tion would, if it were grave enough to justify the operation, be amenable to relief.

As to the gravity of the operation and its technique, we may judge by a large accumulation of evidence. The two dangers are shock from hemorrhage, and sepsis. All cases of root section thus far reported have made excellent recoveries — proof that it adds nothing to the risk of laminectomy to open the dura.

Opening the dura always allows the escape of two or three ounces of cerebro-spinal fluid if the patient is strictly horizontal. The treatment of the dural incision should always be by continuous suture with fine catgut. There is no difficulty whatever in doing this with a small curved eye needle. Leakage of cerebro-spinal fluid afterward is practically nothing; whereas, if no sutures are applied, leakage continues for weeks.

The approach to the cord is best done by a quick and simple method which I have devised and practised in many cases. A long skin incision is made over the spine by a rather large knife, which by one or two rapid strokes separates the muscle from one side of all the spinous processes to be operated on and touches the laminae at their bases. The knife handle is sufficient to scrape the muscle from the laminae. With a bayonet-shaped cutting pliers the bases of the processes are cut through in rapid succession, and with a curved periosteum elevator the series of spinous processes, with uncut interspinous ligament and muscles attached on one side, are pressed *en masse* to that side. The hemorrhage is very slight and entirely controlled by pressure, with perhaps two or three clamps to be taken off in a few moments. A properly curved rongeur (such as shown) now begins the destruction of the laminae. Beginning on the base of any process the dura is exposed at one point carefully, and then the rongeur proceeds up and down with rapidity.

Occasional points of venous bleeding may be met, but a narrow strip of iodoform gauze or MacEwen's sticky gauze pressed down upon them by some pointed instrument allows the work to go on rapidly. When the dura has been slit up as far as desired we can roll the cord from side to side without touching it, by lifting the cut edge of the dura. The roots must be picked up by a blunt hook and a quarter to a half inch cut out, without much handling for microscopic observation. A half-dozen small bottles should be provided, as in my second case, to identify the roots and learn of their inflammatory invasion.

The dura ought always to be sutured by fine catgut, and the outer soft parts fall together easily because there is no perceptible loss of substance. Drainage of the vertebral groove should be done for one day by a small tube not going far in. No plaster jacket or support is ever needed, as the strength of the spine is in no way impaired.

CONCLUSIONS.

A comparatively new and interesting field of work is opened by these few cases.

Thus far, even in weak patients, the operation has been devoid of risk.

It is sound in theory, and has yielded enough results to show that it may become a meritorious operation.

It should be resorted to early in cases of ascending neuritis which have heretofore been subjected to successive nerve-stretching and resection and finally amputation, uniformly without benefit.

The experimental and practical evidence shows that two additional roots higher up than the apparent origin of pain should be included.

There ought to be no risk in severing the posterior roots of the third and fourth cervical, as well as those to the brachial plexus, simply because they supply the phrenic, inasmuch as that needs motor supply only, and at best it has the opposite phrenic in reserve.

A METHOD FOR MORE FULLY DETERMINING THE OUTLINE OF THE HEART BY MEANS OF THE FLUORESCOPE TOGETHER WITH OTHER USES OF THIS INSTRUMENT IN MEDICINE.

BY FRANCIS H. WILLIAMS, M.D.

A SHORT account of some of my work on the applications of x-rays in medicine was read at the meeting of the Association of American Physicians held in April last and has been published in their "Transactions." I now wish to speak further of some of the uses of the fluoroscope in medicine, leaving a fuller discussion of them and of my observations relating to physiology and diagnosis, to a later time, when I shall hope also to describe the methods of examination that I have employed.

The picture which presents itself to the eye when the body is examined with the fluoroscope is full of interest. The trunk appears lighter above than below the diaphragm and the rise and fall of the muscle are distinctly seen; the chest is divided vertically by an ill-defined dark band which includes the backbone; and each side is crossed by the dark outline of the ribs, the spaces between which, are the brightest portion of the picture. One also sees the pulsating heart, especially the ventricles, and under favorable conditions the right auricle and left auricle, but it is difficult to separate the latter from the pulmonary artery; a small portion of one side of the arch of the aorta may be seen in the first intercostal space to the left of the sternum. The organs of the abdomen are much less readily observed, but the presence of a piece of lead or of substances impermeable to the Röntgen rays may be detected in them. The neck and face may be searched with the fluoroscope; and in the arms and legs the bones and certain foreign substances may be seen. The head is the least promising field.

In examining the heart by means of percussion, we can usually determine its left border, but we cannot find its lower border. Now let us see what can be done in this direction by means of the x-rays. The constant motion of the heart and diaphragm interfere with the use of radiography but renders fluoroscopy all the more valuable. The lungs and the organs adjacent to them are the parts of the body which best lend themselves to fluoroscopic examination, because of the great difference in density between the former and the latter, or, in other words, of permeability to the x-rays. The lungs being less dense than the neighboring organs allow the x-rays to pass through them more readily, and thus appear light against a darker background formed by the heart and parts of the liver and spleen, which, owing to their density, are less permeable by the rays and thus appear dark when seen through the fluoroscope, that is, there is contrast.

The heart lies in such a position, however, that ordinarily but a certain portion of its outline may be

seen with a fluoreoscope; a horizontal plane may be imagined through the body, when in a standing position, that would pass through the heart, liver and spleen, as these latter organs overlap the heart to some extent; but it is readily possible to isolate the heart, as it were, by the contraction of the diaphragm; the organs below the heart being then depressed, the overlapping is avoided and the heart being more closely surrounded by transparent lung tissue the whole of the apex and part of its lower border come into view and may be drawn on the skin. A suitable position of the Crookes tube of course facilitates this end somewhat. It is desirable to see as much as possible of the heart at one time in order to best estimate its condition — then if necessary we may study one or another portion separately — and by means of this fluoroscopic examination we can follow a larger portion of its outline and gain more information as to its size, position and action than has hitherto been within our reach. I may add here that I have made an instrument that enables me to listen to the heart-sounds while watching the pulsating organ.

The character of the revelations which are made to us by a fluoroscopic examination of the heart may be most briefly suggested by Figs. 1, 2, 3 and 4, taken from photographs of lines traced on the skin, which follow the outlines of the organs as seen through the fluoreoscope. The patients from whom these photographs were taken were lying on a canvas stretcher and the Crookes tube was placed under and about a foot below the trunk. These illustrations have been selected from a number of photographs I have thus far made.

CASE I. Fifty-seven years old. The Crookes tube was placed eighteen inches away from and under the point indicated by the black dot in Fig. 1. The heavy crossed lines indicate the sixth rib; the full lines what was seen in the fluoreoscope; the broken line the border of the heart obtained by percussion, which on the left side coincides with the line as seen in the fluoreoscope. The lower border of the heart cannot be got by percussion, and is seen in the fluoreoscope only during deep inspiration. No apex beat was felt. The full parallel lines on either side of the body mark the diaphragm in ordinary expiration and deep inspiration respectively.

CASE II. Twenty-seven years old. The full curved line on the left (see Fig. 2), as far as the dot which marks the apex beat, and the broken line inside, indicate both what was seen in the fluoreoscope and what was obtained by percussion — the full line during ordinary expiration, the broken line during deep inspiration. The continuation of the full curved line (beyond the broken line) that runs towards the sternum marks the lower border of the heart, which, as above stated, is obtained by the fluoreoscope, and this only during deep inspiration. The two parallel lines on the left mark the diaphragm — the upper in ordinary expiration, the lower in deep inspiration. The difference between these is greater than in Figs. 1 and 3.

CASE III. A boy, eleven years old. The lines in Fig. 3 indicate what was seen in the fluoreoscope. The full curved line on the left marks the border of the heart as seen during ordinary expiration; the broken line inside, during deep inspiration; the two parallel lines on either side, the diaphragm in ordinary expiration and deep inspiration; the black dot, the point where the apex beat was felt.

CASE IV. Fifty-eight years old. Enlarged heart; examination with the fluoreoscope: the left and part of the lower border of heart are seen (Fig. 4), and the diaphragm lines already alluded to in the other cases. The difference between these last mentioned lines is less than usual.

These outlines of the heart are obtained with the fluoreoscope when the lungs are normal; when abnormal, on the contrary, as in tuberculosis, for instance, if the lungs are much involved, the outlines of the heart as well as those of the liver and spleen are obliterated as the lungs become impermeable to the x-rays, and therefore the outlines of these organs cannot be distinguished.

In another abnormal condition of the lungs, namely, emphysema, I have observed that the heart, liver and spleen are still more distinctly visible than when the lungs are normal. This is because in emphysema the volume of the lungs being increased, and yet retaining their transparency, the diaphragm is depressed and a part of the lungs intruding themselves between the sternum and heart, and their edges between the chest wall and the liver and spleen separate two dense tissues, thus rendering a larger portion of the outlines of the heart, liver and spleen visible in the fluoreoscope than when the lungs are normal. This condition of things assists in making a diagnosis of emphysema of the lungs. On the other hand, in this disease the outline of the heart is ill defined, or in some cases, impossible to define by percussion; therefore, the fluoreoscope in emphysema renders especial service.

The fluoreoscope also reveals the presence of certain aneurisms, as they are dense, if their outline encroaches upon the visible portion of the comparatively transparent lung tissue; likewise, in connection with other physical signs, the presence of fluid in the pleural and pericardial sacs, the presence of pneumonia, edema of the lungs, infarctions, tuberculosis, hydro-thorax, pneumo-thorax, etc. Further, it assists in diagnosis in excluding certain diseases by showing that the lungs are clear; this would be of importance in life insurance examinations.

I have examined about forty cases of tuberculosis, and find not only that the fluoreoscope is of value in determining the extent of the disease, but also sometimes reveals its location, where and when it would otherwise have been unsuspected.

In pleurisy with effusion the outline of the diaphragm is less defined or obliterated altogether according to the amount of fluid present, as are also some of the ribs in the upper portion of the affected side; the lung is also denser, being compressed by the fluid, if there is much effusion. I observed in one case that the line separating the fluid surrounding the lower part of the lung from the compressed upper portion ran from about the junction of the sixth rib with the sternum towards the outer end of the clavicle; this line as seen in the fluoreoscope corresponded with the one found by percussion.

All of the fluids withdrawn from the body which I have thus far examined with the fluoreoscope and by means of radiographs have rather less permeability to the rays than water. About an equal thickness of the heart, liver, spleen, kidney and muscle after death were about alike in permeability and were not much more of an obstacle to the rays than an equal bulk of water. Thus it is easy to understand why fluid in the pleural cavity dulls or obliterates the outline of the adjacent organs.

Fig. 1.

Fig. 3.

Fig. 2.

Fig. 4.

When the lungs become dense by disease they may obliterate not only the outlines of the ribs but also those of the liver, spleen and heart as I have already indicated. When there is not marked contrast between the intercostal spaces and the ribs or when the outlines of the clavicle and of adjacent organs are not defined it should always arouse suspicion of something abnormal in the lungs or pleura.

The application of x-rays to surgery has hitherto formed the prominent side of their usefulness; I have pursued my investigations believing that it would be possible to demonstrate their usefulness in medicine, as distinguished from surgery, and am now confident that the advances these x-rays render possible in medical diagnosis are great, and that they will prove a more valuable instrument in the hands of the physician than of the surgeon. I have found them especially useful in diseases of the heart and lungs. We may now look where we have previously only been able to listen, and sometimes to hear but imperfectly. The advance consists not alone in what we can now see that we could not see before, but also in that we can by hand and ear and eye together strengthen and confirm these separate observations beyond their respective limitations; singly they are beams, together an arch which justifies a heavier weight of inference.

Most of the work here described has been done in the x-ray room at the Boston City Hospital; the cordial interest of the Trustees and of my colleagues on duty have facilitated greatly the carrying out of these observations, and I shall always be indebted to Prof. Charles R. Cross of the Massachusetts Institute of Technology and to the assistants in his laboratory for the opportunity of studying the physics relating to the x-rays.

Clinical Department.

A CASE OF PROLONGED ANURIA AND A CASE OF COMPLETE REMOVAL OF CARCINOMA OF THE NECK.¹

BY F. B. HARRINGTON, M.D.

PROLONGED ANURIA.

MAY 27th. S. Y., a female twenty-three years of age, was operated upon, and the right kidney removed in very advanced stage of tubercular disease.

MAY 28th. As the patient had passed no urine, the catheter was used and about one ounce of thick purulent fluid was drawn from the bladder. There was much vomiting during the day. The usual means were tried to stimulate the kidneys. Nitro-glycerine, hot poultices to the renal region, digitalis, etc., were used with no effect.

MAY 29th. An ounce of fluid pus was drawn by the catheter. Uremic symptoms.

MAY 30th. Pilocarpine and hot-air bath. Caused sweating. No urine.

MAY 31st. The symptoms were more uremic. There was much vomiting. Repeated large enemata of salt solution were given for several days.

JUNE 1st. Bowels were moved with calomel. The patient was decidedly uremic, stupid and vomiting. In the afternoon twelve ounces of blood were taken from the ulnar vein and replaced by a quart of salt

solution. This produced no apparent effect on the pulse, but the patient became brighter. No urine secreted.

JUNE 2d. The patient had held her own. The vomiting was less, and she retained some nourishment. Six ounces of blood were withdrawn, and replaced by two quarts of salt solution. One-half of the solution was Ringer's solution. After the infusion the pulse became stronger and slower. The patient appeared brighter and stronger.

JUNE 3d. Forced sweating was continued and purges were used.

JUNE 4th. The uremic symptoms were more marked.

JUNE 5th. Infusion of two quarts of Ringer's solution into saphenous vein. It made the pulse fuller and stronger. Sweating by hot air was continued.

JUNE 6th. Condition the same. Pustular eruption. Wound clean and nearly healed.

JUNE 7th. Infusion of Ringer's solution one quart.

JUNE 8th. Patient was weaker. No sweating could be produced with pilocarpine and hot air.

JUNE 9th. Took large amounts of water and considerable food. There were copious watery movements with blood from the bowels. No twitchings.

JUNE 10th. The patient was weaker, but still took food and liquids. No urine. In the evening labored respiration. Pulse failed steadily till death on June 11th at 12.05 A. M.

Autopsy revealed total absence of left kidney and ureter.

RINGER'S SOLUTION. :

Sol. sod. chloride (.6 %)		1,000 c. c.
Sol. sod. chloride (1 %)		10 c. c.
Pot. chloride (.75 %)		10 c. c.

Sod. bicarb., 10 c. c. of 1.0 %, formerly used, omitted because it caused precipitation of calcium chloride on sterilizing.

EXCISION OF THE LEFT PNEUMOGASTRIC NERVE AND THE CAROTID ARTERY IN A CASE OF CANCER OF THE NECK.

F. S. D., male, twenty-five years of age, came to the hospital June 1, 1894. Fifteen months before he had noticed a white spot on his tongue. After four operations by Dr. Coolidge for the disease leucoplakia, there was no return in the tongue, although at the last operation, March, 1894, enlargement of submaxillary glands was noticed. At the time of entrance to the hospital they had attained considerable size. The submaxillary lymphatic glands on both sides were removed on June 2d. The patient made a rapid recovery and was discharged on the fifth day after the operation.

July 17th of the same year he was re-admitted to the hospital, and the deep lymphatic glands were dissected from about the vessels on the left side, exposing one and one-half inches of the common carotid. The dissection was carefully made and all suspicious tissue was removed. Discharged on the fourth day.

Notwithstanding this the patient returned on August 10th, showing disease along the anterior border of the sterno-mastoid well up toward the mastoid process extending deeply into the neck. The patient who had very remarkable healing power, was very anxious to have another attempt made to extirpate the disease. At his urgent request a seventh operation was undertaken. An incision was made extending from below the ear almost to the clavicle. After careful dissection it was found that the growth had involved the

¹ Read before the Surgical Section of the Suffolk District Medical Society, April 1, 1896.