joint, but this became septic, and the onset of septicæmic symptoms necessitated amputation through the middle of the thigh. This was carried out on Sept. 24th. There was considerable shock from the operation. His temperature gradually fell until the 29th, when it rose again, and pain was complained of in the left hip. His pulse, which had from the first been rapid, did not improve. On Oct. 10th a large pyæmic abscess was opened in the region of the left hip. The pus contained *Staphylococcus aureus* and a short-chained streptococcus. Immediately after the opening of the abscess, transfusion was carried out, a brother (weighing 10 st.) being used as the donor. The flow was continued for 30 minutes, until the donor suddenly showed very obvious anæmic signs. He had felt symptoms coming on earlier, but in his endeavour to help his brother had not complained. The patient's colour and condition were much improved. This improvement continued for a week or so, but his temperature and pulse began again to rise, and he died from sepsis on Oct. 25th.

The hæmoglobin percentage before transfusion was 45.3, and 67.4 two hours after. It was estimated that the patient had received 1030 c.c. of blood.

Summary of Results.

On analysis of the 16 foregoing cases we find that 1 (Case 10) received no blood owing to an undetected obliteration of the receiving vein. In 3 (Cases 4, 7, and 14) the patients appeared beyond hope of recovery and transfusion was only undertaken as a last resort. Of the other 12 in which improvement might have been anticipated, 4 (Cases 2, 3, 11, and 15) made very rapid and satisfactory progress, which we could have no hesitation in attributing to the transfusion. These cases have recovered or are well on the way to recovery. In Case 9 recovery cannot be attributed to transfusion; he suffered from symptoms during the course of the flow suggestive of a "serum reaction."

The remaining 7 cases are dead, though hopes of their recovery were entertained. Of these cases 4 (Cases 1, 5, 12, and 16) showed decided improvement as the result of transfusion, but this, unfortunately, was not maintained. In 2 others (Cases 6 and 8) slight improvement took place, and in 1 (Case 13) death was probably accelerated by the transfusion. The fact that improvement took place even in most of the cases that died encourages us in the belief that under similar circumstances in future transfusion might just tide the patient over a critical period and allow time and opportunity for further surgical treatment.

As has already been mentioned, a "serum reaction" took place in 2 cases. No serious ill-effects followed in Case 9, but in Case 13 (in which death was probably certain in any case) the final event was hastened.

In addition to the cases mentioned above, there must now be a considerable number in which the method used by us has been tried by officers in our own and other areas. We have given the details only of those for which we are responsible. During the time one of us (A. F.) was doing temporary duty with one of the armies the opportunity was taken of discussing the method with officers of casualty clearing stations in that army. We append a letter from Captain John Fraser, working at one of these clearing stations, and also a communication from Lieutenant A. T. Edwards, working at a base hospital, which we think will help to encourage those who are interested in this subject.

Captain Fraser writes as follows:—

We have had two interesting and successful cases of blood transfusion done with your apparatus. Two officers were wounded by the same shell, both of them in the centre of the upper part of the thigh. Both of them arrived at the casualty clearing station profoundly blanched. One appeared to be dying—no pulse could be detected, and he was scarcely conscious. This case (Case A) was put under light anaesthesia and was found to have complete division of the superficial femoral artery and complete division of the deep femoral artery and vein. The superficial artery was sutured and the channel re-established. The completely divided vessels were ligatured. I transfused blood from the donor—a big Irishman—for 15 minutes, using liquid paraffin (B.P.) as a lubricant. During the whole procedure we had not the slightest hitch, and on removing the tubes at the end of the proceeding no clot was apparent. This officer is making an uninterrupted recovery.

The second officer (Case B) had complete division of the deep femoral artery and vein. No donor was forthcoming and I transfused him with two pints of normal saline. At the end of 18 hours his condition was much worse. The pulse had risen to 160 and his wounds were badly infected. A donor was now obtained and we transfused blood for 22½ minutes. Fifteen minutes after the commencement of the operation the stream was obviously becoming sluggish and I accordingly changed the tubes. Otherwise there was no hitch. Again I used liquid paraffin as a lubricant. This morning officer B has a pulse-rate of 106 and in every way is making an excellent recovery.

Lieutenant Edwards has forwarded notes of a case of secondary hæmorrhage from the kidney which he successfully treated by transfusion of blood, using the method described in this paper.

The patient was wounded in the left kidney by a piece of high-explosive shell on Nov. 25th, 1916. He had severe secondary hæmorrhage on Dec. 24th and was blanched. The affected kidney was removed, and transfusion was performed immediately after. The improvement in the patient's condition was dramatic, and he is now making a satisfactory recovery.

References.

1. Robertson: Brit. Med. Jour., 1916, ii., 38. Archibald: THE LANCET, 1916, ii., 429. Journal of R.A.M.C., November, 1916, xxvii., 636. Primrose and Rutherford: Brit. Med. Jour., 1916, ii., 384.
2. That American authors are not quoted is due to the difficulty of access at present to their extensive literature and not to any lack of appreciation of their work. A full list of the less recent literature on this subject is given by Ingebrigsten, Nordiskt Med. Arkiv., Ab. 1, 1915.
3. Saxton Pope: Journal of Amer. Med. Assoc., 1913, lv., 1284.
4. Experiments not yet published carried out by one of us (H. C. B.) in conjunction with W. C. Quinby, of Boston, U.S.A.
5. All the instruments described may be obtained from Messrs. Down Bros., St. Thomas's-street, London, S.E. They have also been supplied to the Army Base Medical Stores.
6. Robertson, loc. cit.

FRAGMENT OF SHELL EMBEDDED IN THE INTERNAL POPLITEAL NERVE:

ILLUSTRATING THE VALUE OF ACCURATE LOCALISATION.

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THE patient was a second lieutenant, aged 22, who had been hit by two small pieces of shell in the back of the left knee and the back of the left thigh. The wounds healed rapidly without trouble, and there was no sepsis. He was invalided home to the Cliff Military Hospital at Felixstowe. When he began to get about there was acute pain down the inner side of the left leg and foot in the distribution of the left internal popliteal nerve, especially in walking, while any movement of the knee-joint or pressure upon the popliteal space brought on acute spasmodic pain in the nerve. Examination showed a small scar in the popliteal space, and deep pressure at this spot produced acute pain in the nerve; X ray photographs showed a minute fragment of shell deep in the popliteal space. He was then transferred to King Edward VII. Hospital for Officers.

The fragment was localised by Sir James Mackenzie Davidson in the following manner.

The patient was laid prone on the X ray couch, with his toes pointing downwards over the couch-end (Fig. 1). The position was maintained by means of sandbags placed on either side of the leg to be examined. A very small scar on the skin of the popliteal space denoted the point of entrance of the minute fragment of shell which had to be localised, and the cross wires being laid on the part in the usual way their intersection was made to correspond with this scar. Two plates were then exposed, the tube being displaced by 6 cm. for the second exposure, and the localisation worked out with the cross-thread localiser. With the limb in this position the particle of shell was found to be situated at a depth of 30 mm. below the skin of the popliteal space and a mark was placed on the skin by means of nitrate of silver to indicate the point, which was vertically above the position of the foreign body. While the conditions still remained rigid a horizontal line was traced, also with nitrate of silver, along the outer side of the leg by means of a small gauge. This line was parallel with the surface of the couch at a uniform distance of 72 mm. above it and with such an indicator it was possible for the limb to be replaced on the operating table in exactly the same position as it had occupied when the X ray pictures were taken. The surgeon could be sure, therefore, that the conditions under which the localisation was made were exactly reproduced, and that the minute particle of metal was still in a vertical line at the given depth below the marked spot on

FIG. 1.

To be viewed in a small stereoscope. The leg in position on the X ray couch. The plumb-bob points to the marked spot on the skin, vertically below which, at a depth of 30 mm., the foreign body was known to be lying. This view also shows, on the sandbag, the special director which was used during the operation in order to keep the position after the original mark had been displaced owing to the incision. The surface gauge is also shown at the end of the black line traced by it along the outer side of the leg.

the skin. As a further precaution the special indicator (already described and illustrated),¹ the purpose of which is to enable the surgeon to refer back to a previously ascertained position after the displacement of the skin mark on operation, was brought into use, so that at any moment after incision the exact direction and position of the foreign body could still be made out.

The operation was performed on Jan. 1st, 1917, by Mr. Lockhart-Mummery, assisted by Captain W. B. Ainger, R.A.M.C., Sir Mackenzie Davidson being present. The patient was put in the prone position, and an incision was made longitudinally over the spot indicated by Sir Mackenzie Davidson. This incision was deepened for about 1½ inches, great care being taken after displacing structures to return them accurately to the plane in which the fragment had been localised. The fragment, which was very small, was

FIG. 2.

X ray photograph, taken antero-posteriorly, and showing the cross wires and small foreign body.

reached quite easily, thanks to the accurate localisation, and was found to be embedded in the popliteal vein, one edge of it pressing upon the nerve. The telephone probe was used to verify the foreign body, which was then seized with forceps and drawn out. This resulted in a sudden gush of blood from the popliteal vein through the hole made by the removal of the foreign body which was forming part of the wall. The bleeding was stopped by pressure. In the meantime the wound was sewn up and pressure applied with a wad and bandages. No attempt was made to close the opening in the vein, and no subsequent bleeding occurred. The wound healed quite satisfactorily by primary union. The foreign body proved to be a fragment of shell about the size of the head of a wax vesta.

This case demonstrates not only the importance of precision in the preliminary localisation but also the necessity of ensuring that the part to be operated on is placed in exactly the same position on the operating table as it occupied for the X ray localisation. It would scarcely have been possible to find a small and deeply embedded foreign body

such as was concerned in this case had not the surgeon been able to dissect carefully down upon the spot where it was known to be lying. A vague search for such a foreign body could hardly have ended in anything but disappointment, and quite possibly would have been disastrous.

The two plates which furnished the data for this localisation were reduced and mounted as a stereoscopic transparency, and when viewed in a small lenticular stereoscope gave the surgeon a distinct picture in relief. The relative position of the cross wires

on the skin and the depth of the foreign body and its relation to the femur were clearly shown, and the surgeon thus had all the necessary information, both the exact measurements and the stereoscopic view, ready to his hand.

FIG. 3.

X ray photograph, taken laterally, and showing two small foreign bodies, lead wires being placed on the scars at the point of entrance. The one nearer to the knee-joint is that which was removed.

¹ Surgical Director for Assisting in the Extraction of Localised Foreign Bodies, THE LANCET, 1916, ii., 608.