I have chosen this subject for our lecture this morning because many of you will before long enter into the service of your country as military surgeons, and because the application of principles to practice is a most useful lesson for us all.

As you know, the military hospital with which I am associated is situated in a district in which there has always been a big garrison, and much of my work has been devoted to the ordinary surgical ailments arising among a large body of men and some special troubles connected with the training of the soldier. The latter is a matter which will repay review and with which I hope to deal at another time. To-day we are only concerned with the wounded returned from Flanders or the Dardanelles, the "over-seas cases" as they have come to be known.

To many of us the work of this campaign has been our only experience of military surgery, and at first we were mainly impressed by its novelty. One was led to adopt this attitude by the fact that military surgery is commonly spoken of as apart from everyday surgery. Books are specially written on military surgery; colleges are set apart for its study, and in the old days at our own school there was a Professor of Military Surgery. However, it was not long before I learnt that the principles which underlie surgical practice in general are exactly the same as those which govern the injuries met with as the result of modern firearms, and this is the lesson I wish to convey to you to-day. In nearly all the reports from the seat of war the need of guidance by general principles is being recognized.

The peculiarities which undoubtedly exist are due to the nature of the weapons and to the conditions under which the wounds are received and in which the injured man has to exist for some time afterwards. In other words, it is a question of environment, rather than any inherent peculiarity in the wounds themselves. May I remind you of the story told of Ambrose Paré, who was taught that gunshot wounds were somehow different from other wounds and were to be treated by very special means. Paré says:

1 A Clinical Lecture delivered, at the Royal Victoria Infirmary, Newcastle-upon-Tyne.
"I had read in John de Vigo, Book I, of Wounds in General, chapter viii, that wounds made by firearms partake of venenosity, by reason of the gunpowder; and for their cure he bids you cauterize them with oil of elders, scalding hot, mixed with a little treacle. And to make no mistake, before I would use the said oil, knowing that it was to bring great pain to the patient, I asked first, before I applied it, what the other surgeons used for a first dressing; which was, to put the said oil, boiling well, into the wounds, with tents and setons; wherefore I took courage to do as they did. At last, my oil ran short; and I was compelled, instead of it, to apply a digestive made of yolks of eggs, oil of roses and turpentine. In the night, I could not sleep in quiet, fearing some default in the not cauterizing, lest I should find those, to whom I had not applied the said oil, dead from the poison of their wounds; which made me rise very early to visit them; where, beyond my expectation, I found that they to whom I had applied my digestive had suffered but little pain, and their wounds without inflammation or swelling, having rested fairly well that night. The others, to whom the boiling oil was applied, I found feverish, with great pain, and swelling round the edges of their wounds. Then I resolved nevermore to burn thus cruelly poor men with gunshot wounds." (From "Confessio Medici," p. 65.)

This story is of peculiar interest to us to-day and conveys a very important lesson.

**The Treatment of Wounds in War.**

You will have read much during the last few months to make you think that the principles which, up to now, you have been taught to look upon as the basis of successful wound treatment, have been swept away by the same explosive blast that has shaken Europe. It has been said that antiseptics in war surgery are of no value, and some have gone so far as to infer that antiseptics are, therefore, useless in general. These statements have even got into the daily papers, and paragraphs have appeared to the effect that the whole principles of wound treatment have been upset by the experience of the past few months, and that all we have previously been taught is wrong and must be supplanted by what has been learnt as the result of the War. I venture to say that this will ultimately prove to be nonsense and in the meantime is a very dangerous doctrine. Many things have been learnt and much excellent work has been done, but nothing that has upset the principles laid down by Lister with regard to the treatment of wounds.

It is perfectly true that when the wounded man reaches a base or a hospital in England the greater proportion of the wounds are found to be infected, but this is largely a question of environment. Owing to the ghastly nature of modern warfare, the wounded may have to lie for many hours—men have spoken to me of lying for days—before they can receive any attention whatever, and the range of modern artillery
is so great that the attention they then receive is only of the nature of first-aid, for it is impossible at the dressing stations to do more; and it may be only after he had reached the clearing station, situated eight or ten miles behind the firing-line, that his wounds can have anything like adequate attention. Even in these latter hospitals after a big action, when large numbers of wounded pass through, it is only very few that can be dealt with as adequately as the principles of wound treatment demand.

Then, again, the wounds are often inflicted under filthy conditions, for the clothing may have been worn for many days or even weeks, and is nearly always soiled with earth which has been richly manured and highly cultivated for years and which is found to be teeming with organisms. Under these circumstances it can easily be understood that the possibilities of sepsis are infinite.

Further, the nature of the wounds themselves renders proper antiseptic treatment difficult, for they are often irregular and with numerous pockets and side-channels, and frequently contain foreign bodies which in their turn carry into the depths parts of the clothing or equipment.

What chance, then, has the ordinary antiseptic treatment of wounds when carried out with these numerous drawbacks? I know as the result of the experience of men from our own school that when war wounds are attended to before the organisms have actually begun to multiply in the tissues, that is to say within six, or in some cases even twelve, hours, then such wounds can be so treated with antiseptics that they do not become grossly infected and heal much as wounds so treated would heal at home.¹

But you must clearly understand that the nature of many of the wounds, especially those produced by shells, makes them exceedingly difficult to cleanse, even under the best possible circumstances, and to thoroughly deal with some such would be quite a major operation taking a considerable time. I am afraid that unless the body can be protected against sepsis by some means without local interference, then we must always be unwilling witnesses to the septic infection of a certain proportion of wounds sustained in warfare. Lister always admitted that the antiseptic treatment of wounds was of more prophylactic than therapeutic value. What is now wanted is some plan to deal with infection when once started, and along these lines much promising work is being done.

But even when, as in the great majority of cases, the wounds do become infected, you are not to suppose that they are so peculiar, so "envenomed" as the older writers have it, that they refuse to yield to ordinary methods of treatment. Practically all the wounds that have

¹ Since this was written the value of antiseptics in "Wounds in Wars" has been endorsed by Sir Anthony Bowley in his recent Bradshaw Lecture (see *Brit. Med. Journ.*, December 25, 1915).
reached us have been in a septic condition and nothing has given me more satisfaction than the way they have healed when treated by the ordinary antiseptic plan as carried out in this hospital. Lest any of you are strangers to our technique, let me say that for wounds already infected we largely rely on boracic fomentations, gauze wrung out of 1 in 1,000 perchloride of mercury and used moist, or a solution of the same strength made with methylated spirit, and at times irrigation with solutions of peroxide of hydrogen or iodine water.

One or two cases have been disappointing, but the great majority have done splendidly so far as wound healing is concerned. Of course, in the process of healing there are many stages, and the plan may have to be altered from time to time in the progress of the case and other adjuncts to recovery must be employed.

**DRAINAGE.**

All who have had to deal with the wounded are insistent on the importance of drainage and, when one considers the undermining of the tissues, the masses of broken-down material that must be cast off by a suppurative process, and the pockets and side-channels which so frequently occur, then it is easy to understand the necessity of providing a free outlet for discharges.

The method of drainage is important and though tubes are undoubtedly the best means of bringing this about, there are abuses and dangers associated with them which we have learnt in the surgery of civil life to avoid.

Tubes ought not to be too big. They should be removed the moment they have served their purpose, and it is especially important that they should not be placed in the neighbourhood of blood-vessels, for in the presence of sepsis tubes are capable of producing erosion of the vessels, leading to very serious hemorrhage.

Counter-openings are very useful and cannot always be superseded by the use of tubes. Quite recently I had to deal with a case in which a subcutaneous laceration had been produced extending down the whole length of the outer part of the thigh. The torn muscles were infected and sloughing and the patient was exceedingly ill. From a point near the trochanter a large tube, nearly a foot long, had been introduced throughout the whole length of the wound, but it was for the most part merely acting as a foreign body. The necessary requirements for the exit of discharges were met by making a series of counter-openings through which much shorter tubes were introduced and thus efficient drainage provided. This is an extreme instance, but the necessity of providing counter-openings should always be borne in mind. I would also draw your attention to the importance of position as an aid to drainage, and I was especially impressed by this in the case of a lad
who had been wounded through the leg and foot. The bullet entered about the middle of the inner aspect of the tibia and found an exit through the middle of the sole, "blowing out" quite a large focus from the bones which had been traversed. In consequence, there was a large funnel-shaped wound with the apex in the tibia and the base in the sole. The wound was grossly infected and there was a copious discharge of pus. In spite of free drainage, frequent dressings, passive congestion, and the use of sedatives he was constantly in severe pain as he lay with his foot propped up on a pillow. At this stage the case was seen by my friend, the Rev. Robert Stirling (now a Lieutenant in the Royal Army Medical Corps), whose experience of gunshot wounds sustained in the civil life of the Holy Land makes his advice especially valuable at the present time. He suggested that the pillow should be removed and the head-end of the bed raised so that the discharges could constantly run out of the wound. The effect was very striking, for pain immediately ceased and recovery was greatly aided.

One further illustration refers to a similar condition in the humerus in which the wound of exit lay over the head of that bone. This man kept developing secondary abscesses half-way down the arm in spite of a tube introduced right into the medullary cavity. When the foot of the bed was kept raised so that gravity aided the escape of pus this trouble was got over and recovery was much hastened by this simple expedient. In this case a counter-opening about the middle of the arm might have served the same purpose had not the simpler plan succeeded.

Another principle which we have re-learnt during the last few years is the importance of fresh air in combating infections. (This was well-known to our forefathers, and in his delightful account of Alanson, of Liverpool, my friend, R. W. Murray, shows how he insisted upon it one hundred and thirty-eight years ago.) Though principally exploited in connexion with tubercle its usefulness is not limited to the ravages of any particular organism. My septic cases have improved enormously when kept on the balcony or in open tents both day and night, and I believe that no single factor has been of more benefit to patients poisoned with sepsis than the free use of the open air. An illustrative story will suggest to you what happens under these circumstances:

Two practitioner friends met in the street. In response to an inquiry by Dr. M. as to what was doing, Dr. P. said he was sorry to confess that he had a case of puerperal sepsis. Dr. M. enquired how the case was getting on and was interested to hear that it was progressing favourably towards recovery. Curiosity being stimulated, Dr. M. next asked how the patient was being treated and was informed that she was having antistreptococcic serum. He remarked on the great expense of the treatment, to which Dr. P. replied that it was costing nothing, for the patient was manufacturing the serum herself!

There is a wealth of meaning in this story, for there can be no doubt
that if by fresh air, good food, etc., you can help the patients to make their own antitoxins; they will do it more surely and much more safely than you can possibly do it for them. But you must not think that I do not believe in the use of artificially prepared antitoxins, etc. I have to regret three instances of death from septicemia in both its acute and chronic forms which I cannot help feeling might have been cured by some form of antitoxin or vaccine had we been sufficiently informed to know exactly what strain was required. The use of antitoxins and vaccines for the cure of surgical sepsis undoubtedly occupies an important place, but at present it is far behind the other measures which we can employ.

Fig. 1.—Separated and necrosed fragments from a case of gunshot wound of the pelvis.

Fig. 1.—Some large sequestra which I recently removed from the ilium. The patient was a soldier, aged 39, who was wounded on April 26, 1915, by a piece of shell which passed through the right half of the pelvis, shattering the ilium and producing a large wound of exit. The wound was almost necessarily septic and there was profuse purulent discharge. Twenty-two weeks after the casualty he was transferred to Newcastle to be nearer his own home. When admitted on September 27 he looked much older than his reputed age, and was very lethargic and with a tendency to be discontented. The temperature was irregularly elevated and the pulse wanting in tension. He took food badly and generally felt ill and miserable. There was a large sinus over the centre of the ilium in the position of the exit wound from which flowed a copious discharge of offensive pus and at the bottom of which bare bone could be felt. Here, then, was a man
importance of general principles in military surgery

presenting all the signs of a chronic intoxication from sepsis. He had been carefully treated in hospitals in France and at home, but absorption still continued. With careful dressing and feeding he certainly improved a little, but it was not much, and at the end of a fortnight he was much as before, and with a not very hopeful outlook on life. As about six months had elapsed since the infliction of the injury I judged that there would be good formation of new bone and that the sequestra might safely be removed. The fragments shown you were extracted under anaesthesia, and the cavity left, which was almost big enough to hold the fist, was packed with gauze soaked in turpentine. The improvement was immediate and remarkable, for his whole temperament appeared to change and he became bright and cheerful and has made a splendid recovery.

I quote this case to show the importance of removing a septic focus and the great benefit which follows. It is a principle in surgery which is apt to be forgotten, that all the gross sources of sepsis ought first to be dealt with before falling back on vaccines, etc. In these cases it is largely a question of proportion or perspective, and the great thing is to remember to first remove the cause as far as possible, and then to adopt the other measures in the order in which they may be expected to do the most good.

When we come to the question of serum-therapy in prophylaxis we are on very hopeful ground. You will remember that last session I spoke to you on this matter in connexion with the prevention of tetanus (Durham University College of Medicine Gazette, December, 1914), and now I am glad to say that for many months past we have scarcely had a single case, due to the fact that the wounded men are all getting a prophylactic dose of antitetanic serum. The importance of this measure was very well illustrated by the experience of my colleague, Captain Heslop. In one batch of thirty-two wounded admitted to his wards only one man had not had a dose of antitetanic serum, and he developed acute tetanus on the twelfth day which proved fatal in thirty-six hours.

Latent Sepsis and the Recrudescence of Sepsis in Healed Wounds.

That septic organisms often lie dormant in war wounds has frequently been illustrated and has been remarked on by most surgeons. One often sees cases of gunshot wound in which the patient goes on perfectly well for two or three weeks and then without any demonstrable cause there is an outburst of sepsis. Such an outburst may take the form of local inflammation only, but there is often cellulitis, lymphangitis and grave constitutional disturbance due to absorption (saproremia) or to the presence of the actual organisms in the circulating blood (septicæmia). The condition is not always a relapse, for the manifestation may be much worse.
than any primary septic trouble which has been present, and it is not necessarily due to the introduction of fresh infection, because it can occur with healed wounds and without any breach of the surface whatever. I have frequently noticed it after the amputation of fingers shattered by gun-fire, and it may occur as the result of massage or the movement of previously infected joints. Sometimes tetanus has been lighted up in this way, though I have not myself seen it.

As bearing on this problem it is well to remember that the organisms of tetanus and gas gangrene have been found in gunshot wounds, but without either of these diseases resulting. It is, then, feasible to suppose that they may get locked up in the tissues, only to give rise to their specific infections when conditions for their development are more favourable.

That organisms or their spores may survive for long periods is proved by the case of a Belgian who was under my care in October of 1914, with multiple shrapnel wounds of the arm. Six weeks after the casualty he developed symptoms suggestive of tetanus, but they were very mild, and I always doubted the diagnosis. Exactly twelve months afterwards he developed typical tetanus and passed through a long illness with dangerous exacerbations.

The most serious instance which I have come across was that of a corporal, who was admitted to the military hospital on July 30, with numerous small wounds on both legs, the result of a bursting shell. The wounds were not looked upon as serious and there was only little irregular pyrexia, the temperature never rising above 100° F, nor was the pulse ever above 80. The wounds soon became healthy, granulating sores, and the patient was getting on so satisfactorily that he was up and walking about. On August 27, he went out without his great-coat, staying out of doors for a considerable time. He felt cold and poorly at night and next day had a rigor. The right leg became swollen and painful, presenting the signs of a severe cellulitis with lymphangitis and enlarged groin glands. Symptoms of severe general infection rapidly developed, with a temperature of 103° rising to 104° F, and on the day of his death—a week after the onset—reaching 106° F. Post-mortem examination showed evidences of death from general septicaemia without any other cause than the wounds on the legs.

These conditions are certainly very striking though not peculiar to war surgery, and there must be some general principle involved. Many years ago when on a voyage from the Gulf of Bothnia I sustained a scratch over the right elbow in the course of my efforts to help the crew to right a cargo of iron ore in anticipation of the severe weather which followed. I thought nothing of it at the time, but on arrival at home about a week later developed a severe cellulitis which was very painful, made me feel quite ill, and which had to be incised. In the course of two or three weeks everything seemed all right again and I had no
further trouble until exactly twelve months later when, without any reason which I could assign, the cellulitis recurred and was sufficiently bad to require a further incision just by the side of the old one. The following is a brief note of a case occurring in a soldier which illustrates the same thing:

A man was wounded on April 25, 1915, a small fragment of shrapnel lodging in the neighbourhood of the knuckle of the ring-finger on the left hand. It was only a very slight wound and after removal of the fragment it healed in three days. He thought nothing of it, although occasionally the place ached a little. Some time after this a high explosive shell burst close to him and he was invalided home with shell concussion. August and September were spent in the country, and on the 25th of the latter month, when in splendid general health, the injured finger suddenly swelled up and became very sore, while the pain went up his arm and the glands in the axilla became enlarged. There was a little local infection, a small abscess bursting and discharging. There was no sign of any foreign body. After a few days the whole thing cleared up and he was all right again.

**The Reopening of Healed Wounds.**

Another trouble which is sometimes spoken of as if peculiar to war wounds is the breaking down of a scar apparently completely consolidated, but in these cases there is often a definite and tangible cause.

A soldier was wounded on May 16 as the result of the bursting of a hand grenade. He sustained a shattered fracture of the lower end of the ulna, and in France some portions of shrapnel were removed. On May 25 he was admitted to the 1st Northern General Hospital with a healthy granulating wound which was apparently soundly healed at the end of a month. He was sent to a convalescent home, but he had not been there long before the wound broke down and discharged. It again healed, and was apparently all right when the same trouble recurred and delayed his return to duty. At the end of eight weeks the wound was apparently perfectly sound, and after inspection by an experienced surgeon he was marked for sick furlough and return to duty, but on the day on which he was to leave the home the wound again commenced to discharge and he was readmitted to the 1st Northern General Hospital. An X-ray photograph showed there was still some necrosis, and under an anaesthetic I found a small cavity which contained the sequestra shown in fig. 2.
After their removal the wound healed from the bottom and gave us no further concern.

Another similar case was due to a metallic foreign body:—

A young private was wounded in May by the bursting of a hand grenade. The right knee, left leg and left foot were each injured, and in France portions of casing were removed from all the wounds. They all healed soundly except that on the foot, which healed and broke down many times. After being in hospital four months he was discharged with the wound healed, but ten days later it again re-opened and he was admitted to the 1st Northern General Hospital. He then presented a scar on the outer part of the dorsum of the left foot with a small unhealed area at one end. No foreign body could be felt, but X-ray examination showed a metallic fragment imbedded in the os calcis. At the operation for its removal the foreign body was found imbedded in granulation tissue which was directly connected with the under surface of the scar.

SINUSES.

It is an established principle that a sinus is to be looked upon as a symptom and not a disease, and before any consideration of treatment it is necessary to make a diagnosis as to its cause. Nothing is more common than to see men wounded at the War who for some considerable time afterwards, when in perfect general health, present a sinus, discharging more or less pus and a local rather than a general inconvenience.

Sometimes a gross foreign body, such as a portion of projectile, is still in situ, but these are the simple cases that are not likely to be missed. Such an example is that of a man who was wounded at the Battle of the Aisne on September 13, 1914. The bullet entered the upper part of the right thigh just about the trochanter. He was treated at various hospitals and was finally given sick furlough for a month. During all this time the wound never completely healed, and on December 9 he was admitted to the 1st Northern General Hospital with a small sinus just above the trochanter on the right side. The X-ray photograph demonstrated a shrapnel bullet, and under an anaesthetic this could be easily felt and was removed together with a portion of garment. The sinus promptly healed and the patient was soon able to be discharged cured.

I have recently had under my care a man, aged 22, who was wounded in the right thigh by the bursting of a bomb on July 16, 1915. A piece of casing was removed from the back of the thigh by a separate incision on July 24. The wound made for the latter purpose healed almost at once, but the original wound continued to discharge and he was admitted to the 1st Northern General Hospital on July 30. The original wound was quite small and was represented by a sinus which passed right across
the thigh to the inner side. Nothing could be felt with the probe, and X-ray examination was entirely negative. The patient himself was perfectly well, but every now and then there was a considerable discharge of pus from his wound which never completely healed. Rest, with irrigations and suitable dressings, certainly caused a diminution of the discharge but did not obliterate the track, and on September 18 under an anaesthetic I explored, and after enlarging the external aperture removed a piece of clothing about an inch square, evidently a portion of the man's trouser. After this the sinus rapidly closed and the man had no further trouble.

Another frequent cause is the formation of a sequestrum, and the numbers of sinuses which are due to this are very remarkable. In military surgery a very considerable injury to the deeper tissues may result with a very small wound of the superficial parts, and I show you on the screen an X-ray photograph of the femur (fig. 3) together with the sequestra (fig. 4), which were subsequently removed in the case of a man
whose thigh was traversed by a bullet from front to back. The casualty
happened on May 15 and he came under my care on June 20 with a
sinus leading down to the femur. On September 26 the sequestra which
I show you were removed, after which the sinus began to heal.

SECONDARY HÆMORRHAGE.

In connexion with this subject well-established surgical principles are
constantly being exemplified, and it is interesting to know that these
principles were first formulated as the result of the experiences of a great
military surgeon—George James Guthrie—who gained his knowledge in
the Peninsular Wars chiefly between 1808 and 1815, when he operated
on many of the wounded from Waterloo. His "Commentaries on
Surgery" will well repay study at the present time. Guthrie showed
conclusively that in cases of secondary hæmorrhage the bleeding very
often came from the distal end of the injured artery, and that it is there­
fore necessary to expose the artery at the site of the wound and to tie
both ends rather than adopt the plan of the proximal ligature, which was
the favourite method up to his time.

A very striking illustration of this principle was furnished by the case
of a man who was wounded in France by a bursting shell which ploughed
up the tissues over Scarpa's triangle. The femoral had to be tied just
below Poupart's ligament, and the patient was admitted under my care
some days afterwards with gangrene of the leg and a deplorably septic
wound all over the front of the thigh. I had scarcely left the hospital
after seeing the case when I was hurried back on account of alarming
hæmorrhage. The patient was exceedingly ill, and had lost so much
blood that I thought the ligature applied to the cut end of the femoral
artery must have given way. As a matter of fact, the bleeding was from
the end of the profunda femoris which was lying exposed in the wound,
the parent trunk having sloughed away. This, then, was an admirable
instance of secondary hæmorrhage from the distal end, or rather a distal
branch of a severed artery. Had the ordinary principles been neglected
and the external iliac artery ligatured, the hæmorrhage would probably
not have been arrested or would have recurred owing to the freedom of
the collateral circulation. Though the patient was exceedingly ill, he
rallied sufficiently to allow me to amputate the thigh a day or two later,
ultimately making a complete recovery.

ON THE REMOVAL OF FOREIGN BODIES AND THE USE OF THE
RÖNTGEN RAYS.

You cannot see much of military surgery without being confronted
with the problems connected with the removal of foreign bodies, nor will
you be long without appreciating the enormous value of the X-rays.
Let me state very clearly the conclusions at which I have arrived as to
the removal of foreign bodies from patients arriving at a base hospital at home.

Firstly, I think that in the great majority of cases it is a wise thing to remove a foreign body, if this can be done without running any grave risk so far as the life of the patient is concerned or the function of the part affected. We get almost daily confirmation of this, because we are constantly getting patients admitted to hospital whose wounds are healed and who have returned to duty, but who do not feel happy in their minds because of the knowledge of the presence of some extraneous foreign body in their anatomy. I find that it makes all the difference in the world to a man whether his foreign body is in his chest wall or his waistcoat pocket. It is after all a psychological matter in many cases, and if by such a gross mechanical performance as a surgical operation you can lift a permanent load from the patient's mind, then it requires strong reasons before you should desist from your efforts. Of course, I know that some people say directly and many imply that the discovery of the X-rays has been anything but a benefit to the wounded, but if certain principles are always kept in mind then this taunt is unjustified, and, first, you must clearly recognize that if you cannot do good you have no business to run the risk of doing serious harm.

Secondly, no one should undertake the removal of a foreign body without very careful consideration as to its exact position and relation to surrounding structures. An operation for its removal should never be carried out without an X-ray examination, because so often there are multiple foreign bodies or there are concomitant injuries to bones which can be dealt with at the same time. No attempt should be made to remove foreign bodies without careful localization unless they can be certainly felt near the surface. As the foreign body is always potentially a source of infection the area from which it has been removed should always be drained.

I would also plead for the routine use of the X-rays, even in cases in which the foreign body can be felt or in which the lesion, whatever it may be, is apparently perfectly obvious. It is wonderful how many revelations one gets, and often in cases in which the injuries have been apparently trivial. Let me tell you of the case represented in fig. 5.
This man was injured by shrapnel in the lower part of the right thigh. There was a small sinus on the outer side leading to a piece of metal apparently quite close to the surface. An X-ray of the immediate vicinity only showed a foreign body lying just inside the cancellous tissue of the bone. The problem seemed very simple, and it looked as though the case was almost a trivial one, but on examination I discovered a large hard swelling in the upper part of the inner aspect of the thigh. It was smooth, hard, and scarcely tender, but there was a little increased heat. Had there been no question of injury it would certainly at first give rise to the suspicion of a sarcoma, or it might have been an enormous gumma. However, an X-ray picture of the whole femur showed a crack extending from the point at which the foreign body was impacted halfway up the shaft and then across the inner aspect of the bone, the mass being represented by a large amount of callus thrown out about the latter, and probably due to the fact that the patient had not had adequate rest, no serious injury to the bone being anticipated.

Instances of this kind are very common. I would only refer you to the case of an officer who accidentally shot himself with his revolver. The bullet entered over the front of the tibia, four inches above the ankle-joint, and a very tender point just in front of the ankle-joint and apparently not far under the skin suggested the position of the missile. X-ray examination showed that the bullet had really traversed the tibia from just below the wound of entrance to its lower end, producing an amount of injury which would never have been suspected either from the symptoms or from any physical signs.

With regard to the actual removal of missiles, I think we have retrogressed a little. In the old days when Nelaton’s probe was invented the efforts of the surgeon were almost entirely limited to the removal of foreign bodies via the wound of entrance; and I would like to remind you that this is a method which is still sometimes exceedingly useful.

If a foreign body can be easily felt with the probe, and if an X-ray examination confirms the position, and the fact that it is single, then to remove it through the original track is often a simple matter, and I have several times been successful, and especially with the round shrapnel bullets which were so frequent in the early days of the War. Of course, it is sometimes necessary to enlarge the wound of entrance and the aperture in the deep fascia, but nowadays we have the aid of anaesthesia which our forefathers lacked, and this greatly increases the scope of the measures with which they had to be content. If the wound of entrance and the track have healed, then it is often expedient to remove the foreign body by some shorter route, cutting on to it directly.

With deeply situated foreign bodies and foreign bodies in inaccessible parts, you cannot have too much information, and I would urge you never to attempt the removal of foreign bodies without an X-ray plate or plates as a guide. Very frequently the radiographer marks the site of
the foreign body exactly and gives an indication of its depth, but without the plate some important point may be missed which may have a great bearing on the success of the operation.

In a case in which a rifle bullet was embedded in a rib, the wound of entrance was on the surface of the back and close to the point at which the bullet was seen to be lying by the screen. It was accurately localized and I foolishly attempted to remove it without having seen a plate. To my great disappointment I failed to find the bullet, but at a second operation the knowledge that it was actually embedded in the rib made its removal quite easy.

In our X-ray department some simple devices have been found most useful. For instance, it has been observed that when a foreign body is near the surface it can easily be made to move by pressing over its site during a screen examination. We have also found a screw-driver used as a pointer to be very useful, and wires have been found of value in the localization of bullets in the chest and in the head.

Always beware of making ill-considered attempts to remove small foreign bodies embedded in muscular parts, and, indeed, they are of minor importance, because they are scarcely likely to give rise to much trouble in such situations.

At the beginning of the War and for some time afterwards foreign bodies in the chest were supposed to be in sacred ground, and patients were universally advised to have them left alone. Being impressed with the amount of mental anguish which some of these men appeared to endure because of the knowledge that they had a foreign body in their lungs, I have now on four occasions deliberately opened the chest and removed bullets or shell casing, and in each case with complete recovery.

ON THE NEED OF ORDINARY METHODS OF EXAMINATION.

Nowadays, with so many special methods of examination at our disposal, we are all apt to forget the routine plans which have stood us in such good stead for so many years. I have indicated the extreme value that I attach to X-rays, but they should not be used to the exclusion of other and simpler methods of examination.

These points were well illustrated in the case of a man who was wounded in the left side of the back and who complained of persistent pain on defecation. There was no wound of exit and a fruitless search had been made for the foreign body, the whole of the left side of the back and pelvis and all down the left thigh being X-rayed. When he came under my observation, in the course of routine examination I palpated the rectum and found what I took to be the foreign body lying on the right side and within easy reach of the finger. The presence of a shrapnel bullet in this situation was confirmed by the X-rays, and was subsequently removed by an incision to the side of the coccyx and with complete relief to the symptoms.
In another case a man was shot by a rifle bullet which entered above the right hip and which was followed by some paresis of the limbs, with retention of urine and incontinence of feces. It was thought that the bullet had lodged somewhere in the spinal canal, but on careful examination with the screen it was discovered on the outer side of the left thigh in a position in which it could easily be felt had we examined him systematically with a knowledge of the vagaries of bullet injuries in our minds.

In a similar case the bullet had entered in the middle of the left buttock and could easily be felt lying just under the skin in the middle of the front of the right thigh.

In traversing wounds of the limbs it is remarkable how blood-vessels and nerves can be missed, but it is most important never to assume that these structures have escaped and to be constantly on the look-out for evidence of nerve injury or blood-vessel trouble.

In civil practice it is unfortunately quite common to see paralysis of important nerves after wounds of the limbs have been dealt with and have healed satisfactorily, and it is well always to make it a rule to examine all the nerves that might possibly be injured. A dropped wrist or foot is usually very obvious, but there may be a lesion of some other nerve with less characteristic symptoms that may be overlooked.

The same thing applies to the blood-vessels, and in the case of a man who was wounded through the calf as well as in the head and knee it was only many weeks after the accident that a systematic examination disclosed a slight swelling of the limb, together with a widespread purring hum, which was the only evidence of an arterio-venous aneurysm involving both the posterior tibial and peroneal arteries.

In dealing with possible blood-vessel injuries it is also very necessary to re-examine the patients from time to time, for in one case a traumatic aneurysm gave no evidence of its presence until twenty-six days after the casualty, and in another case a man who was peppered with shrapnel on May 15 was sent to a convalescent home on June 12, apparently making an excellent recovery from what was considered to be a trivial injury—yet on June 25 he suddenly developed a large pulsating swelling behind the knee which proved to be a traumatic aneurysm of the popliteal artery.

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The same need of careful examination is exemplified by injuries to the chest. These are commonly thought to be beyond the scope of surgery and to merit very little attention, but they are all worthy of very careful examination from time to time and for long intervals afterwards. This is well illustrated by the case of a serjeant from whose pleura I removed a bullet under the following circumstances:—

The man was shot on May 8, 1915. The bullet entered in the centre of the sternum just below the manubrium, but there was no wound of exit. He suffered from shortness of breath and pain in the chest and for a
time had a high temperature. These symptoms gradually improved and in three weeks he was sent to England. On June 24 he was allowed to go home on sick furlough, and at the expiration of this time rejoined and started work at recruiting. He managed fairly well for a week and then had to give up on account of shortness of breath. When admitted to the 1st Northern General Hospital careful examination showed very definite signs of an empyema at the left base, from which I removed the bullet, complete recovery following.

In ordinary surgical practice the best diagnoses are made when time is taken to go carefully into the history, and the same rule applies to military surgery. This was borne out by the case of a man who was admitted to the hospital because he was supposed to have a bullet in his lung. He had certainly been shot from behind and had spat blood, but on going carefully into his history he volunteered the information that immediately after the accident he saw the end of the bullet sticking out of the front of the chest like a nipple, though the swelling which followed almost at once pushed the skin away and thus obscured the protruding missile. In this case the bullet was found lying on an intercostal space just in the position described by the man, and from which it was removed with the greatest ease.

**Gunshot Fractures.**

In fractures due to injuries by firearms there are some special points which you ought always to bear in mind. The first thing you must realize is that the injury to the bone very often bears no kind of relation to the size of the superficial wound, the extent of damage to the underlying muscles, or to the shock of the casualty. For instance, an injury due to a bullet may present only tiny wounds of entrance and exit and yet the bone may be extensively comminuted; whereas in certain types of shell wounds all the soft tissues may be torn away, leaving the bones bare but uninjured.

Cracks and fissures are exceedingly common and are frequently very extensive, the whole of the shaft being sometimes involved. With such injuries there may be no deformity, abnormal mobility, or want of alignment, and men may even walk or use the affected limb, and it may not be until there is an excessive amount of unexpected callus that the fracture becomes evident. These considerations make routine X-ray examination absolutely essential in helping us to estimate the amount of damage sustained by the bone. It may be as well to remind you that such examinations are worthless, or nearly worthless, unless photographs are made in two planes.

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1 "A crack is a cleft whose sides are very near together and can hardly be seen; a fissure is a visible cleft whose sides are widely separated."—Delorme.
Extensive comminution is the most characteristic feature of gunshot injuries of bone, and it must be recognized that there may be comminution both with and without separation of the fragments. It is this extensive comminution without separation which robs these cases of many of the signs which are characteristic of the fractures of civil life. A bullet may pass through a bone making a regular trephine opening with or without complete fracture or comminution; or the foreign body may be lodged in the bone or in the neighbouring soft parts. When fragments are driven into the soft tissues they may produce very extensive wounds at the point of exit, and it is these cases which commonly give credence to the stories about the use of "Dumdum" bullets. Sometimes quite a mass of bone may be shot clean away—a focus blown out—leaving a gap in the shaft. Splaying out of bone fragments about the track of the bullet is another common feature. It can therefore easily be understood that the ordinary signs of fracture are frequently absent, and the only safe rule is to suspect every case, and to make routine use of the X-rays.

In the leg and forearm it is fortunately common to get a gunshot fracture of one bone only, so that the other remaining intact acts as a very good support.

The surgeon must always be on the look-out for concomitant injuries to vessels and especially nerves.

So far as the wounds are concerned the same principles ought to guide us as in the treatment of compound fractures sustained in civil life. A most important point is to resist the temptation to remove loose fragments (fig. 6), for there is abundant evidence in surgery to show that bone is the best stimulus to the formation of bone. It is impossible to say how much bone will live or die, and this is a question which can only be settled by Nature, and in almost every instance she spares more than one would expect.

I know there is a great temptation to use plates and screws, but for my own part I have not yet made up my mind that this is good practice in compound fractures, and it will take a good deal of evidence to show that internal splinting is to be accepted as a principle in the treatment of gunshot injuries.

But though you are apt to be appalled by the amount of injury to the soft parts or by the amount of shattering which has occurred, you must not forget that the factors which lead to disability in similar fractures produced in civil life will also operate in these cases. This has frequently been exemplified in connexion with the bones of the forearm, and I pass round the photograph of a case of a class which is not at all uncommon. The man has been shot through both bones of the forearm, and you will see that the fragments have united in such a way that he is unable to fully supinate the hand, doubtless because more attention was paid to the wounds than to the position of the bones.
The next photograph (fig. 7) shows a similar fracture at the junction of about the middle with the lower third of the radius. In that case the same disability existed, but in an exaggerated degree.

The next case I would mention is one in which a bullet went right through both bones of the forearm. Entering on the inner side it found an exit at a point just opposite where the fragments of bone which were driven forward by the bullet had produced a very extensive superficial laceration.

In all these cases the important thing is to deal with the fracture so that the bones of the forearm are kept fully supinated. In this way the patient will acquire the best functional result, and on this the ultimate usefulness of the limb will depend. It does not much matter how the arm is put up to secure this full supination so long as the end is attained. It is not a question of some special splint or piece of apparatus, but of a principle which must be borne in mind. Personally, I prefer to use two straight splints made of gocoching and extending from just below the shoulder to the extremity of the metacarpus. The fixation of the splint to the upper arm secures complete supination of the forearm, and in actual practice this plan has been most efficient.
The same thing applies in the case of those fractures at the lower end of the femur, where there is backward displacement, as in the supracondyloid fracture of civil life. Under these circumstances the displacement must be met by flexion of the knee, and the neglect of this precaution, though it may not interfere with union, often gives rise to a very crippling amount of disability with regard to the movement of the joint.

Similarly, gunshot fractures of the upper end of the femur ought to be treated with the limb abducted if the best results are to be obtained. In most cases the principle of extension must be employed, and this more so than in civil life, because so often there is great shattering of the bone or actual loss of substance. Carrying this out often gives rise to much trouble in the lower limb, and a great deal of ingenuity has been exercised in the manufacture of apparatus for this purpose. In the upper limb the problem is simpler, and for the fractures of the humerus which are so common, the weight of the limb can usually be relied upon to secure the necessary amount of extension and with excellent results.

Most of my cases of gunshot fracture of the humerus are simply treated by suspending the wrist in a short sling, sometimes with the addition of pieces of gauze applied over the seat of fracture and fixed to the chest with a circular bandage.

It cannot be too much insisted on that bones require rest and time for their repair, and this is especially important in military surgery where the presence of sepsis so often delays union. Aching and tenderness at the site of the fracture are a sure sign that repair is not yet complete and are an equally certain guide as to the necessity of further rest.

Injuries to Joints.

The surprising way in which many of these injuries recover with a good range of movement has frequently been a matter for comment, but nevertheless all cases do not end so favourably, and after the War there will be an enormous number of ankylosed joints scattered over Europe. Since it is usually impossible to tell at an early stage of the case whether or not ankylosis will occur, it is very important to deal with these cases in such a way that should such an untoward result follow the limb will be in a useful position. This rule should always be followed whatever the cause of the joint injury, but it is especially exemplified by the number of cases met with in military practice.

I mention the case of a man who sustained a bullet wound through the elbow-joint followed by severe sepsis. The arm was treated at a right-angle, and as ankylosis followed the usefulness of the limb was much interfered with.

Injuries of this joint should be treated in a position midway between a right-angle and full flexion, for this is certainly the most useful should...
578 Importance of General Principles in Military Surgery

ankylosis occur. It is then easy to reach the mouth, to brush the hair, to get at the coat pockets, etc. Of course, such a condition may subsequently be treated by arthroplasty, but it may be that the patient will not submit to any interference or there may be some other reason why it should not be carried out, and therefore it is imperative to treat these joints in the most useful position at the outset. This equally applies to the wrist, for should it become ankylosed neither excision nor arthroplasty gives any certainty of a good result. Cases with shattered joints, such as that shown in fig. 8, should all be put up in the dorsiflexed position, for then the grasp is strong and the hand very useful. If ankylosis takes place with the wrist slightly flexed, as so often occurs, the grasp is very weak indeed. It is easy for you to test this matter for yourselves and you will be surprised at the difference the position makes to the usefulness of the hand.

If the shoulder is the joint affected the arm should be kept fully abducted, for this materially increases the range of movement obtained through the scapula and also prevents the annoyance of the arm constantly rubbing against the side.

In the case of the lower extremity, the hip should be slightly flexed and abducted. When the knee is the joint affected it should be kept a little flexed; while in cases of great destruction of that joint it is most important to prevent the outward and backward displacement which is so apt to occur. When the ankle is involved, the foot should be slightly pointed, for this much diminishes the loss of elasticity which a fixed ankle-joint entails.

What has been said about the length of time necessary for recovery in fractures and about the significance of persistent tenderness, especially applies in cases of joint injury. My experience has taught me that “more rest and less massage” is a very sound axiom in dealing with joints that have at one time been infected. If John Hilton, the gifted author of “Rest and Pain,” could but revisit this globe, he would be delighted to find that the principles he so wisely upheld have stood the test of time.

INJURIES TO NERVES.

My time is almost done, but I do not want to omit to impress on you the need of care in the treatment of paralysed parts. Great pains must especially be taken to keep the muscles, whose nerve supply is cut off, in
a state of relaxation so that the recovering nerve will not find them so over-stretched that much valuable time is wasted in "taking up the slack." This is best illustrated by a reference to musculo-spiral paralysis, where the dropped hand means harmful stretching of the extensor tendons, easily provided against by the wearing of a simple straight forearm splint during recovery.

**The Psychological Factor in War Surgery.**

The influence of mind over body is an important factor which is well recognized by all who have to deal with the sick, and it is especially so in our military work. Here we are dealing with men who are frequently a very long way from home and friends; who have suffered the fatigues of war, and have often for the first time been introduced to many of the horrors that follow in its wake. These men are not normal in mind—there is often a temporary loss of balance, and it is a wonderful commentary on the amount of backbone possessed by our nation that the wounded are so constantly cheerful and bright in spite of their great trials. But it is most important that you should recognize this aspect of the matter, and it says much for the wisdom of the authorities that as far as possible they arrange for wounded men to be sent home to England as soon as they are fit to travel. To be once again in their home-country and within reach of friends does much to help recovery in bad cases. Similarly, the bright surroundings of our hospitals are valuable therapeutic agents and they ought to be aided by a cheery optimism which I think it will not be difficult for any of you to cultivate. Always remember that one of the most valuable and cheapest remedies we possess is Hope.

**Reviews.**

A PRACTICAL GUIDE TO THE INSPECTION OF MEAT AND FOODS. By A. E. Bonham, Chief Sanitary Inspector and Superintendent of the Public Abattoirs, City of Exeter, etc.

However good the intention of the author has been, and he emphasizes this fact in his preface, to furnish a practical guide for the use of sanitary officers, he falls far short of its accomplishment. He has attempted to cover the syllabus of the Royal Sanitary Institute for the examination in meat inspection.

Far too much space in the book is devoted to the consideration of physiological and pathological data, with which he appears ill-equipped to deal. This portion of the subject would have better been omitted altogether, or else collaborated with the help of a qualified veterinary surgeon. It is doubtful, however, if the mass of ill-digested detail furnished would be of much use to a sanitary inspector. To a medical Officer of Health it is wearisome and full of inaccuracies.