absolutely dark tent, inside of which the observer should be in total darkness for at least ten minutes, so as to allow the retina to accommodate itself to the perception of the shadows cast on the fluorescent screen, which is placed against one side of this tent. This plan has the additional advantage of allowing all the manipulation of the apparatus, etc., to be done in the light.

CASE II.

Dr. Dundas Grant brought this patient, who had a diverticulum in her oesophagus. We observed her swallow bismuth emulsion by means of the screen; most of it went down the oesophagus, but some of it ran into a small oesophageal pouch shown in the slide. It has been successfully removed by Dr. Dundas Grant.

CASE III.

Another case of Dr. Dundas Grant's showing probing of the frontal sinuses from the nose. Lateral view and front view are shown.

CASE IV.

Case of Master H. Subdiaphragmatic abscess, right side. Screen examination showed right side of diaphragm immobile on respiration, and bulged upwards. Stereoscopically showed a bulging cone in the middle of diaphragm; operation: ninth rib resected, abscess found and drained. Complete recovery.

CASE V.

Lord F. shows a shot in orbit after having injured eyeball in transit. Eyeball was therefore not enucleated.

CASE VI.

Half the portal vein injected shows that vascularly the liver is divided into two halves. Mr. James Cantlie held this opinion, and he injected and brought this specimen, which fully confirms his view.

CASE VII.

A young girl, aged 16, had congenital dislocation of the hip-joint. She went to Vienna, and was operated on; on her return I again photographed her; result showed the same condition, except that the epiphysis of the head of the femur has been injured. The mother was assured that the operation had improved the condition greatly, and, on inquiring if they did not use *x* rays to verify their results, she was informed that they were quite unnecessary. The pictures speak for themselves, comment is quite unnecessary.

I trust that these cases are sufficient to illustrate the great diagnostic value of *x* rays, but to make an accurate and reliable diagnosis it is necessary for the physicians and surgeons to work together with their colleagues who devote themselves to *x*-ray research.

Quite recently an interesting case has come under my observation, which so well illustrates the value of *x* rays as an aid to diagnosis that, with the permission of the Editor, a short account of it is here added. For the notes of the case I am indebted to Dr. Parkinson.

Mr. P., aged 54, was under treatment by Sir Patrick Manson for several months previous to June 1st, 1905, for malaria, from which he had suffered twenty years ago in India. In May he found himself losing weight and energy and suffering from frequent rises in temperature in the evenings. He was treated for malaria and rheumatism, but did not improve. When examined on June 1st he had pains shooting down both legs, pain in sacro-iliac joint in the evenings, along crest of ilium and along the seventh intercostal space. There was no tenderness in the kidneys, but recurrent lumbago. The urine was examined frequently and found normal. He did not improve under treatment, and was sent to Buxton towards the end of June by advice of Sir Hermann Weber.

At Buxton no improvement took place, and he soon began to suffer more lumbar pain, the temperature rising every night and profuse perspirations following, and his strength and weight began to fall rapidly. While at Buxton there were three consultations with London physicians, the diagnosis being "malaria with rheumatism" and "acute lumbago associated with endocarditis." He was brought to London six weeks ago, much emaciated and apparently in a critical condition. The pain became exceedingly severe. Sir Patrick Manson requested me to make an *x*-ray examination to ascertain if it could throw any light upon the case. I found the patient looking ill and dreading the paroxysms of pain. His chart showed an evening temperature of 103°.

X-ray negatives were taken of the chest, abdomen and pelvis, and nothing abnormal was shown except a distinct opacity in the left kidney region. A consultation with Sir Thomas Barlow, Sir Patrick Manson, and myself took place. The clinical symptoms did not in

any way confirm the *x*-ray diagnosis, and so it was decided to repeat the *x*-ray examination next day. The same result followed: an opacity exactly like a renal calculus appeared in all the negatives in the left kidney region. It was arranged that Mr. Godlee, in spite of absence of clinical symptoms, should explore this region. This was done, and a small cyst was found in the left kidney, which was evacuated, and then the whole kidney was excised on account of malignant disease. There was a stone in its centre, or possibly a degeneration of the tumour. (The specimen has not yet been properly examined and reported upon.)

This case well shows the value of *x* rays even in cases where their use seems likely to be of little or no service.

LEAD POISONING FROM ELECTROLYSIS OF WATER PIPES.

By GEO. A. E. ROBERTS, M.R.C.S., L.S.A., D.P.H.,

M.O.H. WINCHESTER RURAL DISTRICT COUNCIL.

A few months ago I was called to see a man who was suffering from unmistakable signs of lead poisoning. This was found to be caused by the water which he was drinking, which contained 0.14 gr. lead to the gallon.

The water is supplied by a water company to a very large area. It is of great organic purity, and is obtained from a deep well in the chalk. The total hardness is reduced from about 14° to 6°. In every instance the service pipes are of lead, and the water has never before been known to attack them so as injuriously to affect the water. It was noticed that the water from the tap at the cottage was slightly turbid, whereas normally it is quite bright.

A piece of the lead service pipe was cut out near the cottage and examined. On the interior could be seen patchy lumps of what proved to be lead carbonate. The lumps projected about $\frac{1}{4}$ in. above the internal surface of the pipe, and could be easily brushed off with the finger as a white powder. No doubt the turbidity of the water was due to this powder in suspension.

The cottage was the entrance lodge to a large house situated some 200 yards away, and midway between the two was an electric-light station which supplied the house but not the lodge. It was thought by the water company's consulting engineer that the lead in the water was due to electrolysis, caused by a leak from the electric cable.

The water main is situated in a road between the large house and the electric station. From the main a lead service pipe about 150 yards long supplies the lodge, and on its way branches to the electric station, and to another cottage close to it. The pipe from the main to the electric station was put in two years ago, but it was only continued to the lodge six months since.

The electric current is supplied to the house by means of an insulated positive main and an uninsulated copper strip return; the latter is supposed to be earthed at each end, but both are enclosed in a wooden trough and embedded in bitumen. The cable passes about 18 in. above the old portion of the service pipe near the electric station. After numerous tests by a firm of electricians employed by the company a leak of 1.8 volts was discovered, and this in their opinion was sufficient to cause the electrolysis.

The lead service pipe was examined at various points, and was found to be most affected near the lodge, whereas

close to the electric station it was hardly affected at all. The electricians account for this by the fact that the difference of potential between the pipe and the earth would become greater the farther away one gets from the source of leakage. The old portion of the pipe was also examined where it passes beneath the cable but was not at all affected, owing, it was supposed, to a protective coating of oxide having formed. Only the inside of the pipe was affected, the outside showing no sign of deposit or corrosion.

Needless to say, numerous samples of water were tested from other houses in the neighbourhood, including one from a cottage a few yards away from the electric station, but no lead was found. If a small leakage of electricity (1.8 volts) can produce electrolysis in this way, it seems to me that in towns which have large electric installations, with networks of cables and water pipes, such a thing should be more common. I am told that the Board of Trade regulations for earth return on tramways allow a difference of potential on the return circuit of 7 volts. Also, is it not a common thing to use a water pipe as an earth for telephones and electric bells? On placing a voltmeter between the cut ends of the lead pipe I obtained a deflection of about $\frac{1}{10}$ of a volt; this amount I could also get in my own laboratory by connecting the gas and water pipe, as also in a town ten miles away supplied with the same water.

THE ACTION OF TRYPSIN UPON THE LIVING CELLS OF JENSEN'S MOUSE-TUMOUR.

A PRELIMINARY NOTE UPON A RESEARCH MADE (WITH A
GRANT FROM THE CARNEGIE TRUST)

By J. BEARD, D.Sc.,

UNIVERSITY LECTURER IN COMPARATIVE EMBRYOLOGY,
In the Research Laboratory of the Royal College of Physicians,
Edinburgh.

THE experiments were undertaken to determine in the first place three points—(1) the action of trypsin upon the living cells of a carcinoma such as Jensen's mouse-tumour; (2) to test the truth of the conclusion advanced by me in 1902¹ that cancer was an irresponsible trophoblast; and (3) the length of treatment and number of injections of trypsin necessary to destroy the tumour.

The inoculations from a Jensen mouse tumour were made by Dr. H. Wade on October 10th, 1905, and the first injections (into the tumour mass) were commenced on November 15th.* By this time some seven or eight mice had well-marked tumours. Of these, two were taken for treatment, and along with them was placed a "control mouse," which was living when the second "trypsin mouse" was killed. The remaining stock of mice with the tumour may also be regarded as controls. The preparation of trypsin employed (Fairchild Bros. and Foster's) was that originally dispensed to Dr. John A. Shaw-Mackenzie's prescription by Mr. F. W. Gamble, and it was with great generosity supplied gratis by Messrs. Allen and Hanburys for these experiments. This firm sent the solution in two strengths—3 per cent. and 5 per cent.—containing no antiseptic such as phenol.

The first difficulty was to decide upon some dose to be tried, and after one injection into each mouse of 2 minims of a 2½ per cent. solution—made by dilution with sterilized distilled water—all the later ones were of 2 minims of a 1½ per cent. solution. The reason for the change was that on the day after the first injection both mice were found in coma and quite cold, with legs in the air. In a warm incubator they recovered, and we did not experience the like result in them again or in the control mouse at any time. After this alarming experience—due, perhaps, to auto-intoxication by some other of the products of the tumour (? an alcohol), as "extracted and digested" by the large dose of trypsin—it was decided to reduce the dose by more than one-half, for in the first instance the amount of the trypsin

solution had exceeded that of water. One of the mice weighed 17 grams, and, taking the weight of an average man at 70 kilos, or 154 English pounds, one hundred times the maximum dose (30 minims) ever employed by Shaw-Mackenzie or any other physician in cases of inoperable cancer in man had in the first instance been given to the two mice! The minute size of the "patients," $\frac{1}{4000}$ of a man, must be the excuse for this error.

After ten days, when four injections in all had been made into each mouse, one of them was found dead by the laboratory servant. The *post-mortem* examination made by Dr. Wade revealed no cause of death. But for the presence of a tumour mass the mouse appeared to be quite healthy. The laboratory attendant thought that it had got caught between the cage and food vessel, and so (? when intoxicated) had caused its own death. The microscopical examination demonstrated that every single cell of the tumour was in degeneration, fully half of them being represented by shapeless masses of particles, probably remains of nuclei, and all the rest were mere skeletons of cells. Even these seemed in very many cases to be crumbling and falling rapidly away, as though in a hurry to quit the scene. The somatic tissues of this mouse, as represented by the leucocytes and connective-tissue stroma cells, were quite normal, and in the following instance also.

In the case of the second "trypsin mouse" the treatment was continued until Thursday, December 7th. In this period of twenty-two days in all nine injections of trypsin were made. On this date one of the other control mice, but not that living with the "trypsin mouse," died of its tumour, and it was then resolved to kill the "trypsin mouse." The tumour was at once exposed, an incision made into it, and the whole with a piece of skin preserved in 5 per cent. corrosive sublimate. Before the mouse was killed it was noted that the skin over the tumour was in necrosis. At the time this was set down to phenol in the trypsin solution, but afterwards it was ascertained that the solution contained no antiseptic of this kind. In the case of the control mouse, which died of its cancer, the tumour was quite as large as the terminal phalanx of a man's thumb, while in that of the second "trypsin mouse" it was only as big as a lentil. Microscopically, this latter apology for a tumour was in advanced degeneration, shrinking away to nothingness, and quite harmless. It appeared probable to us that, at the time we killed it, its "cure" from cancer was not far distant, and the microscopical examination confirmed this opinion. Even without further treatment the tumour would in all probability have been absorbed shortly or its remains cast out.

The experiments will be resumed as soon as the stock of mice with tumours has been replenished.

Though the number of experiments is small, already they have established what in advance I knew that they would. This degeneration of an asexual structure (a malignant tumour or trophoblast) under intestinal (tryptic) digestion I have witnessed again and again in past years.² The experiments were not needed to convince me that trypsin would cause a cancer to degenerate in the same way that it does that of the trophoblast, etc., in normal development. How such a conclusion can be arrived at is, I know, a mystery to many. It is solely by the use of the comparative morphological and physiological method, of which my departed friend, Professor George Bond Howes, was so ardent an exponent.³

In advance I know that, no matter how often we repeat this experiment, even with much smaller doses, the like results will invariably be obtained. In the nature of things it must be so, for in the cancer ferment, malignin, and in trypsin we have an antithesis of ferments, of which the latter is the more powerful. For reasons which cannot be entered upon now, it appears to be certain that the action of trypsin upon the cancer cell is to pull down the cancer albumin—a living substance—and the cancer ferment—malignin—produced by this. Apart from its origin and apart from the parasitic theories proper, the extant theories of the nature of cancer come under three headings—germinal or gametoid, trophoblastic or asexual generation, and embryonic or somatic. In addition to their confirmation of the conclusion that trypsin is the substance which will destroy the cancer cell with ease, and without danger to the individual (Beard and Shaw-Mackenzie), these experiments go far to prove that in its

* My sincere thanks are due, and are hereby rendered, to Dr. H. Wade, F.R.C.S.E., for his great kindness in making the successful inoculations with the Jensen mouse adeno-carcinoma, and for performing the injections on my behalf. It is right to add that, in spite of my entreaties to him to agree to a joint authorship of the research, he declined for private reasons, which I can fully appreciate, while not admitting their cogency.