routine adoption of the flush method we have had the good fortune to lose no case from secondary haemorrhage following amputation in this hospital. The only death in this hospital from secondary haemorrhage after amputation, during the last six months, occurred in a case operated on near the front by the flap method. Secondary haemorrhage occurred during transit and again after admission to this hospital.

6. The need for re-amputation for sepsis or haemorrhage may be expected at a time when the patient is unable to stand further operation, and often when there is no more limb available for an amputation.

Advantages of Flush Amputation.

The advantages of the flush method are:

1. Rapidity with minimum shock.
2. A plain open surface for dressing, which is favourable to the subsequent control of sepsis and which prevents pocketing.
3. Great diminution in the risk of secondary haemorrhage.
4. The operation provides the best mechanical relief of gas tension by dividing all the tissues at right angles to the muscle planes.
5. It allows a temporary amputation to be performed close to the site of injury, so that a permanent amputation can be performed later (when sepsis is under control) a little above the injured area.
6. In cases associated with fracture the proximal end of the bone can be, and should be, left intact (that is, not sawn through) and projecting beyond the plane of muscle section, thus minimizing the risks of osteomyelitis and also providing a useful medium (a) for the application of pressure by means of dressing in case of haemorrhage (a practical point of great value), (b) for moving and fixing the limb, (c) for the application of extension to the skin.

The flush circular method may be modified, according to circumstances, by a single skin flap cut from the damaged area and turned back, thus saving a few inches of bone in the final result, although this flap is liable to slough owing to anaerobic or streptococcal infection.

Amputations for Conditions other than Gas Gangrene.

In my experience amputations are seldom called for at the base hospitals for other conditions. Cases of fractured femur, unless they develop gas infection or severe streptococcal infection, are so well and so thoroughly treated that most of the limbs are saved. Useless mangled limbs, even though not "gas infected," are best treated by the flush method in the first instance, because by this method (owing to the nature of the sepsis) more limb is saved in the end. A few cases of dry gangrene are met with in which an orthodox amputation can be performed at the seat of election.

In field ambulances or casualty clearing stations conditions are somewhat different, and it may be, and often is, practicable to perform amputations with flaps for severely damaged limbs before the onset of sepsis, just as in civil practice. Even under these more favourable conditions the result may be vitiated by a hurried evacuation (as occurred in the case mentioned above). These remarks refer in the main to the lower extremity. Gas infection in the arm is not only less common but also less serious.

After-Treatment of Flush Amputation.

After-treatment of the flush amputation seems to give rise to trouble at home. In many instances at this hospital the amputations have been completed by a secondary operation, and in every case with satisfactory results. Unfortunately, we have been compelled to send most of the cases home after the primary amputation.

The secondary amputation should be done as soon as sepsis is under control and the general condition of the patient is favourable to further amputation, and before extensive cicatrization has occurred.

The details of the secondary amputation are important. If flaps are cut and muscle planes opened up, a "flare up" may be expected, but if the muscle attached to the bone is carefully separated from the periosteum by snipping with scissors until the amount of bone required to be removed has been bared, and if the bone is divided without lacerating the granulation tissue, the operation can be

done without any local or general reaction. Before dividing the bone, the handle of a Lane's bone elevator should be passed over the bone and the blade held upwards by an assistant. This serves to protect the soft parts from the saw and to steady the limb. The flexible metal of the fracture box can be used to serve the same purpose. The skin can be brought together without undercutting and need not necessarily be sutured at the time, although sutures should be inserted for tying later. Deep mattress sutures should be used and rubber tubing inserted beneath the loop and knot of the stitch to avoid sloughing of the skin from pressure. This stage is greatly facilitated if a single flap has been cut and turned back in the first instance. The periosteum should not be stripped back from the bone, otherwise new bone is thrown out in the muscles. During the interval between the first and second operation the skin should be kept stretched by means of an extension attached either to a weight and pulley or to the bone stump, if long enough, or to a Thomas's knee-splint. A big metal ring (18 in. diameter) may be used for the stirrup to facilitate dressing.

When the bone is left long and projecting beyond the divided muscles, troubles in the form of necrosis and intramuscular callus should not arise, troubles which have formed the basis of some complaints in the past. Some critics seem to imagine that the operation is performed (when the bone is cut short) as a permanent procedure, and that healing by granulation is to be awaited. This involves a very prolonged convalescence, and in all probability a painful stump with indifferently skin prone to ulceration. The second operation can and should be performed before any serious cicatricial contraction has occurred. In several instances this has been done here under gas and oxygen, and a completely healed and comfortable stump has been secured within a month of the original amputation.

Consultants to Consult.

A well-known surgeon, who has retired from practice, writing in the *Lancet* (August 7th, 1915) to criticize this operation, says: "It must be remembered that our younger surgeons at the front have not experience to guide them; they are largely guided by what they have read." Every surgical base has the advantage of the advice of a consulting surgeon (contemporaries, more or less, of our critic). Practically all the surgery is done by surgeons who in civil life are on the staff of one or other of the London or provincial hospitals. These surgeons are, in fact, not guided by what they have read, but by what they have seen out here, and should be far better judges (aided by the consultants) of the fitness of any procedure than those who base their opinions of conditions in France on what they read or even on what they see at home when the danger of death has been surmounted by the procedures they call in question.

THE AFTER-TREATMENT OF AMPUTATION STUMPS.

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In amputations performed for septic gunshot wounds it is usually necessary to leave the wound unsutured, and often a rapid operation has to be carried out with flaps insufficient to cover the end of the bone, which must be excised at a later date.

At the exhibition of fracture apparatus at the Royal Society of Medicine in October, 1915,¹ Sir George Makins showed a short Thomas's knee-splint for exerting traction on the soft parts of an amputation stump. I have been using recently a simple and easily-made arrangement which has the advantage of permitting the wound to be dressed without relaxation of the pull on the soft parts, a continual powerful extension of skin and muscles being kept up.

A ring of aluminium, having a diameter of eighteen inches, is made from a length of the splinting supplied in the regulation field fracture box. All round the amputation stump, from the joint above to about an inch from the edges of the wound, longitudinal strips of two-inch

adhesive strapping are applied; these strips are prolonged about twelve inches beyond the end of the stump and attached to the aluminium ring. The ring is then suspended by three pieces of cord, tied to it equidistant from one another, the cords passing through pulleys hooked to a

FIG. 1.—The extension apparatus applied to a stump after amputation through the upper third of the arm.

Balkan splint, to which an extra bar of wood has been bolted (Figs. 1 and 2).

The free ends of the cords are tied together and one or more weights are hooked on, at or near the point of junction, so adjusted that the tension on the three cords is approximately equal. For a thigh amputation a weight of about 8 lb. is used, and for the arm about 5 lb. suffices. For an amputation stump of the lower extremity, the foot of the bed is raised on blocks to provide counter-extension.

The wound is accessible for dressing through the open ring, the pull on the soft parts being kept up uninterruptedly.

The method is used as soon as the acute inflammation of the wound has subsided. If long flaps have been fashioned, they are pulled down by the appliance and their edges approximated. If it has not been possible to form

FIG. 2.—The extension apparatus applied to an amputation stump of the thigh.

long flaps the bone may not be covered, but the soft parts are kept from retraction until such time as a secondary removal of bone can be carried out.

When the wound is granulating and sufficiently healthy to permit of partial closure, the soft parts are dissected up from the bone, and the necessary amount of the latter is removed; in some cases the skin edges can be approximated by a few mattress sutures, free drainage being provided. The extension is then reapplied and kept up until the wound is completely healed.

If at the first operation it is possible to suture the amputation wound, it is advantageous to take the tension

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off the flaps in the way here described, and for the same purpose it may be of use for amputations in civil practice.

The appliance allows the patient free movement and encourages mobility of the joint above; if necessary, the position of the Balkan splint is moved from day to day for this purpose.

I have used the aluminium ring attached to a Thomas's splint, but the method of extension by weight and pulley gives more powerful and continuous traction than a fixed extension, it allows more movement in the joint above, it adjusts itself to the patient's movements in bed, and he is more comfortable and more easily nursed.

I wish to express my thanks to Lieutenant-Colonel T. McDermott, R.A.M.C., for permission to publish this note, and to Lieutenant C. H. Hopwood, R.A.M.C., for the photographs with which my description is illustrated.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, October 16th, 1915, p. 574.

A METHOD OF TREATING GUNSHOT FRACTURES BY AN EXTERNAL FIXATION APPARATUS.

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THE difficulty of maintaining the bones in good position in some cases of gunshot wound, in which large septic wounds were present, led me to devise this method.

My plan is by means of an aseptic operation to insert into the bone, at a distance from the seat of fracture, screws which are long enough to project well beyond the surface of the skin, and to immobilize the fragments by means of a rigid plate fixed to the screws by nuts, the whole operation being done without interfering with the original wound.

Since I have devised this operation I find that other methods of fixation by means of an external apparatus have been used, but can find no record of such an apparatus being used for the treatment of compound fractures. Parkhill, by means of an open operation, exposed the fractured ends of the bone, placed them in correct position, inserted long screws and fixed them in position by an apparatus external to the skin, afterwards closing the wound. Lambotte has described an apparatus for the treatment of simple fractures by means of a rigid bar external to the skin attached to four long screws inserted into the bone. In this case also the bones are placed in position by means of an open operation, and I can find no statement that he has used it in septic compound fractures. Further, the apparatus also is complicated and expensive.

Experience in all recent wars up to the present has taught that in cases of septic compound fractures the wound should in no case be explored, on account of the risk of the serious spread of infection. But in the present war some surgeons have plated these fractures, leaving the wounds freely open, with excellent results. This operation, I believe, however, is not recommended by the majority of surgeons, the results in many cases being unsatisfactory.

The apparatus which I have been using is shown in Fig. 1. It consists of a plate of the form indicated made

FIG. 1.—The apparatus used in the operation.

of sheet brass $\frac{1}{8}$ in. thick and plated with tin, four screws long enough when fixed in the bone to extend about $1\frac{1}{2}$ to 2 in. beyond the skin, and a pair of nuts for each screw by means of which the plate is fixed in position. The screws I have been using consist of a wood screw thread for screwing into the bone, attached by means of a collar to