METHODS EMPLOYED IN THE X-RAY DEPARTMENT OF A MILITARY HOSPITAL, WITH A FEW NOTES ON ONE OR TWO CASES OF INTEREST, AND ON THE TREATMENT OF TRENCH FOOT ADOPTED THERE.

By RUSSELL J. REYNOLDS, M.B., B.S.

Medical Officer in Charge of the X-ray, Electrical and Massage Departments of a Military Hospital.

It is impossible to give anything like an adequate résumé of the work undertaken in the X-ray department of a military hospital in a short article, owing to the very wide field covered, both the medical and surgical sides claiming attention.

A fair proportion of cases are from the medical side, many from the wards devoted to pulmonary tuberculosis. Of the chest cases one may mention, tubercular infections, bronchiectasis, peribronchial fibrosis, silicosis, affections of the pleura, etc., also certain heart and alimentary conditions, require examination, and occasionally cases come for treatment by the rays.

As it is impossible to enter into these at all here, I will confine my remarks to a few special points of interest among the surgical cases, and I propose to give the methods of localization which we employ, and the class of case to which each method is most suitable, together with a few remarks on the value of stereoscopic radiography.

It is necessary to state that practically all the work is carried out by the use of a couch where the X-ray tube is placed below the patient under the couch, as this method lends itself better for screening and localizing than where the tube is placed above the patient, and it is equally good for obtaining a radiograph.

The upright tube stand is only employed where it is impossible to obtain the result with the patient lying down, for example, in examining a stomach after a bismuth meal.

Localization.

In order to obtain accurate localization of an object, it is necessary to be sure that the X-ray tube is correctly centred so that the position of the central ray is known, and to ensure that this shall pass vertically through the object to be localized.

Couches are therefore made with a tube box underneath running on a carrier having both a longitudinal and transverse movement in relation to the couch, and in order to enable one to fix the position of the central ray many devices are used.

The most simple and satisfactory in working is as follows: an upright arm is rigidly fixed to the tube box carrier and moves with it; this runs up by the side of the couch and carries a horizontal arm adjustable in height, and hinged so that it can be put out of the way; the horizontal arm is slightly adjustable in length and has cross wires fixed at the end which can be placed vertically over the anticathode of the tube, i.e., in a line with the central ray.

Localization by Method of Right-angle Planes.—In many cases of fracture or where a foreign body is present in a limb, after a preliminary screening of the part, it is frequently only necessary to take two photographs at right angles to enable the surgeon to judge of the condition. When the fracture is much comminuted, or when it is compound and comminuted, it is often of greater assistance if a stereoscopic radiograph is obtained, as it is easier to judge of the position of the fragments.

Localization by a Screening Method.—Sometimes where a foreign body is present in the limb, e.g., a small piece of shrapnel or bullet casing, it is localized either by the method of right angle planes mentioned above, or by some screening method. In the one I generally employ, a lead pointer is placed over the shadow of the foreign body when the central ray is vertically below, and the skin is marked on the spot, the depth then being obtained by placing the pointer on the skin at the side of the limb *opposite* the shadow of the foreign body, and shifting it vertically until the shadows of the foreign body and the pointer move together on the X-ray tube being moved under the part examined.

Localization by a Calculating Method.—In dealing with cases of fracture or gunshot wounds where localization is necessary in such situations as the chest, abdomen and pelvis, the methods mentioned above are seldom applicable, owing to the difficulty of obtaining radiographs in these regions at right angles to each other. It is then that one has to resort to a method where calculation is employed. I prefer the Mackenzie Davidson method, as it is quick, simple in working and accurate.

If the foreign body is in a position to be easily extracted, and in cases where it is unnecessary to obtain a stereoscopic radiograph, one plate only need be used. Screen examination is made and the rays centred, a mark is placed on the skin over the shadow of the body, the X-ray tube is then moved three centimetres in one direction and the first exposure is made, the plate is left in position and the tube moved six centimetres in the opposite direction and the second exposure made; in this way a double image of the foreign body is obtained on the one plate. It will be seen that the central

ray has shifted six centimetres between the two exposures, three centimetres each side of the vertical line. The depth of the foreign body from the mark on the skin is then very quickly found by measuring the distance between a corresponding point on the two shadows and by applying the following formula :—

$$h = \frac{a}{a + b} \times H$$

Where a = foreign body shift.
b = tube shift.
h = depth required.
H = distance of plate from anticathode.

Localization by a Method of Calculation combined with Stereoscopy.—In more complicated cases it is sometimes necessary to combine a calculating method with stereoscopy, as it enables one to form a mental picture of the position and direction of the body when viewing the negatives in the stereoscope. Stereoscopy cannot in any way take the place of accurate localization, but it forms a valuable adjunct to it.

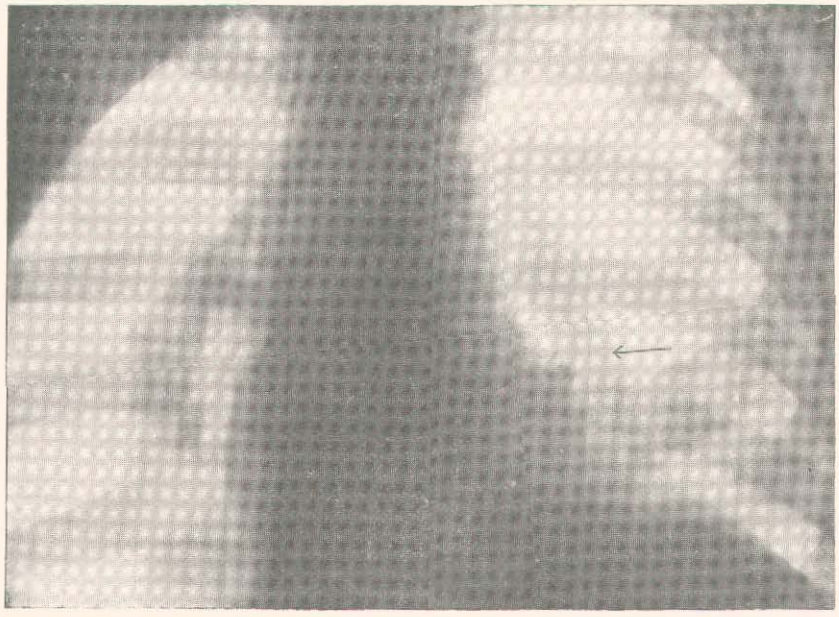
The method adopted in obtaining a stereoscopic radiograph is very similar to that described above, with a notable exception that each exposure is made on a separate plate and the position of the central ray is recorded by means of cross wires. This is accomplished by fixing a plate-holder over the part to be examined with cross wires attached to its under surface, and each plate is placed in the holder in turn; the essential point being that the position of the cross wires must be fixed in relation to the patient.

It may be of interest to give a case which illustrates the value of this method.

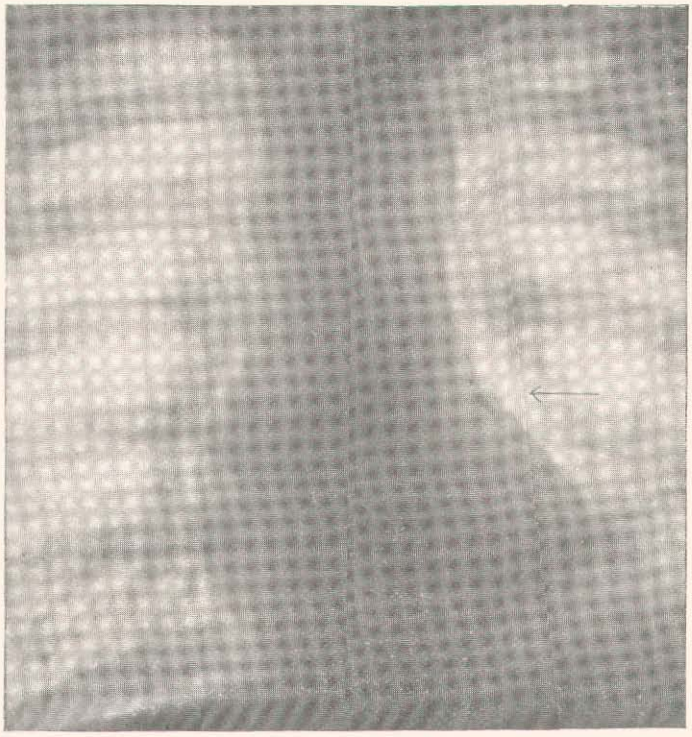
Case 1.—A man was admitted suffering from paraplegia extending from the lumbar region, and had an entrance wound to the left side of the middle line opposite the second lumbar vertebra (see figs. 1 and 2). Diagnosis was made of pressure on or severance of the spinal cord. The man was examined by the rays and a piece of shrapnel was seen to be lying either in, or on, the left side of the second lumbar vertebra and measuring about 1½ by 1 centimetre. On calculating out the depth one found it to be 5·3 centimetres in from the mark on the skin, but it was impossible to see its *exact* position; on examining the plates in the stereoscope, however, one could clearly see that the piece was lying deep to the vertebral arch yet superficial to the body. One could not say with certainty whether it was dorsal or ventral to the spinal cord itself; as there seemed to be signs of returning power to the patient's sphincters, it was thought that the man's symptoms might be caused by

pressure on the cord which could be relieved by an operation and it was hoped that the cord might not be severed. It was therefore decided to operate. Mr. E. Gillespie performed a laminectomy and it was found that the shrapnel had penetrated the pedicle and carried a fragment of bone through the cord. The piece of shrapnel was lying just embedded in the body of the second lumbar vertebra; it was not taken out as no good object could have been attained. The patient was suffering from cystitis and subsequently developed pyelitis from which he died. It will be seen how essential the use of the stereoscope is in such cases, but it also points out its limitations, in that one is not able to locate the foreign body by a visual method with absolute accuracy.

Case 2 (figs. 1 and 2).—A case which perhaps deserves to be mentioned is that of a man who had two small pieces of shrapnel in the wall of the heart without causing him any inconvenience. This man, a New Zealander, was wounded in August, 1915, he had a portion of his fractured third rib removed. He was then transferred to England. It is necessary here to give a few of the surgeon's notes on the case. "On admission his general condition was decidedly poor, there was considerable pain in his left shoulder joint, obviously reflex in origin, there was a large scar extending more or less horizontally across the precordial lesion one inch above the left nipple, and about five inches long, with a discharging sinus in the centre." The patient was sent up to be examined under the rays, and on screening his chest it was seen that he had two small pieces of metal (probably fragments of shrapnel) which appeared to be embedded in the wall of his heart. The radiograph was taken with as short an exposure as was possible at the time (three seconds) and a blurred image of the shrapnel was obtained. I then radiographed the heart from different angles, and on examining the resulting negatives the shrapnel appeared in each case to be within the shadow of the heart. It was agreed that this did not account for the man's general condition. He was then opened up by the surgeon and the underlying tissues explored. The origin of the sinus was found to be the necrosing cartilage of the third rib, which was removed. No deeper communication could be found. The wound was sewn up and completely healed in a fortnight. The man's general condition improved rapidly and his pain entirely disappeared. After he had recovered I took a further radiograph of his chest instantaneously (about one-tenth of a second) and so was able to see the pieces of metal sharply defined. The point to which I want to draw attention is that although by the instantaneous

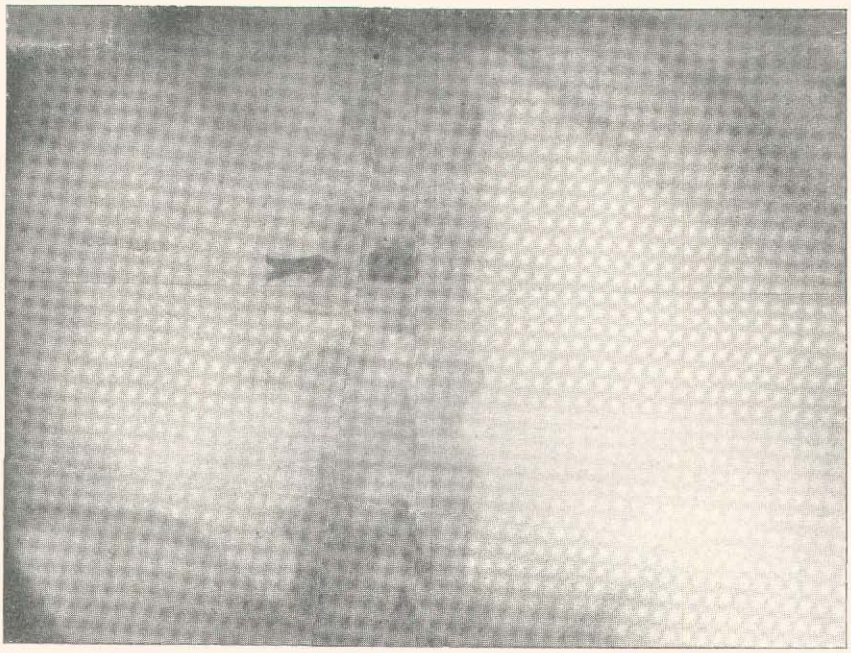


CASE 2. Fig. 1.—Exposure 3 seconds.

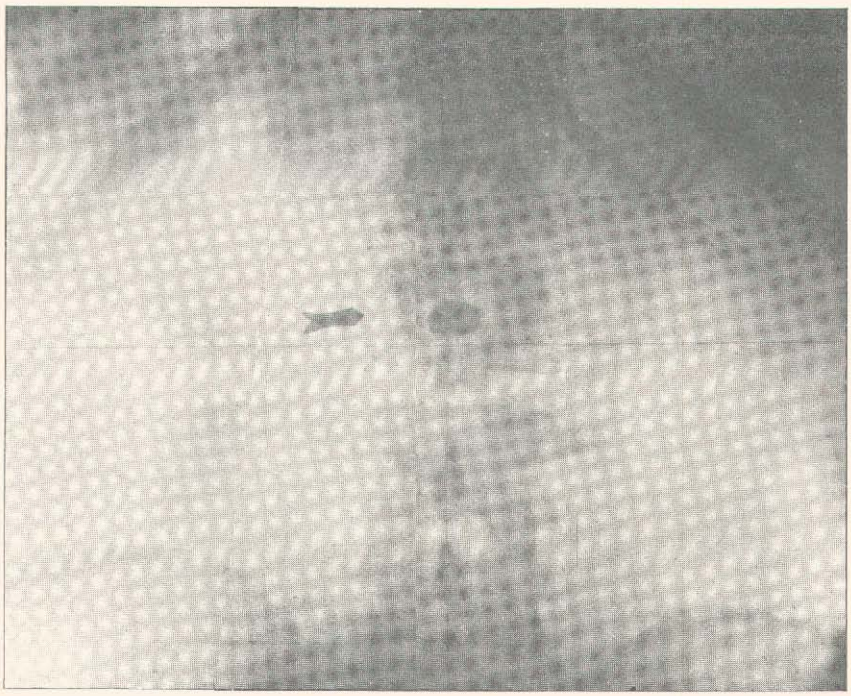


CASE 2. Fig. 2.—Exposure $\frac{1}{10}$ second.

To illustrate "Methods employed in the X-Ray Department of a Military Hospital, with a few notes on one or two Cases of Interest, and on the Treatment of Trench Foot adopted there," by RUSSELL J. REYNOLDS, M.B., B.S.



CASE 1. Fig. 1.—Stereoscopic View (Left).



CASE 1. Fig 2.—Stereoscopic View (Right).

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method a clearer image was obtained, yet *without* the time exposure it would have been difficult to diagnose these pieces as being in the ventricular wall, as the blurred image clearly shows the extent and direction of the movement.

The foregoing case affords a very good illustration of a condition which is occasionally met with when it is exceedingly difficult to localize with any accuracy the position of a foreign body. The heart being a continually moving organ, any localization attempted by calculating methods could only be very approximate, and, to obtain a good stereoscopic effect, it would be necessary to take radiographs instantaneously in the same phase of its best.

In conclusion, one may say that experience teaches that no one particular method of localization is applicable to every case, and each case must be dealt with according to its merits.

Telephone Probe.—As an accessory instrument I should like to mention Sir James Mackenzie Davidson's Telephone Bullet Detector. This has proved very valuable on occasions by definitely fixing the position of metallic foreign bodies at the time of the operation. There are two classes of case which mainly call for its use.

(*a*) Where the shrapnel lies embedded in some thick mass of tissue, such as the buttock, where directly the surgeon makes an incision his landmarks are lost owing to the mobility of the part. Here if a sharp probe is inserted to the required depth, and the foreign body hit upon, it becomes an easier matter for the surgeon to extract it.

(*b*) Where a *small* piece of metal is embedded in the tissue, it is exceeding difficult for the surgeon to feel it, even although he may be actually holding it in the fingers. Instances such as these are continually occurring. When the muscle is explored by the needle attached to the instrument, the characteristic sound will be heard in the telephone when the metal is touched.

A modification of the ordinary method suggests itself of adapting three separate probes to the one pole of the instrument, each of which is inserted in the tissues from a different angle in seeking the foreign body, and these can then be held in position by light clips attached to a central support. It is just worth while to mention that a sharp probe cannot be employed with safety in a region where large blood vessels exist.

Treatment of Trench Foot.

So much has been written on the subject of trench foot recently that it seems unnecessary to describe the condition here in detail.

It certainly differs from so-called "frost-bite" in many important details. The essential factors which set up the condition seem to be that the patient remains in a wet sodden situation for a considerable period with his feet kept constantly wet, the temperature being at the time low, but not necessarily down to freezing point. The cardinal symptoms presented are pain in the foot and swelling, often with discoloration of the skin, occasional numbness and tingling. Sometimes, however, the feet exhibit hyperæsthesia. They are nearly always cold to the touch, and in severe cases ulceration has occurred, and even portions of the tissues may have separated, a gangrenous condition having set in.

Treatment.—Many forms of treatment have been suggested and carried out. So encouraging have been the results obtained here by the use of Dowsing heat baths, combined with massage, that at present all our cases are treated in this way. Where there is an ulcerated surface or open wound, the part is *well* protected with fire-proof lint sheets, and the heat applied gradually. This applies also to cases where the part is anæsthetic, as blistering of the skin may be set up very easily. Where the foot is hypersensitive, very gentle effleurage is undertaken at first, or this may even be postponed for a week or so. In an average case the Dowsing heat baths are given daily for twenty minutes, the foot in all cases being surrounded by two layers of lint sheeting. The massage is commenced after this and continued for ten minutes; effleurage with friction movements and foot rolling are given. As the condition improves, and the part becomes less sensitive, more stimulating movements are adopted. The average length of a course is about three weeks. Of these cases we have treated about fifty-five per cent have recovered sufficiently in this time to omit treatment, the feet appearing normal, and the patients are free from pain and able to walk well.

It is very important to insist upon the patient keeping his feet up and resting them during the earlier stages of the treatment. It seems preferable to let them use their feet in moderation as soon as they are free from pain and the swelling has subsided, even though they may still complain of a burning sensation and some pain in the night, as by so doing the circulation is stimulated; if, however, they are on their feet too much progress towards recovery is retarded and the pain and swelling may return.

I wish to thank Major McDowell, C.M.G., R.A.M.C., for permission to publish the cases mentioned in this article.