Major Gibbard and Major Harrison at the Military Hospital, Rochester-row.

Fever to some degree is the most constant symptom and occurs in about 30 per cent. of cases. Wechselsmann has pointed out that salvarsan fever may be caused by contamination of the saline solution, and not be due to the salvarsan; and numerous observers, working independently, have since confirmed this theory. Contamination with bacteria or their products is not, however, responsible for all cases of fever, and even if the solutions are prepared and administered with every possible care, cases of fever occasionally occur. A considerable rise in temperature most constantly occurs in cases of florid syphilis, and I am in agreement with Schreiber, who advanced the theory that this temperature was due to the setting free of the endotoxins contained in the bodies of the destroyed spirochaetæ. Rigors are rare and do not occur in more than 5 per cent. of cases; they usually arise from half an hour up to two hours after the injection. Vomiting occurs rather more often and at about the same time. Headache is met with in a considerable number of cases. Diarrhoea and constipation are occasional effects of treatment; the former occurs after injection, the latter after a few days; neither is, as a rule, of serious import.

A temporary exacerbation of an existing skin eruption, the so-called Jarrisch Herxheimer reaction, is occasionally met with. Two hours after the injection cutaneous lesions become deeper in colour and are more pronounced. This effect reaches its highest point in from 12 to 24 hours, and then gradually passes off. A sense of cardiac oppression, sometimes going on to syncope and throbbing in the head, has been described as occurring at the time of the intravenous injection, but I have not met these symptoms in properly prepared cases.

Perhaps one should add amongst the after-effects the results of faulty technique in administration, so that all the salvarsan does not pass into the blood stream, but some of it escapes into the tissues surrounding the vein. Such leakage may produce considerable aseptic infiltration, accompanied by pain, swelling, phlebitis, and thrombosis.

Precautions to be Taken to Avoid Complications.

The precautions to be taken in order to render the occurrence of these dangerous, alarming, or unpleasant symptoms minimal may be grouped under four headings: (1) The preparation of the patient; (2) preparation of the solution and correct technique of administration; (3) the after-treatment of the patient; and (4) interval between the injections.

Preparation of the patient.—The blood pressure should be lowered so that the vascular system may be enabled, without effort, to accommodate the additional 400 or 500 c.c. of fluid. It is obviously incorrect to assume, because a patient in a state of shock, with his blood pressure extremely low, is able to accommodate two or three pints of fluid without trouble, that when his blood pressure is normal no unpleasant symptoms will follow the introduction of a pint of fluid.

I have only had one case of serious collapse immediately after injection, and in this case I found that, owing to a misunderstanding, the patient had not been prepared and had had a meal one hour before the injection. My usual routine is to administer a pill the night before and a brisk saline purge on the morning of the injection, and no food or drink whatever is permitted for five hours before the injection.

Preparation of the solution and correct technique of administration.—The solution should be prepared immediately before use. Only freshly distilled water should be employed in the preparation of the saline solution, which should be prepared and sterilised within a couple of hours of administration. I think a simple infusion apparatus is preferable to a syringe. If during the injection of the salvarsan solution any local swelling develops at the site of injection or the flow stops, the clip should be at once applied to the tubing and the needle removed, and hot fomentations applied to the area in question, so as to assist the removal of any salvarsan solution that may have escaped into the tissues around the vein.

After-treatment.—I keep the patient in bed for 24 hours and then allow him up, provided that the temperature is normal, the site of the injection free from all phlebitis, and

no albumin in the urine. If there is any temperature I advise the patient to remain in bed until the temperature has been normal for 24 hours. I forbid alcohol for a week after the injection. The patient is encouraged to drink large quantities of barley water for 48 hours after the injection, and only a milk diet is permitted for the first 24 hours.

Pulmonary embolism and its consequent alarming symptoms can usually be avoided by keeping a careful look-out for phlebitis and thrombosis in the vein receiving the injection, and, if they occur, by insuring absolute rest to the limb and by the application of lead and opium fomentations.

Interval between the injections.—Since the occurrence of meningitis and nephritis in the case I first mentioned I have not given a second injection at a shorter interval than one week, and so have altered my procedure from that which I advocate in my book on the "Clinical Pathology of Syphilis and Parasyphilis," in which I recommend that the doses should be given at intervals of 48 hours. I based this opinion on a considerable number of cases in which at that time no untoward result had been obtained. If a patient shows any symptoms of intolerance to the drug I advise a month's interval between injections.

I use a Marsh's apparatus and some filter paper soaked in silver nitrate to enable me to make a rough guess at the amount of arsenic that is being eliminated, and it is advisable that the second dose should not be given while arsenic is present in the urine.

Conclusions.

The large amount of evidence now at our disposal points clearly, in my opinion, to the following conclusions:

1. That the risk of death is so small that if due care is taken in preparation of the patient, and no errors are made in preparation of the solution of the drug, technique of administration, interval between injections, or subsequent treatment, fear of death cannot justifiably be advanced as a reason for withholding salvarsan treatment.

2. That the slight risk of serious complications or sequelæ is more than counterbalanced by the therapeutic results obtained.

3. That all sufferers from syphilis, in whatever stage, and all cases of early parasyphilis should, as a matter of routine, be permitted the advantage of salvarsan treatment.

Upper Berkeley-street, W.

A CASE OF PHTHISIS WITH COMPLETE CAVITATION OF THE LEFT LUNG.

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THE patient, a female, aged 21, married, attended Westminster Hospital for phthisis in September, 1912. She had had good health until one year previously, when a child had been born; six weeks after parturition she had a severe attack of pneumonia and was ill for four months; she never recovered her health, but had a continual cough and occasional night sweats, and steadily lost weight; she had profuse expectoration, especially in the early morning, but no hæmoptysis. The child died from tuberculosis when a year old.

On examination there was extreme wasting; the weight was 6 st. 7 lb., and was stated to have been 10 st. 4 lb. three years before. No abnormality was detected in the alimentary, nervous, or excretory systems. The chest was much wasted; the heart appeared normal in position, but the left border could not be made out owing to dullness involving the whole left lower lobe; there were no adventitious sounds, but the pulmonary second sound was much accentuated. There was some respiratory distress with overaction of the accessory muscles, which was much increased on the least exertion, and there was some limitation but not abolition of movement on the left side. The right side was resonant throughout; the left upper lobe was resonant, but from the fifth rib downwards the lower lobe was extremely

dull in front and at the side, but not quite so dull behind. The breath sounds were very harsh throughout, cavernous over a part of the right upper lobe in front, and cavernous over the left upper lobe. There was no air entry over the dull area of the left lobe at the side and in front, but weak breath sounds were heard behind. There were no adventitious sounds, and the voice was feeble, so that vocal

incontinence of faeces, the breath became excessively foul, and on Jan. 22nd the patient died.

Report by Mr. WORRALL.—Radioscopic examination.—Patient sitting. One was at once struck by the intenseness

FIG. 2.

FIG. 1.

Section through right lung showing large cavities in upper lobe and extensive fibrosis.

resonance, and fremitus gave no reliable signs. Expectoration only occurred in the early morning, when some ounces of extremely viscid sputum, all forming one continuous mass, were brought up, in which tubercle bacilli were very numerous.

In December the patient grew rapidly worse, the larynx became severely affected, and it was difficult to take food. The liver grew tender and much enlarged, reaching two or three inches below the costal margin; a little albumin and numerous casts appeared in the urine, but there was no amyloid reaction. The temperature was not much disturbed till the last weeks of life, generally varying between 98° F. in the morning and 99° at night, never exceeding 100° while under observation, and sometimes not varying half a degree

Left lung laid open, showing much thickened pleura and complete cavitation.

of the X-light reflex of the upper part of the left chest, terminating below near the middle of the lung in a sharply defined horizontal line, below which the light reflex was markedly diminished. On making the patient incline to either side, the line separating the light and dark areas remained horizontal in all positions. A slight disturbance of the horizontal line synchronous with the pulse could be made out. The heart was not seen, being lost in the dark area of the lower part of the left chest. No movement of the diaphragm could be made out on this side. The right lung showed a large vomica near the apex; the light reflex here was almost equal in intensity to that of the

FIG. 3.

FIG. 4.

Skiagrams showing fibrosis and cavitation in the right lung, and free fluid in the left lung, which maintains a horizontal surface in different positions of the body. Observe the clearness above the fluid in the situation of the cavity of the left lung, suggesting collapse.

throughout the day. On Jan. 7th, 1913, however, an unsuccessful attempt was made to explore the chest, and severe coughing was induced. After this the condition grew rapidly worse, the temperature varied between 101° and 97°, there was a marked hectic flush, vomiting occurred, there was

upper part of the left chest. Over the rest of the right lung the reflex was markedly diminished and the lung presented a mottled appearance. The diaphragm excursion was much limited. From the above screen examination I concluded that this was a case of tuberculosis affecting the whole of

the right lung, there being a large vomica near the apex, whilst on the left side there was a pneumohydrothorax. I then took the radiograms. (Figs. 3 and 4.)

Radiographic examination.—(a) Plate in front of chest; patient standing erect; exposure 3 seconds. (b) Plate in front; patient standing and inclined to the right; exposure 3 seconds. These plates confirm what was made out in the screen examination, and show the right lung to be diseased throughout and presenting a large vomica near the apex. There is no shadow of lung tissue in the bright area of the left side. The mediastinal shadow seems to project somewhat to the left of the spine, and this I thought to be due to collapsed lung tissue. In the lower part of the dark area of the left side the plate shows a curved line convex downwards and limiting the densest part of the shadow, which for the moment made me wonder if this could mean that the fluid was in the pericardium, which in that case must be perforated to be in communication with the atmospheric pressure. I thought, however, the curved line might be caused by the mamma throwing its superadded shadow; a similar line, though less well marked, is to be seen on the right side. On investigating with the screen and moving the mamma this was found to be the explanation, and I put the appearances down as due to pneumohydrothorax.

Post-mortem examination.—This examination was made by Dr. J. A. Braxton Hicks, and the points of interest were as follows. The larynx was much infiltrated, the epiglottis and cords nearly destroyed. Both pleuræ were adherent throughout. The right lung showed universal chronic tuberculosis and a large cavity in the upper lobe. (Fig. 1.) The left lung was almost completely destroyed; it was merely a bag, communicating with the trachea through a bronchus, adherent to the chest wall, and about half full of foetid pus. (Fig. 2.) The liver weighed 64 oz., and that and the spleen showed the amyloid reaction. There were several tubercular ulcers of the lower end of the ileum and the head of the cæcum.

The necropsy was necessary to reconcile the physical signs and X ray pictures in this case. From the latter the diagnosis of hydropneumothorax appeared almost certain. The physical signs, however, never agreed with this, since the left chest moved with respiration and air could be heard to enter—in fact, in the upper lobes little difference could be heard on the two sides, and the classical signs of pneumothorax—namely, resonance and silence—were certainly absent. But in examination of the chest in any case in which there is extensive disease of the larynx the auscultatory signs are likely to be deceptive.

The physical signs indicated fluid in the left chest; the X rays showed that air and fluid were present together, and suggested that the lung was collapsed; there was, however, undoubted air entry into the left lung, and it is easy to see now, in the light of the post-mortem findings, that the signs were those of an undoubtedly rare condition—namely, complete cavitation of the entire lung.

A METHOD OF COUNTING BACTERIA IN WATER.¹

By R. DONALD, B.Sc. N.Z., D.P.H. OxF.

With Remarks upon the Bearing of the Method upon the Subject of "Saline Fever," by PAUL FILDES, M.B., B.C. Cantab.

(From the Bacteriological Laboratory, London Hospital—Professor W. Bulloch, F.R.S.)

IN a recent number of the Proceedings of the Royal Society² is published a short article on my apparatus for the measurement of liquids by drops. The article concludes with a list of practical applications of this drop-measuring method. One of these applications, the enumeration of bacteria in water, has been more fully worked out during the last couple of months, with results that not only are of special interest in connexion with (so-called) "saline fever," but also are of general practical importance in the many processes in which water is concerned.

This method of enumerating bacteria in water consists in taking a small definite-sized drop of the water, drying it in a circular patch on a slide, fixing effectively the circular film, staining clearly the bacteria present, and counting them under the microscope. The definite size of the drop is determined by the outer circumference³ of the vertically held clean glass pipette at the level where the drop-surface curving upwards and inwards joins the outer surface of the pipette point and clings round it. This particular size of pipette gives exactly that definite-sized drop of that liquid only at a particular rate of dropping and a particular temperature.

The pipettes are gauged to any particular size required in the proper hole of a steel gauge plate such as is used for wire. The gauge sizes most used in the work here described are as follows, the drop-rate being one per second and the temperature 20° C.:—

	Size.	Diam. mm.	Corresponding to drops of water each.
Morse drill and wire gauge ... {	77	0.457	1/101 c.c.
	80	0.34	1/131 c.c.
French draw-plate	8	0.29	1/173 c.c.

The pipettes are drawn, e.g., in a Bunsen large by-pass flame from glass tubing about 3 mm. in external diameter, and are gauged by gently pushing the capillary part down through the proper hole till arrested. Then with a glass-cutting knife the capillary is cut off close to the upper surface of the plate. The capillary ought to be very nearly cylindrical—i.e., not sharply tapering—at the part arrested in the gauge hole. The knife as well as the gauge plate and holes ought to be thoroughly freed and kept free from grease. Also the capillary end of the pipette must be touched by nothing but grease-free cotton wool or clean blotting paper.

The slow well-controlled rates required can, in dropping merely a few drops, be attained very conveniently by using the hand pattern of the mercury plunger tube.⁴ In use this is held at such an angle that the drop-rate is not faster than one per second. At all rates slower than one per second a dropping-point as small as 0.3 mm. in external diameter yields of a given liquid at a given temperature drops that are practically constant in weight.⁵

It is desirable that the drop of bacterial liquid, when deposited on the slide, should dry in a circular sharp-edged patch. This is secured by polishing with a clean cloth the rinsed slide and thus imparting a slight degree of greasiness. On such a surface a bacterial liquid, especially if slightly alkaline, will usually dry in a uniform film. The edge is most strongly marked when the drop is dried at a uniform gentle heat. Such drying is suitable for distilled water.

If the dried film contains more than a mere trace of dried salts only, some of the bacteria are deposited directly on the glass slide so that they can be fastened to it by a suitable fixing process. Now if such films are to be stained clearly—that is, if they are to be stained after drying—the bacteria, especially those deposited on the dried salts, must be held together by a suitable reticulum, so that when the salts are dissolved away the bacteria shall not also be washed away. Such a reticulum may be formed by adding to the liquid, before dropping and fixing, a trace (1 in 300) of 12 per cent. gelatin medium, of hydrocele fluid, or of egg-white (diluted and filtered through cotton wool to remove the globulin). Such toughened films have a too strongly staining edge unless they are dried cold under the air-pump.

Of course, the bacteria may be stained before dropping by adding a small quantity of bacteria-free methyl-violet solution and heating for a few minutes in a bath at 60° C. But the drop when dried has so many stain-granules and sharp circular droplets of stain that even an approximate count demands much careful scrutiny and much time.

³ Only the outer measurement of the pipette need be taken into account unless, as is rarely the case, the liquid is acid in reaction. In this case, to allow free passage of the colloids, the internal diameter of the capillary ought to be not less than 0.17 mm. Sahlbom: *Colloid-chemische Beihefte*, 1910, ii., 79. But so small a nozzle as 0.25 mm. in outer diameter allows acidified diluted vaccines to pass as freely as the same dilution alkaline in reaction.

⁴ Made thus: A piece of clean dry tubing 12 to 15 mm. long and 1½ or 2 mm. bore is opened out slightly funnel-shaped at each end, one end is tightly plugged with grease-free cotton-wool, the tube is filled two-thirds with clean mercury, the other end is tightly plugged with cotton wool, and a short piece (about 3 cm.) of rubber tubing is fitted for attachment to the small pipettes.

⁵ Ollivier: *Annales de Chimie et de Physique*, série 8, tome x. (1907), p. 2. Donald: Proceedings of the Royal Society, Series B, 1913, vol. lxxxvi., p. 198.

¹ The main part of the matter of this paper, with a demonstration of bacteria stained in distilled water, was communicated to the Pathological Section of the Royal Society of Medicine at the laboratory meeting on March 4th, 1913.

² Donald: Proceedings of the Royal Society, Series B, vol. lxxxvi., 1913, p. 198.