY LIND INFIRMARY FOR SICK CHILDREN.

AS we do not possess any comprehensive account of the possible effects of sewer-air I have thought the following cases worthy of publication.

CASE 1.—A youth aged nineteen years was seen in consultation with Mr. Charles Williams in 1892. Nine weeks previously he had pain in the limbs; a rash appeared on them, but the joints were not obviously affected. After a few weeks at the seaside he improved; he was then seized with a rigor and next day we saw him. He complained of severe pain throughout his arms and legs; the temperature was 104° F., with a morning fall of about two degrees. The bowels were constipated, but he took nourishment well, without nausea. There was a petechial rash on the extremities; there were also visible distinct red lines, about a quarter of an inch in width, running from the knees to the groins, where the lymphatic glands were enlarged; similar red streaks occurred on the arms and the axillary glands were shotty. The first sound of the heart was reduplicated and later a temporary diastolic bruit appeared. The urine was of specific gravity 1028, contained one-eighteenth albumin, and many hyaline and hyalo-epithelial casts were present. He remained in about the same serious condition for fourteen days and then began to improve; after another fortnight, however, he suddenly had an exacerbation, the temperature rose to 106°, he had four rigors in forty-eight hours, and died. This patient had frequently complained of bad smells in his room and it was found that an untrapped pipe led from the main sewer to beneath his window, and in the adjoining room the bath-waste pipe led also directly into the sewer.

CASE 2.—A middle aged man was seen with Mr. Burton, whose children had been similarly affected, but who quickly recovered on leaving their home. The patient's illness had commenced two months previously with a shiver, pains in the limbs, sore-throat, and fever, which were at first ascribed to influenza. However, for two months with the utmost regularity his temperature reached 102° F. every evening, falling again after midnight to normal. The feverish period was always accompanied by severe shooting pains in the calves, which were disproportionately wasted; the sensation and knee-jerks were normal. A fine petechial rash was present on the feet. The spleen was palpable below the costal arch. The urine contained neither albumin nor casts. The smoke test revealed the fact that the patient's study and bath-room were in direct communication with the sewer. He was removed to another house at once, but his illness lasted thirteen weeks and left much prostration to be slowly recovered from.

CASE 3.—This was much less severe in degree and occurred in the person of a young man whom I saw with Dr. Watson. For three months he had suffered from oppressive frontal headache with pain and suffusion in the eyes, which came on every day about 5 P.M. Besides slowly increasing languor the only other manifestations of his illness were fever—100° F. in the evening—enlargement of the lymphatic glands in the groins and neck, with faint red lines on the arms, three patches of erythema annulare on the forearms, and the presence of hyaline casts in non-albuminous urine. Before my visit the patient had undergone a thorough course of treatment with quinine and iodide of potassium, the inefficacy of which helped my insistence on an examination of the drains. A disused soil-pipe was found under the floor which was damp with sewage. Within a week of leaving this house the temperature declined and the other symptoms gradually disappeared.

CASE 4.—A man aged forty-five years, whom I saw with Dr. Watson, had noticed his susceptibility to bad smells and had complained of an odour in the house. He began having pain in the neck and back of the head, with an evening temperature varying between 99° and 102° F., the height corresponding with the severity of the headache. There was a distinct red line up the flexor aspect of one forearm and the inguinal glands were slightly enlarged. The urine contained a trace of albumin and some hyaline casts. The watercloset near

the patient's bedroom was found to be foul and defective and the pipes were untrapped. Within a few days of leaving this house all symptoms improved.

CASE 5.—For the inclusion of this case I am again indebted to Dr. Watson. A main sewer was opened twenty yards from the patient's shop and the smell was complained of. The next day he vomited and had headache and slight fever. The following day he had pain in the right leg, and distinct lymphangitis was found along the course of the internal saphena vein, with enlargement of the femoral glands. I did not see him till four days afterwards, when he was nearly well, and I then found nothing abnormal in the urine.

CASE 6.—This patient, a woman, who was seen with the late Mr. Vincent at Dereham, had been ailing for a year. She had been obliged to keep her bed for the last month, with an evening temperature of about 102° F. Her chief complaint was pain in the back, which shot through to the epigastrium; this bore no relation to food, but occurred in severe attacks, which often ended in vomiting. She had pain in the head and legs, and there had been lymphangitis on the fronts of the thighs with enlarged femoral glands. She suffered from exudative tonsillitis. The urine contained a few small hyalo-granular casts, but no albumin. In the yard, where she often worked, was found an overflowing cesspool. She began to improve within a few weeks of the removal of this nuisance.

CASE 7.—A man was admitted into Addenbrooke's Hospital under Professor Bradbury, to whom I am indebted for permission to examine and record the case. The patient had been standing for three weeks at work in offensive liquid sewage and was suddenly seized with pain and numbness in the legs. He had headache, vomiting, and shiverings. On his admission the pains were his chief complaint, but nothing abnormal was detected in the legs except a few purpuric spots. He became jaundiced, the urine was scanty and contained one-fourth albumin, bile pigments, and granular casts. The liver was a little enlarged and he had some bronchitis. He had an irregular temperature curve for three weeks, between 102° and 98° F. He left the hospital well after two months. Mr. Cobbett kindly undertook to examine bacteriologically this patient's blood and urine. From the former he obtained no growth, but from the latter a considerable number of colonies developed. Among these were three kinds of organisms; two Mr. Cobbett considers were staphylococcus aureus and albus, while the third was a short bacillus, which he was unable to identify.

CASE 8.—A young woman was admitted into the Norfolk and Norwich Hospital with fever, some weakness, and emaciation. For three months she had suffered from frequent headache and epigastric pain with and without food; she had menorrhagia also, for which no local cause was found. For twenty-eight days she had an evening temperature of about 102° F., while the morning temperature varied between 98° and 100°. This was her only marked symptom. She had temporary phlebitis, slight enlargement of the spleen, and albuminuria for a few days. Typhoid fever, tuberculosis, and other forms of blood-poisoning having been excluded, I ascertained that she had complained of constant smells in the kitchen where she worked, next to which was a blocked and defective watercloset. She left the hospital after six weeks and slowly regained strength at home.

CASE 9.—A boy six years old was admitted into the Jenny Lind Infirmary for Sick Children. He had been suddenly seized with epigastric pain and dyspnoea. He had slight oedema of the eyelids and feet, but the prominent symptom was profound prostration, any movement inducing faintness. The pulse was 140 and often became so weak as to be uncountable. The throat was normal and his knee-jerks present. There was uncontrollable vomiting, which increased the alarming dyspnoea and faintness. The urine was scanty and contained one-eighth albumin; it was not examined for casts. The temperature was 101° F., but became subnormal before death, which occurred from heart-failure on the fourth day of illness. At the necropsy were found moderate gastro-enteritis and hyperæmia of the spleen and kidneys. Microscopic sections were made of the heart and kidneys. The former showed no marked change, but the latter manifested that of acute tubular nephritis. A visit to the patient's home elicited the fact that an especially bad smell had been noticed in the yard on the day before his illness. The sanitary inspector had already been sent there on account of a case of diarrhoea attributed by the attending medical man to insanitary surroundings.

¹ Abstract of Thesis for M.D.

A privy bin had been allowed to become full of very offensive excrement.

CASE 10.—A previously healthy boy aged four years was suddenly attacked with severe vomiting, which persisted and formed the chief symptom throughout. There was also distressing pain in the epigastrium, which became tender. The temperature ranged about 100° F. The patient continually asked for water, which was usually at once rejected. The urine was scanty and albuminous. He became restless and prostrated and died on the fourth day. The house drain was found not to join the sewer, but to empty itself into the soil of a yard, in which the patient had spent a considerable time each day.

CASE 11.—A boy aged nine years had fever for over three months, the evening temperature averaging 102° F., while in the morning it was one or two degrees lower. At first he also had headache, slight tonsillitis and constipation, with pale motions. There was once heard a doubtful pericardial rub, but otherwise slowly progressive anæmia and weakness were the only symptoms in addition to the fever. After excluding typhoid fever and tuberculosis Mr. Candler decided that it was sewer-air poisoning, and found that smoke permeated freely from the drains into all the rooms of the patient's country home owing to extensive cracks in the pipes. For two months he was thought to have been convalescing at the seaside, but even there his evening temperature was occasionally raised. Then without exposure to cold he developed simple pleural effusion with an initial temperature of 104°, which became absorbed in a few weeks. I believe this pleurisy was also due to sewer-air poisoning and that it illustrates the tendency of this trouble to lie dormant and then recrudescence. At the same time a brother suffered from jaundice accompanied by malaise only.

In reviewing these cases one is first met with the difficulty of proving their dependence on sewer air. My opinion of their nature is based on the following facts: they did not conform to any described disease, they presented many features in common amongst themselves, in the surroundings of all the cases some grave sanitary defect existed, and the removal of this was followed in most of the cases by recovery. On analysing their symptoms we find that fever was present in all the cases. As a rule the temperature was hectic in type, and in three cases with its daily remissions a remarkable abatement of the other symptoms concurred. Three of the patients had rigors. As one would expect, headache was a prominent symptom, but more noteworthy were pains in the limbs and elsewhere. Two of the patients also had pain in the back and one had pain and stiffness in the neck. The two children had severe epigastric pain. Petechiæ were noticed on the lower extremities of three severe cases; in another there was erythema annulare. Of the eight adult patients five had lymphangitis on the legs or arms, with enlargement of the neighbouring glands but without any wounds. It is to lymphangitis that I wish to especially draw attention, as I do not think its occurrence in this class of case has been previously noted. In one case there was phlebitis. In two cases there was a suspicion of peri- or endo-carditis. In two children cardiac asthenia was the prominent symptom; by both I was forcibly reminded of the syncope of diphtheria. Pleurisy was, I believe, a late manifestation of sewer-air poisoning in Case 11. I have noted its occurrence twice among neighbours of the above patients. Bronchitis was present in three cases. Excessive vomiting was only present in two of the children; to a less extent it was present in two adults; while in another two nausea was complained of. In only one case did diarrhoea occur. In three cases the spleen was enlarged, and in one of these the liver was also affected. In this case there was jaundice, which was also present in the brother of Case 11. In one case there was menorrhagia. My cases confirm the late Sir George Johnson's² observation of the occurrence of albuminuria in sewer-air poisoning. The urine was examined during the height of the illness in ten cases and in six albumin was found. In other two cases where no albumin was present casts were found. Acute nephritis was found in the one necropsy made. Of the ten cases, therefore, only one presented no evidence of renal affection.

It is interesting to compare the above cases with a few recently published examples of the supposed effects of sewer air. Dr. Webber's³ patient was a child aged four years who

had sore-throat and fever. The tonsillitis improved, but anæmia and threatened syncope remained and the heart became dilated. The liver was enlarged and the abdomen was tender, and in a few days the urine became albuminous and scanty. The child became apathetic and died on the fourteenth day. Dr. Sharp and Mr. Summerskill⁴ record the case of a child aged eight years whose first symptoms were dyspnoea, oedema of the face, and frequent micturition. The urine was scanty and of a chocolate-brown colour, with masses of amorphous hæmoglobin and a few red corpuscles under the microscope. Faintness and anæmia were noted, but the patient made a good recovery. Mr. Jollye⁵ writes of two cases of chorea caused, he thinks, by sewer-air poisoning, in one of which and in another member of the family valvular lesions of the heart presented themselves. A "Member"⁶ believes that sewer-air poisoning was the cause of death in a child who for twenty-four hours had violent purging and vomiting, slight rash, without other symptoms of scarlet fever, and whose necropsy revealed only gastro-enteritis.

Excepting Mr. Cobbett's results in Case 7 I have no light to throw on the nature of the *materies morbi* in these cases. In some removal of the cause is at once followed by improvement, while in others weeks elapse before the symptoms begin to abate, and for an indefinite time recrudescence may occur. In this latter group a micro-organism is probably the agent; while in the others the poison may be of the nature of a volatile ptomaine or alkaloid.⁷ The work of Parry Laws, Andrewes, Haldane, Carnelly, and others points to the bacteriological innocence of sewer-air.

As regards diagnosis I would emphasise the importance of bearing in mind the possibility of sewer-air poisoning when attempting to determine the nature of a doubtful case. Other causes of continued fever must be excluded, and perhaps the recognition of some of the above symptoms may help. In my experience typhoid fever, ulcerative endocarditis, and rheumatism are the most difficult to exclude. Case 1, for instance, simulated ulcerative endocarditis, but the cardiac bruit was only temporary, and there was the highly characteristic lymphangitis. Case 8 was thought to be typhoid fever, but the three months' previous illness and the temperature chart negated it. Case 7 somewhat resembled "Weil's disease," but it occurred sporadically and under circumstances which it was hard to ignore. The treatment consists in removing the cause, and preferably, I think, by changing the patient's home, as diffusion of the noxious emanations often follows the necessary operations for its rectification. Quinine, sodium salicylatum, salol, and other antiseptics appear to me to be useless. But I do think that the tincture of the perchloride of iron was of benefit in several cases.

Norwich.

THE PRODUCTION OF POTENT DIPHTHERIA ANTITOXINS.

By G. E. CARTWRIGHT WOOD, M.D., B.Sc. EDIN.

[From the Laboratories of the Royal Colleges of Physicians, London, and Surgeons, England.]

IN the interesting lecture on the Serum Treatment of Diphtheria, by Dr. Sidney Martin, which was published in THE LANCET of Oct. 17th, the great importance of using only the most powerful antitoxins was so clearly shown that I think it may be interesting to indicate briefly how this antitoxin was produced, and why we may expect that much more potent forms of the remedy will shortly replace the weaker serums now in use. The use of more powerful antitoxin not merely lowered the death-rate, but greatly lessened the number of cases of paralysis following on the disease. When employing the weaker antitoxin in 1895 the death-rate was reduced by 11 per cent., while in 1896, when more powerful antitoxins were injected, the mortality was reduced by 18.5 per cent., thus showing an additional decrease in the mortality of almost two-thirds on that recorded in the previous year. This indicates that this proportion of the more severe cases, or of those brought under treatment in the later

² Brit. Med. Jour., March 3rd and July 14th, 1893.

³ THE LANCET, Sept. 22nd, 1894.

⁴ THE LANCET, Dec. 9th, 1893.

⁵ Brit. Med. Jour., vol. i., 1896, p. 269.

⁶ Ibid., vol. i., 1895.

⁷ THE LANCET, Feb. 9th, 1895.