WEIL'S DISEASE AMONG SEWER WORKERS IN LONDON

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Since the causative organism was first demonstrated in Japan by Inada and Ido in 1915, Weil's disease (spirochaetal jaundice, infective jaundice, leptospirosis) has been recognized in many different countries, and during the war it affected German, French, and British troops on the Western Front. Schüffner¹ (1934), who reported that during the past ten years 452 cases have occurred in Holland with forty-six deaths—that is, 10.2 per cent. mortality—distinguishes three pathogenic leptospirae which may affect man in Europe: (1) the cosmopolitan *L. icterohaemorrhagiae* in rat and dog, the cause of classical Weil's disease; (2) *L. canicola*, causing a specific canine disease, but capable of infecting man (one case); and (3) *L. grippo-typhosa*, the infective agent of swamp fever of Eastern Europe. Other strains have been encountered in the Dutch East Indies, Malaya, and the Andamans.

Weil's disease has been diagnosed among sewer workers on the Continent, but no such cases have been recorded in Great Britain, though in London Foulerton² (1919) found that four out of 101 rats harboured leptospirae pathogenic to guinea-pigs, and Stevenson³ (1922) reported leptospirae in 30 per cent. of rats examined. Only one authentic human case originating in England appears in the literature—namely, that described by Manson-Bahr⁴ (1922) from the Albert Dock Hospital in a seaman developing the disease four days after falling into the Thames at Gravesend. Wenyon and Brown⁴ isolated *L. icterohaemorrhagiae* from the citrated blood of this patient, collected on the seventh day of the disease.

During 1923 an epidemic of jaundice of unknown origin broke out among miners working in certain coal pits in East Lothian. Gulland and Buchanan⁵ (1924) investigated the epidemic. There were some eighteen cases with jaundice, and of six patients admitted to the wards of the Royal Infirmary two died. Clinically they were typical, and followed a course similar to that in the cases occurring in British troops in France, described by Stokes and Ryle⁶ (1916), and Dawson, Hume, and Bedson⁷ (1917). Guinea-pigs inoculated with urine from the East Lothian cases died with typical post-mortem findings, and *L. icterohaemorrhagiae* were demonstrated. The pits where the disease was contracted were all "wet," and rats, some of which were proved to harbour leptospirae in the kidneys, were plentiful there. Later, when investigating carrier hosts, Buchanan⁸ (1927) showed that sixty-one out of 166 wild rats were infected with virulent leptospirae, and found leptospiral organisms in fungal slime hanging from the roof of the mines and in pit-surface waters. Inoculation of a certain specimen of slime into two guinea-pigs produced typical leptospirosis. He concluded as a result of experimental investigations in the guinea-pig, and from conditions in the coal mines, that human infection was more likely to arise as a result of leptospiral invasion through skin abrasions or by way of the eye and the nasal mucosa from contaminated hands.

Case History I

A sewer worker of fine physique, aged 25 years, was admitted to the Hospital for Tropical Diseases on May 17th, 1934, with jaundice and a history of five days' fever.

PAST HISTORY

The patient, who was an ex-soldier, had returned from India in November, 1932, after seven years' service. During the voyage home, he stated, he had had an attack somewhat similar to the present one, with generalized aching pains, anorexia, lassitude, and (?) jaundice. He was kept in hospital on board ship for about sixteen days, and was treated with quinine, although malaria parasites were not found. Since then he had had at least two milder attacks, without jaundice, which subsided in two to three days after quinine therapy.

PRESENT ILLNESS

The present illness started on Saturday evening, May 12th, 1934, with aching pains in both shoulders and neck, which later became generalized; there was associated headache and shivering, but no nausea or vomiting. The following day his legs "felt too weak for him to get up." On the third morning (Monday) he went out to work, but in the afternoon was so ill that he had to return to bed. On the fourth day he began to cough up blood and black sputum. Jaundice appeared on the fifth day, and the urine was extremely dark coloured; constipation had been marked for several days. He was now seen by Dr. Rosen, who next day noted that the jaundice was increasing and sent him to hospital (May 17th).

PHYSICAL EXAMINATION

The patient was prostrated and markedly jaundiced. The conjunctivae were injected, and had a deep icteric tinge, which also involved the skin and mucous membranes. The temperature was 100.4° F., the pulse 118, and respirations 28.

Examination of the heart and lungs revealed no abnormality. The abdominal wall moved moderately with respiration, but on deep palpation there was definite generalized tenderness, most marked in the right iliac fossa. There was very little rigidity immediately on palpation, but the abdominal muscles contracted after deep pressure was applied, and the patient flexed the knees, grunted, and obviously resented what was being done. Digital examination of the rectum elicited some tenderness anteriorly, but next day this had entirely disappeared. The rectum was then ballooned out, and there was no evidence of any pelvic collection of pus. There was no demonstrable enlargement of the liver or spleen, although, owing to muscular tenderness, examination was difficult. The pupils were pin-point in size and reacted sluggishly, if at all, to light. The tendon-jerks of the arms and legs were absent and the calf muscles exceedingly tender. The plantar reflex was flexor in type.

LABORATORY INVESTIGATIONS

Blood collected under paraffin was oxalated and centrifuged and the plasma examined spectroscopically: no trace of haemoglobinaemia was found. Malarial parasites were absent from the blood smears, in which anisocytosis and a polymorphonuclear leucocytosis were evident. The blood count showed: red cells, 4,300,000 per c.mm.; haemoglobin, 90 per cent. (Haldane); colour index, 1.0; leucocytes, 18,000 per c.mm., of which there were 90 per cent. neutrophil granulocytes and 10 per cent. lymphocytes. Van den Bergh reaction: direct, prompt biphasic reaction; indirect, positive (24 units). Eight ounces of urine were obtained by catheterization: specific gravity, 1010; acid reaction; albumin ++; acetone, a trace; sugar, nil; bile pigments ++; bile salts ++; urobilin ++. A few pus cells but no casts were observed in the centrifuged deposit. Spectroscopic examination revealed an absence of both oxyhaemoglobin and methaemoglobin.

These findings eliminated blackwater fever from the differential diagnosis, which was now considered to lie between some form of toxic jaundice, Weil's disease, and suppurating pyelophlebitis, the abdominal condition suggesting the possibility of peritonitis. Mr. A. H. McIndoe saw the patient in consultation from this standpoint: it was decided to withhold food per os and give large intravenous injections of glucose (5 per cent.) in normal saline, 1 litre of which was given at 6 p.m. and repeated at 11 p.m.

PROGRESS OF CASE

The patient vomited eight ounces of blood and had a severe epistaxis. Herpes was present on the lips. A catheter was passed, but only a few drops of bile-like material were obtained. Massive intravenous glucose injections were continued. Blood cultures on different media were negative. As leptospirosis was suspected on clinical grounds citrated blood was sent to Dr. C. M. Wenyon of the Wellcome Bureau of Science for inoculation into guinea-pigs.

On May 19th the condition was worse, with headache, epistaxis at frequent intervals, and a troublesome hiccup. Anuria and obstinate constipation continued. Intravenous injections of glucose were maintained. On May 20th the patient was drowsy. Melaena was present, and the bowels were opened five times. Epistaxis and hiccup still occurred. Faeces were negative for ova and protozoa. Intravenous injections were continued. On May 21st the mental state was confused and drowsy. The following day the patient was desperately ill and intensely jaundiced, with oedema of the subcutaneous tissues and ascites. Intravenous injections were stopped.

Wassermann reaction negative. Van den Bergh reaction: prompt biphasic reaction, indirect positive (41 units). Blood urea: 346 mg. per 100 c.cm. Urine obtained by catheterization showed albumin ++, bile pigments ++, bile salts nil. Centrifuged deposit contained a few leucocytes and epithelial cells, with an occasional red blood corpuscle but no casts. Bilirubin crystals and amorphous urates were present.

The patient died at 7.45 a.m. on May 23rd.

POST-MORTEM FINDINGS

A necropsy was performed by Colonel F. P. Mackie, I.M.S. The body was well nourished, the skin was deeply jaundiced, and the subcutaneous tissues of the neck, feet, and legs were oedematous.

Abdomen.—Much clear, bile-stained fluid was present in the peritoneal cavity. There were submucous haemorrhages in the cardiac portion of the stomach, and the small intestine was congested. The liver was very large (87½ oz.), soft in consistency, and a yellowish chocolate colour on section; the contents of the gall-bladder consisted of brownish-black fluid, which contained bile salts but no bile pigment. There was no bile duct obstruction. The spleen weighed 12 oz., and was dark in colour and firm in consistency, with prominent Malpighian bodies on section. The kidneys were large and semi-lobed, the right weighing 12 and the left 12½ oz.: the capsule stripped readily, the cortex appeared swollen and yellowish red in colour, while the medulla was deeply congested. The mesenteric glands were somewhat prominent, and the pancreas and suprarenals were normal.

Thorax.—The endocardium was bile-stained; there was oedema of the lungs and free fluid in the pleural cavities.

MICROSCOPICAL FINDINGS

The sections of special interest were those of the liver and kidney.

There was cellular infiltration of the periportal zone of the liver and cloudy swelling of the polygonal cells, but no focal or general necrosis. Malaria pigment was absent from Küpfer's cells, the liver cells contained haemofuscin, while the infiltrating cells in the vicinity of the bile ducts were mainly neutrophils with occasional macrophages.

There was widespread destruction of the tubular epithelium of the kidney, with no change in the glomeruli other than some surrounding leucocytic infiltration, while some of the straight tubules were plugged with debris, red blood corpuscles, and disintegrating haemoglobin. Immediate examination of liver smears with Indian ink failed to reveal leptospirae, and sections of the liver, spleen, and kidneys stained by the Levaditi method were also negative.

In the absence of demonstrable leptospirae the cause of death was assessed as (1) toxic jaundice, (2) nephrosis.

LABORATORY DATA

Major H. C. Brown, I.M.S., subsequently reported from the Wellcome Bureau of Scientific Research that both the guinea-pigs inoculated with blood collected on May 18th—the seventh day of the disease—had sickened, and that necropsy revealed the characteristic post-mortem features of Weil's disease—

jaundice and visceral haemorrhages. Typical leptospirae were demonstrated by dark-ground illumination in emulsion of liver pulp from one animal and in the heart blood of both. This strain was isolated in pure culture, and subcultured in series on Fletcher's medium.

Professor Schüffner also reported that the serum of the patient, collected on May 22nd (that is, on the tenth day of the disease), gave a strongly positive agglutination reaction (1 in 1,000) with the typical "Weil" strain, whereas it was absolutely negative for *L. canicola* and the "Rachmat" strain from the Dutch East Indies.

Comment on Case I

From a clinical point of view this case was typical of Weil's disease, presenting the usual sudden onset with rigor; extreme prostration; muscular tenderness; severe jaundice on the fifth day; multiple haemorrhages, including epistaxis, melaena, and haematemesis; herpes; renal involvement with albuminuria, oliguria, anuria; and, finally, death on the eleventh day. Interesting features were the severe constipation, the temporary non-passage of flatus, tenderness on deep palpation of the abdominal muscles of such a nature as to arouse suspicion of peritonitis, and free fluid in the abdominal cavity. The terminal waterlogging was probably related to the massive intravenous injections of glucose in an anuric subject; the nitrogenous retention at this time was marked, the blood urea equalling 346 mg. per 100 c.cm. The jaundice itself was very intense, the bilirubin content of the blood equalling 41 van den Bergh units, or 20.5 mg. per 100 c.cm. Early in the disease the urine contained both bile pigments and bile salts, but before death the latter had disappeared. At necropsy, on the other hand, the brownish-black fluid contents of the gall-bladder contained only bile salts and no bile pigment, the iodine test and the van den Bergh both being negative. Evidently, during the latter phase of the illness, the liver had lost the power of excreting bilirubin, while retaining its excretory function in regard to bile salts; the reverse happened in the kidney.

Since returning from India this patient had been mostly unemployed, but twenty-two days before the onset of his illness he joined a gang of workmen engaged in repairing a sewer in Chesham Street, Hyde Park Corner. His work included chiselling out the old bricks, the inner surfaces of which were stated to be covered with a slimy deposit from the sewer, and in other ways he came in contact with sewer water. Furthermore, being new to this occupation, his hands were badly contused and abraded by the hammer used for the work. His father, who had been a flusher of sewers for twenty-seven years, stated that rats were common in the sewers, and that jaundice was a not uncommon complaint among sewer labourers and builders in London. As an instance of this, a fatal case of jaundice in a sewer worker was cited where the coroner had given an "open verdict." The records of this case were consulted, and the facts, based on medical and lay evidence, were as follows:

Case History II

A sewer repairer, aged 34 years, who enjoyed excellent health, came home on October 14th, 1933, and in the evening complained of feeling ill with a sore throat; shivers and rise of temperature followed. Next day he felt better, and attempted to get up, but had to go back to bed. Anorexia and constipation were marked. On the third day (October 16th) he was seen by his panel doctor, who reported he had a red and slightly ulcerated throat, and was suffering from acute tonsillitis. His general condition, instead of improving, became worse; he was markedly prostrated, and had difficulty in moving the limbs. On the fifth day he developed jaundice and passed a blood-stained stool. The jaundice deepened, his condition became more and more grave, and he was removed to hospital on

the ninth day, dying four days later—that is, on the thirteenth day of the disease. A necropsy by the medical officer revealed jaundiced organs, a liver normal to the naked eye, and an enlarged gall-bladder, but no gall-stones were found anywhere in the biliary system.

The panel doctor, in his statement, said "there were no signs of liver disease, and it was difficult to account for the jaundice except on the grounds of some form of toxic poisoning which, in fact, it seemed to be." A foreman employed in the same firm as the deceased said that the work of the deceased on the last day had been to take bricks down to the bricklayers inside the sewer and to remove any rubbish down there. He made no complaint of having smelled gases, but he complained of foul smells; the man-holes were open every day, so gases could not accumulate. It was suggested that certain sewer gas, such as sulphuretted hydrogen, might cause jaundice, and a pathologist stated that he found sulphaemoglobin, 2 to 3 per cent., in the blood, and had searched for arsenic and phosphorus, but had found none. The coroner returned an "open verdict—toxic hepatitis—but there was no definite evidence to show how or by what means the toxic condition had arisen."

Past Jaundice in Sewer Workers

The facts regarding this case appeared so similar to Case I that it was decided to inquire into the history of some of the sewer workers who had suffered from jaundice in the past, and also to subject their blood to certain specific leptospiral agglutination tests, to which Schüffner and his colleagues have recently made such valuable contributions.

AGGLUTINATION REACTION IN WEIL'S DISEASE

Professor Schüffner was actually lecturing in London on leptospirosis at the time Case I was admitted to hospital, and later, when I wrote informing him of my suspicions regarding an endemic focus of Weil's disease among sewer workers in London, he generously agreed to test sera from these cases in his own laboratory at Amsterdam, specimens being sent across by air mail.

Weakly formalized (1/2 per cent.) cultures of leptospirae, which prevent lysis, were used as antigen, and each serum was tested against the classical "Weil" strain, *L. icterohaemorrhagiae*, the East Indian human strain "Rachmat," and the dog strain, *L. canicola*. In addition, living cultures of *L. icterohaemorrhagiae* were employed as antigen in most instances. In performing the tests sera are diluted 1 in 10, 1 in 30, 1 in 100, 1 in 300, 1 in 1,000, etc. The reaction is highly specific, weak positive being indicated by 1 in 10 and 1 in 30 dilutions, and strong positive reactions by dilutions of 1 in 100 and upwards. Control sera have never shown agglutination in Schüffner's hands, even in a 1 in 10 dilution.

Residual agglutinin persists for many years, and Postmus⁹ (1933), re-examining Schüffner's old cases, found positive reactions of from 1 in 100 to 1 in 300 over a range of from 218 to 6,066 days after the disease. The last patient contracted his jaundice in the war, and his serum gave a positive reaction (1 in 300) sixteen years and seven months later. Obviously, therefore, the reaction affords a very important index to past infection.

Case II had been employed at the Kensal Road sewer when he contracted his fatal malady, and the first workman with past jaundice to be interrogated (Case III) stated that he also had developed his illness while working there some eighteen months previously. His case history is epitomized below.

Case History III

The patient, aged 28 years, had been employed for five years in rebuilding sewers. On December 26th, 1932, he felt ill, and went to bed with aching pains in the feet; in the morning he had severe stiffness and pains in the legs, and next day his doctor reported a high temperature and diagnosed influenza. Anorexia and vomiting were present. On December 31st (the sixth day of the illness) jaundice developed, and subsequently increased in severity. Constipation was marked; the motions were black like tar (melaena); and the urine was dark yellow. The jaundice persisted for several weeks, and the patient lost his hair during convalescence.

Agglutination.—Serum collected eighteen months after jaundice—"Weil" strain + (1 in 1,000); "Rachmat" strain 0; dog strain + (1 in 100).

The clinical history, combined with the high titre agglutination of the serum when tested against the classical "Weil" strain of leptospira, shows that this patient had undoubtedly suffered from true Weil's disease. The fact that he contracted his infection some ten months before Case II when working in the same sewer entirely supports the view that Case II also died from the same disease.

Case History IV

The patient, aged 22 years, was repairing the Priory Street sewer, Bromley. On June 12th, 1933, he felt weak, and two days later had cold shivery feelings also. There were severe pains in the legs. By June 15th he could not stand up, and went to bed. Generalized jaundice set in on June 17th (that is, the sixth day), and persisted for nearly six weeks. The motions were clay-white and the urine was black. In the early stages the muscles were so tender that he could hardly bear being touched. Catarrhal jaundice was diagnosed by his panel doctor. During convalescence most of his hair came out.

Agglutination.—Serum collected twelve months after jaundice—"Weil" strain, both living and formalized cultures, + (1 in 300); "Rachmat" strain + (1 in 30); dog strain + (1 in 10).

Case History V

The patient, aged 28 years, was engaged on the same sewer. At 5 a.m. on August 19th, 1933, while at work, he suffered from a shivering attack with fever and aching pains in the head and body, but stayed on until 9 a.m. next day, when he went home to bed. He did not get up again for about two months. He raved for the first three days, and was diagnosed as a case of influenza and bronchopneumonia by his panel doctor. Jaundice developed on the fourth or fifth day; fever also was present. The jaundice increased; vomiting was severe; he coughed up blood and had tarry black motions. The limbs ached, and the legs felt like "falling off." The jaundice lasted nearly a month, and he was home almost eight weeks after that. His eyes became troublesome, necessitating treatment at Moorfields Hospital, and he did not return to work for six months.

Agglutination.—Serum collected ten months after jaundice—"Weil" strain, living cultures + (< 1 in 300), formalized cultures + (1 in 300); "Rachmat" strain + (1 in 10); dog strain + (1 in 30).

Case History VI

The patient, a labourer aged 31 years, was also handling bricks in the sewer at Bromley. He came on to relieve another worker, and thirty-six days later, on November 13th, 1933, developed shivering, fever, and backache, and went home to bed. He became very restless and light-headed, and next morning lacked the strength to get up. He tried to shave, and when a looking-glass was brought to him states he was astounded to find he was yellow. The urine later became black and the stools putty-coloured, and he could neither micturate nor get the bowels to act. On November 19th, 1933, there was coffee-ground vomit. Herpes also was present, as well as severe loin pain. He was jaundiced for six weeks while in hospital, and this had not completely cleared when he was discharged. He was about four months away from work, had trouble with his eyesight, and lost his hair in convalescence.

Agglutination.—Serum collected seven months after jaundice—"Weil" strain, living cultures + (1 in 1,000), formalized cultures + (> 1 in 300); "Rachmat" strain 0; dog strain 0.

Comment on Cases IV, V, VI

These three cases are of special interest as they had all occurred within the last year, the patients having contracted the illness when working in sewers at Bromley some twelve, ten, and seven months previously. Their histories are very typical, except that the jaundice in Case VI appeared early—according to the patient's statement on the second day of illness. The agglutination reactions were of high titre in all instances, and leave no doubt regarding the diagnosis.

Case History VII

The patient, aged 32 years, had been engaged as a sewer labourer since January, 1932. One Saturday evening in June, 1933, while working at the Wick Road sewer, Hackney, he was seized with a shivering attack, loin pain, and fever. Generalized pains, especially involving the head and neck, followed. He spent next day in bed, and on Monday went over to Peckham, took to bed, and was treated by his panel doctor. On Tuesday the temperature was 103.6° F., and on Wednesday (fifth day) jaundice with itching of the skin was noted. The motions now resembled "white paste," and were sometimes admixed with dark red blood. Epistaxis, haematemesis, and labial herpes subsequently developed. Weakness was extreme and the pains in the legs excruciating. He was in bed for two months, and the jaundice itself lasted six weeks: even then a yellow tinting of the conjunctivae persisted some time.

Agglutination.—Serum collected two years after the jaundice—"Weil" strain, living cultures + (1 in 1,000), formalized culture + (> 1 in 300); "Rachmat" strain 0; dog strain + (1 in 30).

Case History VIII

A sewer repairer, aged 60 years, stated that one Sunday evening in March, 1929, he felt cold and shivery, and developed fever. The preceding day he had been quite fit, being engaged in chiselling out brickwork at the Alexandra Road sewer, Kilburn. On Monday he had a severe headache and was so weak that he could not lift his head from the pillow; the following day his panel doctor diagnosed influenza. On Wednesday (fourth day) jaundice first appeared; this increased in intensity, and the skin became exceedingly itchy and the urine very dark. The stools were tarry black (melaena). Jaundice persisted for about six weeks, and during convalescence his hair came out "in handfuls."

Agglutination.—Serum was collected five years and four months after the jaundice—"Weil" strain, living cultures + (1 in 30), formalized cultures + (1 in 30); "Rachmat" strain 0; dog strain + (1 in 10).

Case History IX

The patient, aged 40 years, stated that in April, 1926, when doing brickwork in a Tottenham Court Road sewer, he had a headache and began to feel cold and shivery. He collapsed that evening and became semi-conscious; he remembers very little about his illness, which lasted six to seven weeks, except that he was intensely jaundiced, his skin was extremely irritable, and the pain in his muscles was so great that "he screamed when touched." It is noteworthy that prior to the onset of jaundice pleurisy was first diagnosed, and later, owing to abdominal tenderness, appendicitis was suspected.

Agglutination.—Serum was collected eight years and two months after the jaundice—"Weil" strain, living culture + (> 1 in 300), formalized culture + (1 in 100); "Rachmat" strain + (1 in 10); dog strain + (1 in 10).

Case History X

The patient, a brother of Case III, stated that he had fever about Christmas, 1922, when cutting out brickwork at a sewer near St. Pancras. Intense jaundice followed and persisted for several weeks.

Agglutination.—The serum was collected twelve and a half years after the jaundice—"Weil" strain, formalized culture + (1 in 100); "Rachmat" strain 0; dog strain + (1 in 30).

General Discussion

Most of the sewer workers in this series were treated by their panel doctors, and in the early stages, prior to the onset of jaundice, the provisional diagnosis was generally some general infection like influenza or tonsillitis. The absence of evidence of local hepatic disease, such as gallstones in the common duct, naturally led to the diagnosis of catarrhal jaundice in those patients who recovered, while fatal cases, such as Case II, which appear generally

to have been admitted to hospital in the later stages of the illness, were regarded as due to toxic or obstructive jaundice of unknown causation. Several such cases among sewer workers have been brought to our notice during the course of this very limited inquiry.

When viewed in retrospect, the occupational relationship to sewer rats, the course of the disease, and its symptomatology leave little doubt on purely clinical grounds that for many years sewer workers in London have been subject to the ravages of Weil's disease. This is entirely supported by the mode of onset, the great prostration, the pain and muscular tenderness, the prolonged and severe jaundice generally commencing about the fourth to the sixth day, the tendency to haemorrhage from mucous membranes, and the occurrence of patients dying from the ninth to the thirteenth day of the illness; all these features the case histories definitely reveal. Loss of hair, sometimes amounting to actual baldness, was a not infrequent sequel. What little doubt regarding diagnosis might exist on the basis of these data is immediately dispelled when the results of the agglutination tests performed by Professor Schüffner are considered. In seven out of eight cases strongly positive agglutination reactions were demonstrated, the titre of the serum varying from 1 in 100 to 1 in 1,000 in different instances when living or formalized cultures of the classical "Weil" strain, *L. icterohaemorrhagiae*, were employed. The remaining serum (Case VIII) alone gave a weak positive reaction (1 in 30), but, as control sera do not react even in a dilution of 1 in 10, here also the serological evidence supports the clinical diagnosis. Three out of eight sera had lower titre group reactions (1 in 10 to 1 in 30) with the Dutch East Indian "Rachmat" strain; while seven out of eight presented group reactions with the dog strain, *L. canicola*, the titre in three being 1 in 10, in three others, 1 in 30, and in one instance (Case III) 1 in 100. Group agglutination of this nature, to which various leptospirae are prone, can be distinguished from specific agglutination by absorption tests where necessary.

One other case of jaundice in a sewer worker (as long ago as 1912) was also investigated. The history was atypical, the patient stating that at the time he had been definitely diagnosed as a case of typhoid and that jaundice had occurred as a later complication. On the supposition that the diagnosis might have been erroneous, his serum was sent to Professor Schüffner as that of Weil's disease: the agglutination reactions for all strains were, however, negative.

These serological findings, no less than the clinical evidence, prove conclusively that the cases cited have suffered from true Weil's disease, and that this disease has been endemic among London sewer workers for at least twelve and a half years.

Mode of Infection and Treatment

The present series of cases comprised sewer labourers engaged in repairing or rebuilding old sewers; none of them were "flushers," whose duty it is to clean the sewers. Amongst other duties their work consisted in chiselling away and removing the old brickwork in a section of sewer under repair, and during this process the skin of their hands was often traumatized. The inner surfaces of bricks lining the sewer are covered with a slimy deposit, and all stated that soiling of the hands was unavoidable. The sewers in which the repair work was undertaken were wet and, especially in the smaller sewers of from four to six feet in diameter, the work had to be undertaken in a very confined space. Contact with sewer water was inevitable, though waders were worn.

The incidence of sewer rats was said to vary in different sewers, and some of the men stated that it was occasionally

necessary to remove dead rats from sewer water. As rats in London are known vectors of *L. icterohaemorrhagiae* the opportunities for human infection with leptospirae must be considerable under the conditions described. Buchanan* (1927) found that the fungal slime in the East Lothian coal pits contained leptospirae pathogenic to guinea-pigs, and similar inoculation experiments with slime from London sewers might well yield positive results.

A discussion on prophylactic measures hardly falls within the scope of the present paper, but it is obviously important, as approximately only 50 per cent. of cases of leptospirosis develop jaundice, that a serological as well as a clinical investigation of sewer workers for infection with Weil's disease should be undertaken to determine the real extent of this disease: this must be considerable, since the present inquiry was only made at odd times over a period of a few weeks, and was restricted to a limited section of sewer workers employed by a large firm of London contractors.

Specific therapy in the form both of convalescent serum and of anti-leptospiral serum (B.W. and Co.) is available, and the institution of such treatment, especially if carried out prior to the onset of jaundice, should undoubtedly save life. For early diagnosis both clinical and laboratory investigations, such as the centrifugation of blood to concentrate leptospirae, are essential, and for this purpose the early centralization of doubtful cases in one hospital might prove advisable. Prophylactic leptospiral vaccines might also prove valuable in sewer workers.

Summary

1. A widespread and hitherto unrecognized focus of Weil's disease affecting the sewer labourers of London has been demonstrated.

2. Its existence for at least twelve and a half years has been conclusively proved.

3. The mode of acquiring infection and certain other issues are discussed.

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R. S. F. Hennessey (*East African Med. Journ.*, May, 1934) records an outbreak of eighty-two cases of typhus which occurred in the Western Province of Uganda in June, 1932. The general manifestations of the disease corresponded more or less closely with those of the European form of typhus. Thirty-six were males and forty-six females; sixty-three out of seventy whose ages had been recorded were between the ages of 10 and 30; practically all were peasants. There were eight deaths—a mortality of 9.7 per cent.—four of the fatal cases being males and four females. The high degree of infestation with the body louse made it probable that the insect played an active part in the transmission of the disease, and this view was confirmed by inoculation of guinea-pigs, who developed a definite form of pyrexia of from four to ten days' duration.

CASE OF SPIROCHAETAL HAEMORRHAGIC JAUNDICE (WEIL'S DISEASE)

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The rarity of Weil's disease in this country makes it worth while to publish a case which has occurred in Eastbourne.

Clinical History

A female Post Office employee, aged 23, was admitted to hospital on April 7th, 1934. The condition on admission was as follows: very considerable jaundice, enlarged glands in general, especially the left parotid, swelling of the neck, swollen tongue, erysipelatous condition of the face, which was much swollen, and general inflammation of the skin, with commencing desquamation all over, particularly of the hands and feet. There were two small bullae similar to pemphigus on the fingers. The left conjunctiva was half covered with haemorrhage, and there were haemorrhages all over the skin from the size of a shilling downwards, especially on the arms and abdomen. There was also rectal haemorrhage. The liver was enlarged, but the spleen was not felt. The temperature was 102° F. There was no "typhoid" condition, but the patient was obviously extremely ill with slight delirium.

The history was that on March 29th she had had a slight shivering fit, with backache, and gradually her legs felt heavy. Her tongue was ulcerated, and she had been vomiting and coughing up mucus from time to time. The jaundice was not noticed until the day of admission, but the swelling of the neck and of the parotid had occurred the day before. The haemorrhages had started eight days before admission, in the arms and per anum, and there was increasing pain in the back, arms, and legs, especially in the arms.

Course of the Disease

There was occasional vomiting even after the temperature became normal, which it did in two or three days. There was a gradual improvement, and desquamation became general. There was no objection by the patient to taking fats or eggs, and the digestive processes were all normal. The patient steadily recovered, leaving the hospital on May 8th. On May 16th she was convalescing with still a little trace of jaundice and faint haemorrhagic stains in the skin, and the weakness that would follow an illness of some duration. She is now (May 28th) practically well. There was no relapse. Since the symptoms appeared to point to Weil's disease, pathological examinations were made, and *Leptospira icterohaemorrhagiae* were found in the urine on three separate occasions.

In trying to trace the cause of this isolated and unusual case, it was ascertained that no animals were kept in the house, and that no rats or mice were known to exist there. There was no history of any bite from a rat or other animal, and the other causes of jaundice were excluded. The girl was healthy and enjoyed a normal life. The disease resembled the numerous cases of Weil's disease that have occurred in Holland in the last few years, particularly in Amsterdam and in Dordrecht, in which the patients had been for the most part bathing in the canals. Shortly before the onset of the illness, the patient had eaten "Dutch" tomatoes. The recorded cases in this country are very few and far between.

The patient was not given any specific treatment, as she began steadily to improve from the date of admission to the hospital. After the temperature had become normal she seemed especially to improve on a tonic which contained strychnine and nitro-hydrochloric acid.