movements carried out, and that their knees have become stiff.

Such were some of the ultimate results of cases which had healed by first intention, showed no signs of subsequent sepsis, and should have obtained good movable joints, before I instituted my present method of procedure. Of seven cases which healed by primary union after arthrotomy in October, 1917, the best results I have knowledge of are (1) 25 degrees of movement, (2) 10 to 15 degrees, (3) four-fifths of full mobility. The last is the only one of these seven who, apparently, has been returned to his *dépôt* for duty.

Advantages Claimed for this Procedure.

1. The movements, being so insidious, are nearly painless.
2. Painless movements do not set up reflex spasm.
3. Movements can be commenced early and prevent fixation due to intra-articular or extra-articular fibrosis.
4. Elimination of the danger of acute flare-up, as may happen when forcible movements are carried out under anaesthesia.
5. Where masseuses are not available, a nurse or intelligent orderly may carry out the treatment. A number of cases may be treated at the same time.
6. The patients are informed that the qualification for England is that their knees shall bend to a right angle. This encourages their best endeavours—a factor of incalculable value in all orthopaedic measures.
7. The apparatus is cheap and can be set up by any one mechanically inclined. The necessary material may be collected in almost any camp hospital on the lines of communication or at the base.

I have been tempted to adopt the principles outlined above to prevent stiffness of knees occurring during the treatment of fractured femurs. With the present-day methods we can, as a rule, obtain good alignment and little or no shortening. Fractures of the lower and middle third, however, are nearly always followed by limitation of knee movement, especially where the usual method of leg extension is adopted. The stiffness has in most cases an extra-articular source; it results from cicatrization of the traumatic and operation wounds, and is accentuated in cases where there is prolonged suppuration. Can we not prevent this stiffness of the knee from becoming established?

When acute sepsis has subsided, good alignment procured, and the fractured ends are becoming "sticky," I have tried this method of knee flexion with encouraging results. Firm support at the seat of fracture in addition to extension is imperative.

Example.—Pte. C., comminuted fracture of lower third of left femur, December 5th, 1917. Two days later I removed a large piece of high explosive, one loose fragment of bone, and applied bipp to the exposed muscles. On January 22nd, 1918, the bones were "sticky" and movements commenced. He was sent to England early in March with a range of movement from complete extension to considerably less than a right angle.

I am not equipped with a sufficient number of results to be able to state dogmatically that this method is advisable. However, the few cases I have treated encourage me to further trials.

It appears that early institution of movement after penetrating gunshot wounds of the knee may determine whether or not the wounded man will become fit again for military service. It seems justifiable to postpone evacuation to England for a week or two in order to adopt measures which yield prospects of at length getting men back to duty, or at any rate making them more fit for subsequent civil employment.

Since writing the above I have learnt that Willems has for some time advocated mobilization of knee-joints immediately after operation. He commences active movements from the very first, and claims an early return of full-range mobility in most cases, even where there is considerable bone injury. Not uncommonly there is an effusion of blood into the joint which checks progress; however, when this is drawn off, movements make good headway, and walking is usually possible in the second or third week. He is not deterred from carrying out active movements even in the presence of suppuration, holding that the movements express pus from the recesses of the joint through the incisions made for drainage.

Such treatment is somewhat revolutionary, but, after all, many of our pre-war ideas have had to undergo an upheaval equally dramatic.

Note by COLONEL FULLERTON, C.M.G., A.M.S.

The difficulties encountered in obtaining a freely movable joint in wounds of the knee and in fractures of the lower third of the thigh are notorious. Most massage operators are inclined to be too brusque in their endeavours to obtain joint movement.

Major Everidge has devised a plan by means of which a graduated range of movement may be calculated with almost mathematical precision. The insidious coaxing into function accomplished by his method prevents the painful spasm and the lighting up of infection which is so liable to accompany unmeasured attempts by even the gentlest manual manipulation. I have watched most of his cases with interest during the earliest periods of their convalescence, and I have been struck by the absence of febrile reaction and pain.

The method is scientific, and has proved successful in the cases I have been able to follow with him.

It is to be hoped that surgeons at home who see cases of injured knee-joint and fractured lower third of the femur will be encouraged by Major Everidge's success to persevere with this or similar methods, to avoid what has hitherto been somewhat of a reproach in war surgery.

SUGGESTIONS FOR THE TREATMENT OF SEPTIC WOUNDS.

BY

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THE following paper deals with the impressions derived from an analysis of a thousand cases which passed through the writer's hands at an auxiliary hospital. These cases were taken in rotation and not by selection. They were all in a more or less convalescent stage, having been treated at various hospitals, so that in the majority of cases many months had elapsed from the commencement of their illness to the time of their admission to the auxiliary hospital.

There was of necessity some finality in their symptoms as shown in a depreciation of their potential capacity as soldiers. The symptoms, too, were more or less dissipated and attenuated, and in this sense possessed a value of their own as enabling them to be more easily classified and their importance appreciated. The constant association of neurasthenia with other diseases, such as frost-bite, rheumatism, wounds, gas poisoning, tended to show how the ordinary symptoms of these diseases could be materially modified, and that chiefly in the direction of persistence and exaggeration.

The majority of cases of neurasthenia were sent as cases of "shell shock," but however much the symptoms may have approximated to those of shock in the initial stages, at the time they were admitted into our hospital they were undoubtedly neurasthenic, representing a condition of cerebral and spinal exhaustion. For instance, one case had a history of unconsciousness for some days following a bursting shell; another had a history of prolonged mental and physical strain in the trenches, yet in both these cases the symptoms were identical. In every case noted as neurasthenia there was some gross manifestation of the disease, though the cases of a milder degree not noted must have been manifold. Some symptoms which are generally regarded as casual or ordinary in the neurasthenia, traumatic or otherwise, met with in civil practice become dominant features in these shell-shock cases. Such, for instance, are tachycardia, stammering, tremors, which are far more in evidence in these cases.

In the 1,000 cases analysed, 75 were neurasthenic, while 505 were the subjects of wounds; of the latter, 249 suffered from disability owing to pain, limited movements, and deformity. Of these latter, all complicated with fracture were excluded. The disability was entirely due to scar defects. These scars were distinguished by their multiplicity in individual cases and by the large number that were adherent, irregular, and infiltrated. There was a marked contrast between the scars in these cases and the scars met with in the South African war, the proportion of cases producing disability being much larger. This

was not due to any fault in the treatment at the front, where, as every one knows, the arrangements are perfect, and the best surgical skill is everywhere available. It was due to the very early infection of these wounds, and the impossibility of applying appropriate treatment at the early stage.

The kinds of disability are classified according to their cause, pain, limited movements, and deformity. Pain may be divided in five categories:

1. Paroxysmal pains of neuralgia. These are distinct paroxysms, with intervals of freedom from pain. These pains are independent of movement.

2. Neuritis pains. These are more continuous, and there is tenderness along the course of the nerves. They generally occur in wounds infected at the outset or represent a transition stage from a traumatic neuralgia. Most of the head injuries, I consider, belong to this category.

3. Pain at the site of wound and caused by movement. These cases are generally associated with limitation of movement. The largest number of cases belong to this category.

4. Deformities occurring as the result of adherent and contracting scars. For instance, talipes equinus following on a contracting scar of the calf; the fixed flexure of joints from scars in their vicinity. The pain in these cases comes on after exercise.

5. Referred pains. These are referred to some remote part of the body, and have "apparently" no connexion with existing scars. In these cases there is, as a rule, a multiplicity of scars or a large area of scar tissue. There is invariably neurasthenia.

Example.—Sergt. V., West Riding Regiment. He presented five scars: Left arm and forearm, right arm and forearm, and over right eyebrow. He suffered from no inconvenience from these scars, but complained of great pain at a point a little below and to the inner side of the angle of left scapula. He was markedly neurasthenic, suffering from insomnia, tremor, and vertigo, etc.

The etiology of these cases would seem to be that when there is peripheral irritation from many sources in a neurasthenic patient a hypersensitive state of nerve centres is produced by which impressions are intensified and widely referred.

The following case is interesting, though difficult to classify. The history is incomplete, as I was only able to get a glimpse of it at a travelling board. It was a case of gunshot wound on the back of the left wrist. There was a large, irregular, non-adherent scar. There was no evidence of injury to the joint, bones, or extensor tendons. The muscles of the hand and forearm were wasted. The history that he gave was that the illness was a long one and that the loss of power was gradual and progressive. The hand was in a condition of complete drop-wrist. It occurred to me that this might be a case of neuritis migrans.

From a perusal of the above one cannot help noticing the large number of intractable neuralgias present. Three factors would seem to enter into the causation of this condition:

(a) The large number of wounds infected at the outset originating a septic neuritis.

(b) The presence of the neurasthenic state in which an unduly sensitized mental register modified the results so that ordinary impressions were intensified.

(c) The large number of adherent scars. This probably was the most potent factor.

As a result of much work and research at the front it has been conclusively proved that, owing to the condition of the soil, wounds are infected from the very first. It was also shown that modern germicides, on account of their low penetrating powers, are unable to reach the infected areas which lie in the lacunar spaces beneath and outside the wound itself.

As a result of these researches the physiological treatment of wounds by irrigation has largely superseded the older methods. This treatment, however, cannot be applied in the very earliest stages, when it is so necessary. The consequence is that gangrenous and septic processes have already begun in the wound before irrigation can be applied. This accounts for the large number of unhealthy and adherent cicatrices with their resulting disability. Whatever treatment, therefore, is adopted, it must be prompt, and it should aim at reaching in the very earliest stages these outlying infected areas, to reach which has taxed the efforts of our most skilful surgeons. It would seem that to throw around these infected areas a circle of bactericidal serum would most nearly approach the conditions required, and would best anticipate the treatment of irrigation which is to follow.

In a few emergency cases in South Africa, where prompt attention and immediate removal were required, I adopted the following somewhat crude but otherwise effective method:

I grasped the wound with the left hand well beneath its base,

at the same time drawing it well forwards and making the thumb and fingers compress the tissues tightly. I then transfixed with a needle, entering the point immediately beneath the tips of thumb and fingers. In a similar manner I transfixed the tissues about an inch beyond each end of the wound, taking care to include the same depth of tissue. I then passed a rubber ligature round the wound beneath the needles. This was tightened to the desired extent and fixed by a clip. The points of the needles were protected by pieces of cork wrapped in sterilized gauze. It will be understood that the only idea in these cases was quick transport.

The knowledge of these cases suggested to me the instrument figured in the illustration. It was made by

a local watchmaker of the only materials at hand and is necessarily somewhat crude, though the plan is quite correct and the larger scale serves to emphasize its main points. It can, however, be made on the smallest scale and adapted to the finest surgical needles.

It consists of two slender looped splints, a system of wormed needles with detachable points and nuts which travel on the needles. In this way the splints are made to approximate to each other and so compress the intervening tissues.

The manner of using it is sufficiently indicated by the illustration. It is practically the same as the description given above of my own method of treating cases in South Africa, with the exception that the splints are looped on to the needles and made to approach each other by the nuts. By transfixing the tissues in the manner suggested by me an immobility is obtained in the simplest, easiest, and quickest manner possible. The immobility is far more perfect than can be obtained by splints. There is no traction on any part of the area included within the needles. The edges of the wound are quite flaccid and tend to fall together.

In the compressed area the circulation is controlled and easily regulated. It is more equable, and protected from reflex vasomotor impressions. The physiological engorgement ensures a flooding of the basal areas with bactericidal serum and the infected interstices and lacunae are in this way reached. One effect of compressing either by splints or ligature a circumscribed area of tissue well outside the margins and base of a wound is to elevate, unfold, and flatten out both the basal and other parts of the wound itself. This is shown in Figs. 2 and 3.

The base of a wound is thus rendered more superficial and more adaptable for any surgical toilet that may be necessary. The lymphatic spaces are opened out and easily reached. The same may be said of any wound diverticula which under ordinary circumstances would be difficult to reach. The wound in its new position is in a condition to be more effectively dealt with. Haemorrhage would be easily controlled, blood clots or sloughs removed, sinuses opened up, and infected areas disinfected. The elevation of the wound will depend upon the amount of outlying tissue engaged in the compressing agent. Wherever possible—and this will apply to the majority of cases—splint compression should be used, leaving the ligature to control the ends of the wound.

Where there are wound diverticula at the base some modification is required, and the ligature in these cases plays the most important rôle. This is shown in Fig. 4. Small portions of tissue are pinched up and transfixed, and retained by small splints. An encircling ligature is thrown round the wound, passing beneath the needles, and drawn tightly.

The direction and depth of any diverticula should be ascertained before transfixing, and a portion of tissue should be selected on the skin which corresponds to their terminations; a spot should be fixed upon well beyond these but in the same line. All diverticula should be treated in this manner.

In order to simplify the above description, the areas of skin transfixed will be spoken of as "standards." In mapping out an area of skin for the encircling ligature the following arrangement of "standards" should be observed. In case of irregularities at the base the "standards" are placed in relation to

FIG. 1.

FIGS. 2 and 3.

FIG. 4.

wound diverticula in the manner above described. The disposition of other standards is immaterial, always providing that a wide circle is obtained, and that the distance between the wound margin and ligature is always greater than the deepest part of the wound.

To summarize what has been said, the elevation of a wound in this manner furnishes the following advantages:

It allows of a complete toilet. The bactericidal serum enhances the defensive properties of a wound, which, as is well known, are at a high state of development at the time of infection. During the progress of healing the perfect immobility of the compressed area, since all circumferential forces are inhibited at the line of constriction, gives the best condition possible for the building up of healthy scar tissue. The part inside the constricted area is free from any kind of traction, and the edges of the wound are quite flaccid and tend to fall together.

Of equal importance in the healing process is an avoidance of anything that would tend to depreciate the vitality of the growing cells. The practice of packing a wound with an unabsorbable dressing, such as sterilized gauze, is a familiar example of the continued disturbance of growing granulations wherever such a dressing is removed; not only is the proceeding exceedingly painful, but a layer of germinal tissue is taken away in the dressing to which it has adhered. This of course means delay, and what causes delay will eventually show in the final cicatrix. It is urged, too, that germicides in destroying bacteria must in some measure impair the vitality of the surrounding cells; it is considered improbable that the bacterial protoplasm should be killed outright, and that the protoplasm of the neighbouring cells should escape untouched.

Many years ago I invented a dressing from cancellous tissue of bone. This is deprived of fats, decalcified and bleached, and forms a soft white sponge-like tissue which adapts itself readily to the soft parts. It is both absorbent and absorbable. Though its utility has been circumscribed and limited, it is still a most serviceable dressing for chronic wounds, as I have had the opportunity of witnessing in this war. It fails in freely secreting wounds, as it does not provide sufficiently for drainage. I still think that if modified the matrix of bone tissue will ultimately form a basis for dressings. The need for a dressing which can be removed without disturbance of the granulations and without causing pain has been greatly felt in this war. Xylonite and celluloid dressings have been invented to meet this requirement. I have made the suggestion that cancellous tissue might still be utilized by a modification of the method adopted in making the dressing in its present form. Briefly, it would consist of only partially decalcifying the bone in the first instance until it was of such soft consistence as would enable it to be planed into exceedingly fine films. The face of these films could then be perforated. The films could then be completely decalcified and subsequently hardened in formalin to make them more adaptable and to secure the perforations from collapsing.

Any dressing which is to be applied to a granulating surface should possess three qualities: It should be absorbent, absorbable, and perforated. Absorbent, so that the plastic lymph could be held in its meshes for the nourishment of the ingrowing plasma cells. Absorbable, so that the dressing could yield, and be gradually replaced by the new tissue. Perforated, so that drainage could be obtained in the early stages, and the graft would thus be enabled to adhere to the granulations; otherwise the dressing is liquefied and prematurely absorbed. Healing by granulations should be "continuously progressive," and there should be no pauses in the process and no "retrograde movements," such as must always occur when a wound is treated with unabsorbable dressings.

For the development of perfect scar tissue one factor is essential—absolute rest in the healing zone. A healthy scar should be smooth, elastic, free from adhesions, and non-contractile. Contractility in a scar presupposes undue traction in the wound, against which it is an opposing force. It is the presence of this quality in a scar that is responsible for so many disabling conditions that remain after healing, such as deformities, intractable neuralgias, paralysis of nerves—such as ulnar paralysis where the symptoms are late in developing—chronic oedema, etc.

WEISSENBACH and BOUTTIER have reported to the Société de Biologie of Paris that the inflammation following penetrating wounds of the brain is usually due to the *Streptococcus pyogenes*, and that this is specially true of diffuse cerebro-meningeal inflammation arising at an early stage—that is to say, during the first two weeks after receipt of the wound.

A BED AND SOME APPLIANCES FOR GUNSHOT WOUNDS OF THE FEMUR AND BACK.

BY

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THE accompanying illustrations show a special bed and some other apparatus found useful in the femur wards of a base hospital in France. Most of it has been in use for over a year, and all of it long enough to have proved its value.

The bed is intended primarily for gunshot wounds of the femur, but is also useful for any wound of the shoulder, back, or pelvis where turning the patient is difficult. It is an extension of the "sectional mattress" idea, with this addition—that not only the mattress, but the whole of that part of the bed that underlies the wound, can be removed altogether, giving unimpeded access either for dressing the wound, for radiography, or for ordinary nursing purposes, so that it is unnecessary to move the patient at all.

FIG. 1.—Femur bed stripped: one movable section with "quick-release" attachment let down as for dressings or radiography; the plank underneath is to support a dressing bowl.

It consists of an ordinary tubular frame army bedstead with the spring mattress removed and replaced by tight canvas slings, 11 in. wide, fastened by straps and buckles to one side-bar of the bedstead, and by metal hooks or a "quick-release" contrivance to the other.

Upon the tight slings lie the mattresses in three or more sections. For a femur case, one square "biscuit mattress" is under the patient's head and body, another under the lower part of the legs, and a small piece of mattress similar in shape and size to the canvas slings lies immediately under the wound and is the one that is removed, with its corresponding canvas, for dressing purposes.

As a matter of convenience the bed stands 36 in. high, the head of it supported on a wooden trestle, the foot either on a trestle or hung from the roof by chains, the length of which can be easily regulated to tilt the bed, if wished. In flimsily-floored huts the vibration is also much reduced by this means. A movable arch of round iron resting on the side-bars of the bed affords means for suspending the Thomas splint, or the pelvis of the patient if it is necessary to expose a large part of the back or buttock at one time. I would like to lay great stress on the value of the suspension of the ring of the Thomas splint: it prevents slipping of the ring, thus adding to the efficiency of the splint and the comfort of the patient.

Fig. 2 shows the other femur apparatus which is in ordinary use here. The patient arrives at the base hospital with his leg generally very well put up in a Thomas splint with strapping or glue extension applied below the knee. Our object is to retain the complete immobilization and extension of the thigh while securing the greatest possible freedom of the knee and ankle. Both of these objects can be attained without disturbing the adjustment made at the casualty clearing station, and without removing the Thomas splint there applied.