ON THE EXTRACTION OF FOREIGN BODIES.

BY

J. R. CALDWELL, CAPTAIN R.A.M.C.

SINCE the commencement of the present war the number of so-called new methods of localizing foreign bodies lodged in the tissues of the human frame has been enormous. Obviously such an expenditure of energy in the planning of these was a response to some weakness in those systems in existence previous to the present struggle. The localization of projectiles has in these days been forced into a position of prominence under the pressure of work entailed in the examination of large numbers of wounded men. Of paramount importance in work of this nature is the question of speed. Complex work entailing the taking of several radiographs, or involving the use of complicated measuring instruments, must go by the board. Simplicity is an essential, as work may have to be done under the most adverse conditions, and any ordinary apparatus should be sufficient at a pinch with which to do good work. Many methods have been evolved; indeed, there is scarcely a radiographer of experience who has not thought out for himself a method of localization, and yet on the operating table vexing failures may occur. It matters not what method is employed, complex or simple, when it comes to the actual extraction of projectiles from the tissues and from accessible situations defeat is still a possible termination of a search.

The rock bottom principle of localization is practically the same in all systems; the main difference lies in the mode of application. Diagram I represents, say, a section

Fig. 1.—Scheme of general arrangement (see text).

of a patient lying on a couch. The x-ray tube is in position under the table, while above is the screen. The essential of localization resolves itself into a geometrical calculation—we know the distance of the anticathode of the tube from the surface of the patient's body. We shift the position of the tube a known distance, and we note the apparent distance traversed by the foreign body on the screen. Given these three measurements, it is obvious that the extent of the movement of the shadow on the screen will depend absolutely on the depth of the foreign body. The nearer the projectile is to the screen the less will be its apparent movement. As has been said, the modifications in the method of application are innumerable. Most of those of recent introduction make for greater speed, but the fundamental principle underlying is the same in all. The radiographer fancies his duty finished when he is able to state that below a certain mark on the patient's skin, at a certain depth will be found the foreign

body in question. The value of such information has been overrated. Undoubtedly when the surgeon has hunted down a foreign body, he may verify his radiographer's findings to a millimetre, yet, before the commencement of the operation, the information given could at the most give the slenderest help as to the anatomical situation of the foreign body. The unknown variations in thickness of the tissues overlying the muscles, and in the muscles themselves, and moreover the variation brought about by the inflammatory reaction around the new body, render the most accurate localization of but the slightest assistance. It has been suggested that an atlas of frozen transverse sections of the human trunk and limbs might provide information on which to base the data supplied by the radiographer, and so to furnish us with the ideal and anatomical localization, but the sources of error are most obvious, and render this but of little help. Another important source of error in the extraction of projectiles is the difficulty of repeating exactly on the operating table the conditions which obtained when the localization was made. The surgeon is told that vertically below a certain mark on the skin at a certain depth he will find the foreign body in question. It is at once obvious that the slightest change in position of the patient may produce a deviation from the vertical path and so lead astray. Open to criticism also is the custom of marking the skin, as, after the preliminary toilet, there may be little left of the guiding point. Moreover, when the case is a multiple one and the surgeon is faced with the removal of perhaps half a dozen pieces of shell, his difficulties are enormously magnified. An anatomical localization, then, seems an almost unattainable ideal, as, unfortunately, stereography, which is the nearest approach we can have to this, is often erroneous and misleading. Moreover, the taking and developing of two plates takes time, and the help of these should only be employed as accessory in the extraction of projectiles from very difficult and dangerous situations.

To have speed in this class of work we must approach the subject from a somewhat different point of view. Why should we still grope in the dark when we can so readily work in the light? In war work the operating table and the x-ray table should be combined. The operating theatre and the x-ray room must be in one as the x-ray theatre.

During the past few months, as surgeon radiographer for two Calais hospitals, one French and one Belgian, I have been permitted to treat on the x-ray operating table over 350 cases involving the removal of foreign bodies from the tissues. Shell, shrapnel, bullet, and hand grenade have been removed with a facility and speed which grew with experience, but in no case from the very first in which an attempt was made has a failure been recorded. Moreover, many of these were multiple (as many as thirteen pieces of shell have been removed from one patient), and many were old and healed and showed the scars of previous fruitless search. The beginning was necessarily small and the technique now employed was evolved step by step, difficulties being met as they arose, until ultimately practically all cases of foreign bodies became the property of the x-ray theatre.

The apparatus employed is of the simplest description and was supplied by Mr. A. Dean, of London. The table is of the ordinary type with a large tube box underneath giving transverse and longitudinal movements. The top used for operations is of thin well-polished wood, and an extension in the form of a flap is attached to one end to accommodate the patient when dealing with the lower limbs. The high tension wires approach the tube box from the opposite end that operations may be performed from both sides of the table.

A troublesome question was the lighting of the theatre, as the strong light necessary for dissections interferes with that visual acuity so essential in x-ray work. The difficulty has been met by using an old automobile head-light above the table. With a powerful condenser this concentrates the light only on the field of operation, while the remainder of the room is in comparative darkness. A blue glass in the lamp still further improves the light for x-ray purposes, and does not strain or tire the eyes, while still giving sufficient light for minute dissection.

It is rarely necessary for the anaesthetic to be administered for any lengthy period in the dark, but in the

event of such a necessity arising the anaesthetist is equipped with a small pocket lamp also giving a blue light. This permits him to examine his patient without interfering with the screening.

The protection of the surgeon from the harmful effects of the x ray is of the utmost importance. The tube box is entirely encased in lead 3 mm. thick with the exception of the opening above for the passage of the acting rays. Additional protection is afforded by the use of a leaden screen of ample dimensions, and of the same thickness as that covering the tube box. This should be hung on to the front of the table, between the box and the operator, and should be freely movable along the length of the table, and easily detachable to give ready access to the tube. Operations are always performed with the smallest diaphragm possible, and hence it becomes feasible, with care, to keep the hands out of the direct line of fire, but to afford still further protection lead plates 3 mm. in thickness and with circular openings in the centre varying in diameter from 1 in. to 4 in. are used. These serve to cut off stray rays, and being readily sterilizable can be laid in the field of operation in a manner which will be described later. Long slightly curved Spencer Wells forceps are used in extraction, the curve involving the handle only, forceps which have a rectangular bend being more difficult of control. It is usual here for two pairs of gloves to be worn during an operation on the x -ray table, an outer thick pair such as are worn by housemaids, and an inner thin pair of the ordinary type. The outer pair can be removed on the completion of the actual extraction, or to permit of delicate work.

Each case on admission is subjected to a preliminary radioscopical examination, and if a foreign body is present its position is determined roughly by parallax. Advantage is taken of any neighbouring bony structure, the position of which is fixed and known, and the relative rates of apparent movement of the bone and the projectile on shifting the source of illumination are studied with the help of the screen. A brief glance at Fig. 2 will show

Fig. 2.—The diagram represents, say, a section of a thigh with two foreign bodies, one, A, in the same lateral plane as the bone, the other, B, anterior to it. Two screens, for the sake of simplicity, are shown. On moving the tube from C to D the foreign body A apparently moves the same distance as the bone ($x-x'=y-y'$) (screen 1). The foreign body B makes a smaller apparent movement ($x-x' < y-y'$) (screen 2).

that if a foreign body is in the same lateral plane as the shaft of some long bone, its rate of apparent movement upon shifting the source of illumination will be similar to that of the bone. A foreign body anterior to the bone will move less, and when under the skin will scarcely move at all. On the other hand, when the projectile is situated in a plane posterior to that of the bone the conditions are the opposite of those just described. At this preliminary examination one determines the site of the skin incision

and also the most suitable position for the patient at the actual operation. When it is possible to cut vertically down on the foreign body—that is to say, when it can be approached by a route which is at right angles to the screen—there is no difficulty as a rule, and the operation is a matter of a few minutes, but such a method of approach is not always feasible, for on the x -ray operating table you cannot put your patient into all the positions permissible on the ordinary table. In operating, for example, on the upper and outer aspect of the thigh, the patient must lie on his back or face in order that the opposite thigh may not come in the way and interfere with the screen. If a bullet were situated in such a position, the procedure of turning the patient on his side is impossible, as the screen could not for obvious reasons be employed. In such a case the patient must be placed on his back, and the forceps must approach the foreign body in a plane parallel to that of the screen. How, then, are we to find the most suitable site for the incision in this type of case? The method I adopt is that of prodding the part from above downwards in a plane parallel to that of the screen. When the point of maximum excursion of the foreign body is reached, this is noted and used as the site for the incision (if not forbidden for anatomical reasons). The method, though apparently somewhat rough, is very accurate, and a little experience will soon indicate the types of cases to which it is applicable; but, briefly, they are the lateral aspects of the trunk and neck, the axilla, and the upper parts of the thigh. In the great majority of cases no further localization is necessary, but in dangerous situations stereographs are useful accessories. Methods giving detailed measurements are never employed here.

At the operation the care of the apparatus and switch turning is in the hands of a trained orderly, while the screen is in charge of a second. The patient is anaesthetized, and the part is prepared in the usual fashion. The sterilization of the skin should be wide, and when one of the extremities is involved the entire circumference should be made ready. Mackintosh sheeting should not be used, as it is too opaque, but the table should be covered with thin jaconet. The towels are then applied, and over the now cleansed and prepared area is laid the screen towel. This is of sufficient size to cover completely the under surface of the screen with a margin all round of about 2 inches. The screen orderly pushes the tube box into the vicinity of the part involved and lays the screen on the towel. This is now clipped all round and securely fastened on with Diffenbach's bulldog forceps. When the screen is laid on the part the rays are turned on and the lights off and the foreign body is located. The tube box is manipulated by the orderly until the projectile is in the centre of the illuminated field, using always the smallest diaphragm possible. Over the apparent position of the foreign body on the skin the point of a pair of long forceps is now laid and the lights are turned on. The incision is made as near to this point as possible and the skin, superficial and deep fasciae are divided. One of the sterilized lead plates, previously described, is placed over the part, the circular opening surrounding the incision, and keeping the hands in the shadow of the plate under the rays, closed forceps are pushed down on the projectile. This is grasped, but, before extracting, the light is turned on and, if the case be a septic one, the track is well opened up to facilitate drainage and, above all, to permit of the removal of "wardrobe." Should, however, the part affected contain delicate structures, the operation should merely be controlled and guided by occasional reference to the screen. Where it is not possible to cut vertically down on the foreign body, but where we are forced to approach it in a plane parallel to the screen, or nearly so, the sterile lead shield is placed on the table and under the part in such a way as to direct the pencil of almost parallel rays on to the foreign body. The prodding manoeuvre is now repeated, the site of the incision determined and made as before. When the forceps have been introduced it is very useful to make a slight movement of the tube and to note the relative rates of apparent movement of the foreign body and the forceps point. The information to be gleaned from this simple manoeuvre is often very helpful, and is explained by reference to Fig. 2, if in imagination we substitute for the bone a forceps point.

The removal of foreign bodies in septic cases greatly

promotes healing, for it is usually possible at the same time to take away fragments of cloth, which are such a potent cause of prolonged suppuration. The adoption of such a method as that described makes for such speed and such certainty of success that the more routine removal of all projectiles of any size should be the rule. Moreover, the man in the trenches can never understand that a piece of shell left in his leg is anything but an unmixed evil.

Thus he ponders, he worries, and ultimately its presence becomes a source of irritation to him. It may cause him real pain, or it may be imaginary or assumed, but in any case it interferes with the proper discharge of his duties. Unless there are contraindicating factors present, the rule should be to remove all foreign bodies of any size from accessible situations, and as soon as possible after the infliction of the wound.

OPEN-AIR TREATMENT FOR WOUNDS.

A SIMPLE AND INEXPENSIVE FORM OF OPEN-AIR WARD, AS USED AT THE V.A.D. HOSPITAL, HENLEY-IN-ARDEN.

BY

W. ERNEST NELSON, M.A.CANTAB., M.R.C.S., L.R.C.P.,
MEDICAL DIRECTOR, WARWICKSHIRE BRANCH, BRITISH RED CROSS SOCIETY.

DURING the present war open-air treatment has played a large part in the cure of wounded soldiers, and any medical man who has had charge of wounded knows what excellent results can be obtained by this method, especially in the more serious kinds of suppurating wounds and in cases of general infection.

I submit this short account of an open-air ward because I think it may be of interest to your readers and also because it has one or two features which may specially commend it.

The ward was built for use at the V.A.D. Hospital, Henley-in-Arden, of which hospital I am Commandant and Medical Officer, and is specially adapted for such hospitals, as it has the merit of being cheap and at the same time efficient.

This particular ward has accommodation for eight beds, though I have had as many as nine beds in it at one time, but buildings can be constructed on these lines to take two or three beds, or twenty or thirty.

The chief features which I claim for this particular form of building are as follows:

1. It is open to the air on both sides, the ends only being closed in. Most open-air wards that I have seen are closed in on three sides. The protecting screens, at the back of the bed-heads, seen on the right hand side of the view of the interior, are 4 ft. high, and afford ample protection from draught. The left hand side is open down to the ground, except for an open balustrading. Thus there is a free current of air continually passing over the heads of the patients as they lie in bed, and yet they do not feel any draught.

2. The deep sloping eaves are set at such an angle that the rain cannot drive in, even on the most windy and rainy days. During the past month of July, in which we have not had a single day without rain and have had some of the most severe thunderstorms I have ever seen, the interior of this ward has always remained dry and the patients have suffered no inconvenience from wind or rain.

3. If it is desired to close in one side completely, this is done by a system of spare screens, which either fit into grooves provided or are hinged on to the already existing screens at the back of the beds, and are then thrown upwards and bolted to the wall plate or roof. In this way either side of the ward, or both, can be entirely or partially shut in.

4. It is easily built, the materials being wood and asbestos sheeting, the latter being cheaper than wood, besides having the additional merit of being fireproof. The roof is of match-boarding, covered with rubberoid. The floor is constructed of boards, tongued and grooved, so that no draught can come through. The whole structure is raised some twelve inches from the ground on small brick pillars; this allows a free current of air under the building, and at the same time does not kill the grass, should it be found necessary to erect such a building on a lawn or in a field.

5. It is quickly and easily erected. This particular building was put up complete in four days—ten days from the date of the order being given.

6. It is easily connected with the main building of the hospital by a covered way, so that nurses and patients can pass to and fro in any weather.

I shall be pleased to give further details to anyone interested in the subject, or these can be obtained direct from the architects, Messrs. Osborne,

Pemberton and White, 40, Bennetts Hill, Birmingham.

THE late Mr. Arthur Rich Saunders, M.B., of Victoria Park, Dover, formerly President of the Jamaica Medical Council and Board of Examination, left estate valued at £15,117.