lower end of the femur, in skiagraph No. 3 is quite straight, and the obliquity of the upper end of the diaphysis of the tibia must be compensated for by the shape of the cartilaginous part of the epiphysis, for otherwise a wedge-shaped space would be present in the knee-joint. This obliquity is evidently due to the curvature of the shaft, as is clearly seen to be the case in skiagraph No. 3, and it is probably of no importance. In Mr. Footner's skiagraph of the bones after osteotomy this obliquity (though present before operation) is not apparent, but then the whole outline of the upper end of the tibia is blurred.

[Since this paper was sent for publication I have operated on another case in this way. The deformity was easily and satisfactorily corrected, but the limb is still on the splint.]

SOME OF THE MEDICAL USES OF THE ROENTGEN RAYS.*

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It gives me great pleasure to have the honour of being present at the meeting of this Association and of reading a paper before this Section.

During the past year I have spoken several times on the subject of the Roentgen rays and their uses in medicine¹; in the few minutes at my disposal to day I shall only attempt to review briefly some of the clinical questions the *x* rays assist us to look at from a new standpoint (thus lending confirmatory evidence to our older methods of examination), and also to some of the few ways in which the *x* ray examinations can place new evidence at our disposal. To consider the surgical uses would be out of place here, and to touch upon all the medical ones would take too long, therefore, by way of example, I will speak briefly of certain uses of the fluoroscope in diseases of the chest. But first let me remind you that the differentiation which the rays make between different tissues in the body depends upon differences in bulk and in chemical composition. This point is illustrated by these radiographs, which explain themselves.

The chest offers an excellent field for examination with the fluoroscope because it contains so much air that the contrast between the normal lungs, which are light, as seen in the fluoroscope, and some pathological conditions, which make them darker, renders many abnormal conditions readily visible, and, further, the motions of the organs in the chest may be studied with this instrument; this cannot be done with the radiograph. The physician can make an examination in his office by means of a suitable apparatus with such readiness that it is far more practicable than any method involving photography. I have been using the fluoroscope regularly as a means of examining the chest as I do the stethoscope, and find that the two instruments supplement each other.

To illustrate the uses of the fluoroscope let us consider certain outlines of the organs in health as seen in the fluoroscope, and then take up the ways in which they may be changed in disease. In health the diaphragm lines move as follows: Quiet breathing, half an inch; full inspiration, two and one-half to three inches, a little more on the right than on the left side.

In health the outlines seen on the left of the sternum are as follows: A part of the aorta in some patients may be observed in the first intercostal space; in the second intercostal space a portion of the pulmonary artery; the left border of the ventricle is chiefly seen in full inspiration when the apex and a portion of the lower border are also visible; the maximum pulsation is at the point corresponding to the cavity of the ventricle about where its outline crosses the fourth rib; during full inspiration the heart moves downward and toward the median line about an inch.

To the right of the sternum the outline of the large vessels is seen, and, less distinctly, the right auricle between the second and fourth ribs.

Let me enumerate some of the diseases in which the changes that have taken place in the diaphragm lines may be

seen in the fluoroscope: such are tuberculosis, pneumonia, pneumothorax, carcinoma, etc.

Fig. 1.—Tracing from a man, aged 23, showing position and movements of heart and diaphragm during expiration and in full inspiration. Line B the position of the ventricle during full inspiration. Line C the position of the ventricle during expiration. The dotted line, S, indicates the border of the ventricle in systole during full inspiration. The curved line A, the right auricle. Lines D, D, indicate the position of the diaphragm in full inspiration. Lines E, E, indicate the position of the diaphragm on the right side in inspiration during quiet breathing at which time the heart was as in expiration (C). I, II, III, IV, V, VI, VII, indicate parts of the ribs seen in the fluoroscope during inspiration; during expiration only those parts above lines E, E, and outside of C are visible.

Fig. 2.—Normal thorax. Diagram showing the heart and the outline of the diaphragm of normal chest, as seen in the fluoroscope during full inspiration. The broken lines show position of heart and diaphragm during expiration.

In many cases of pulmonary tuberculosis (see Fig. 3) the range of movement of the diaphragm is shorter than in health; it does not descend as far as it should, and this shortening of the excursion precedes in some cases the increase in density of the lungs (which makes these organs appear dark in the fluoroscope), and sometimes is one of the

* Read in the Section of Medicine at the Annual Meeting of the British Medical Association held at Montreal in September, 1897.

earliest signs of pulmonary disease. These variations from the normal are at times recognised earlier by the fluoroscope than by auscultation and percussion.

Fig. 3.—Tuberculosis. Diagram illustrating appearances seen in the fluoroscope in a case of tuberculosis of the lung. The apex of the right lung is seen to be darker than normal, and the range of movement of the diaphragm on the right side to be less than normal. The position of the diaphragm in full inspiration is shown; the broken lines give its position in expiration.

In pneumonia the lungs are not only darker than normal, but the excursion of the diaphragm is also seen to be shortened, as in tuberculosis, and it does not, in some cases at least, resume its normal range of movement until after one ceases to recognise in the fluoroscope the abnormal density of the lungs. In other words, the diaphragm line may be a more delicate test than the diminished brightness of the lungs. In both tuberculosis and pneumonia the amount of lung involved is better estimated in some cases by means of the fluoroscope than by auscultation and percussion. A central pneumonia may be readily noted in the fluoroscope which has not been recognised by auscultation and percussion.

In emphysema (see Fig. 4) the position and movement of the diaphragm are very characteristic. During full inspiration it goes lower down towards the abdomen than in health, and does not rise to so high a point in the thorax as it should. The lung area is brighter than in health, and the heart in the later stages is seen to be enlarged, to be in a more vertical direction, and to lie lower down in the chest than normal. The fluoroscope enables us in some cases to make a diagnosis of emphysema or to exclude it.

In pneumothorax the curve of the diaphragm is characteristic; this muscle is very low down on the affected side, and is motionless except at its median end, where the movement of the healthy side imparts some motion to it; the heart and blood vessels may be seen to be displaced towards the normal side.

In certain conditions in the abdominal cavity—as in ascites—the diaphragm may be pushed up into the chest, and thus its excursion may be very much restricted. In carcinoma below and near the diaphragm, for example, the movement of this muscle may be much restricted on the median end, while on the outer ends it may move nearly as much as in health.

In pleuritic adhesions we have still another cause for a limited movement of the diaphragm and also of the heart. The heart is seen to be displaced in pleurisy with much effusion, especially when the effusion is on the left side, and this displacement is sometimes not recognised by percussion. The increased density due to the presence of fluid is of course recognised by the fluoroscope.

In cardiac disease the size and position of the heart may be more exactly obtained by the fluoroscope than by percussion, except the right border of the ventricle, the outline

of which is not usually seen in the fluoroscope. This instrument shows that in some cases the position of the apex is not at the point where the impulse is felt in the chest wall, but much below it. We may by the fluoroscope determine the position of the heart and whether it is smaller or larger than normal, and gain more definite information about it in these respects than has hitherto been possible. We may see aneurysms of the aorta, pulsations in the venæ cavæ, a dilated right auricle and pulmonary artery, displacements caused by abscess, or growths in the mediastinum.

Fig. 4.—Emphysema: diagram from a tracing made during full inspiration. The dotted lines indicate the position of the diaphragm during expiration. While the diaphragm descends quite as far as in health, it rises much less during expiration, in this case only about half as far as in health. The ventricles are lower and nearer the median line than in health, and the right auricle is larger. The patient was a man, aged 57, in whom the signs of emphysema by auscultation and percussion were not well marked.

Some cases of harmful effects from x-ray examinations have been reported, but there is no danger to be apprehended from the proper use of the x rays; in the more than 500 patients which I have examined at the Boston City Hospital and at my office during the past eighteen months not the slightest harm or inconvenience has resulted. The tube should not be too near.

In closing allow me to direct your attention especially to the fact that in some instances we get our earliest evidence of disease in the chest from the fluoroscope, while in others this instrument strengthens and supplements the observations obtained by auscultation and percussion. I have had patients brought to me in whose chests auscultation and percussion showed only slight signs of tuberculosis at the apex of one lung, whereas the fluoroscope showed that one-half of this lung was involved, and that the other, in which no physical signs were present, was also diseased; and still other cases where the first indication of an abnormal condition of either lung was detected by the fluoroscope. In some patients with obscure thoracic disease brought to me in consultation I have been able to make a certain diagnosis by means of the fluoroscope only.

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