three hours after the operation, I was sent for, as there was a good deal of bleeding. On taking down the dressings, a large blood-clot was found distending the wound, and passing under the surrounding skin. Having cleared out the clots, a small vessel was found and secured, after which there was no further trouble. Had the opening into the peritoneal cavity not been efficiently closed, no doubt internal bleeding would have gone on, to a possibly fatal extent. Subsequently, the patient had very violent diarrhoea, and gradually sank. She died on the tenth day after operation. At the *post mortem* examination, it was found that a small portion of the intestine (about the size of a threepenny-piece) which had occupied the hernia had sloughed; the abdominal opening was closed by a plug of lymph, and from it spirally radiating folds of peritoneum could be traced for a considerable distance, adherent in many places by recent lymph to the attached peritoneal surface; showing, when the specimen was recent, very beautifully the result of torsion.

My experience of this operation is as yet but small; I trust, however, that the present communication may be the means of inducing other surgeons to give this method a fair trial, so that soon we may have sufficient statistics from which to draw conclusions; and I am convinced that a large number of permanent and complete cures will eventually be credited to the operation by torsion of the sac.

ON THE NATURE OF RIFLE-BULLET WOUNDS, AND THE PRINCIPLES OF THEIR EARLY TREATMENT.

Read in the Section of Surgery.

By GILBERT KIRKER, M.D.,
Surgeon, R.N.

WHILE attending to the Turkish wounded in the services of Lord Relyea and the Stafford House Committee, I was struck by the facility with which some severe bullet-wounds—notably one of the thigh, with fracture of the bone—were healed. This directed my attention to the nature of rifle-bullet wounds, on which subject I made some observations in Turkey, and a number of experiments after returning home. A few of the results of my work, having been experimentally examined by Professor Longmore, were referred to by him at the meeting of the International Medical Congress in London, while a fuller record of them is published in a paper in the *Transactions* of that meeting.

In the present paper, I propose to refer briefly to the more important points, in what I stated was the nature of rifle-bullet wounds; to show how what I have seen of wounds produced in the South African and Egyptian wars has sustained my statements; and to point out what principles of early treatment can be founded on a knowledge of the nature of these wounds.

It will assist in a more thorough understanding of the first subject, to look at the attributes of the projectile by which the wounds are produced; and, as the most typical rifle-bullet, I shall take the cylindro-conoidal.

The transverse or wounding area of this bullet is relatively small, its impinging end is somewhat pointed, and, when in motion, it rotates screw-like. These attributes enable it to travel with a minimum expenditure of force, and, consequently, it retains for a long time a high velocity.

If we were to consider what would be the effects of such a projectile traversing an animal organism, we should expect that its track, in direct proportion to the small amount of obstruction which can be offered by the tissues, would show little evidence of destructive action. This conclusion, I submit, is in harmony with what generally takes place; but, remembering the instances in which there is great destruction of tissue in rifle-bullet wounds, it may seem to disagree with experience. These latter instances, however, I believe, are exceptional, and due to some uncommon accident affecting their production, by which the great force which the projectile has conserved to the distance at which wounds are generally inflicted is brought into action and transformed into tissue-destruction, and also sometimes to improper early treatment. That the possession of great momentum which is not brought into play by a projectile in the production of a wound augments the destruction of tissue seems to me impossible. In the paper to which I have referred in connection with this point, there occurs the following passage. "Because the cylindro-conoidal bullet, as a rule, wounds at a greater velocity than the round, it is, therefore, by most authorities, said that, *ceteris paribus*, it produces a greater amount of tissue-injury. I not only hold, however, that this opinion is incorrect, but that reason will build on the same

fact just the opposite conclusion. The disturbance or injury to a body penetrated by a projectile is in proportion to the loss of momentum the projectile suffers; the resistance of the one is overcome by a proportionate expenditure of force by the other. The great characteristic of a rifle-projectile is that, owing to its shape and mode of rotation, it penetrates substances with the minimum expenditure of force, and thus conserves its momentum, and also the varying factor of its momentum velocity. That the greater wounding velocity of the cylindro-conoidal bullet is due to the characteristic facility with which it penetrates, and not to greater initial velocity, is proved by the fact that the modern rifle expels its projectile with less initial velocity than some of the old smooth-bore fire-arms. Therefore, since the cylindro-conoidal bullet retains a greater wounding velocity than the round, it penetrates with less expenditure of force, and in a given wound produces less tissue-injury."

As a rule, a rifle-bullet carries none of the soldier's clothes or accoutrements before it into the wound.

The entrance and exit openings of rifle-bullet wounds are small, and represent only the rupture of the skin. To this rule, there are exceptions in the case of entrance-openings, where the bullet has impinged on skin lying immediately over a bone; and, in the case of exit-openings, when the bullet has been altered in shape, or has carried pieces of bone with it. It is always possible, I believe, immediately after the production of the injury, to distinguish between the entrance and exit openings. The former is small, round, and its edges, which may be blackened, are inverted; while the latter is more irregular in shape, its edges are everted, and some of the subcutaneous tissue protrudes from its centre. Changes, however, soon take place, which make it impossible to distinguish one from the other, and I have generally observed the wound of exit to heal before the wound of entrance.

In the subcutaneous soft parts, the character of a rifle-bullet track seems to depend very much on the arrangement of the constituent tissue-fibres; in aponeuroses, or in the subcutaneous cellular tissue, the fibres are reticulated, the track is round, and has a tendency to remain open; but where, as in muscle, the tissue-fibres have a certain parallelism, the bullet seems to slip between, and leave a slit-like track, whose sides tend to come together. In most cases, therefore, I believe that, other things being equal, an injury of bone in a rifle-bullet wound will heal better where there is a good covering of muscle, than where it lies immediately below the skin and subcutaneous cellular tissue.

The injuries to bones which rifle-bullets produce, owing to the nature of the bone struck, and the manner in which the bullet strikes, are, of course, extremely various, but they have all certain common characteristics. In them, there is little comminution of the bone, but extensive fissuring; for, fractures being produced by the bullets clearing for themselves a passage through the bone, the more they do so by splitting, the less breaking down they have to do.

I have been able, I believe, to actually demonstrate what is here stated. While experimenting, some time ago, with reference to the relative amounts of splintering at the entrance and exit apertures of penetrating fractures of the skull, I noticed that, when the force was applied to the inner surface of the bone, fissures were more apt to be produced than when it was applied to the opposite side. Subsequently, I made this accidental result the subject of examination. I fired a small rifle-bullet through a number of calvaria, aiming sometimes at the inner side, and sometimes at the outer. These experiments not only showed that fissures were oftener produced under the former circumstances than the latter—being the rule in the one, in the other the exception; but again, by accident, I observed that the hole with fissures, which the bullet made in passing from the inside, was less in size than the hole without fissures, which it made in passing in the opposite direction.

Owing to rifle-bullets fracturing bones in this manner, the fragments produced are not deprived of their connections with soft tissue. They retain their own attachments to periosteum and muscle, and, immediately after the injury, they are all connected to each other and the parent bone by the periosteum stretching across the fissures. I look upon the knowledge of this fact as one of the most important acquisitions which military surgery has lately gained; for I expect, when surgeons are able to give to gunshot fractures a fitting treatment in the light of this knowledge, the most dangerous of the not immediately fatal wounds of warfare will lose much of their gravity.

When a rifle-bullet strikes cancellous bone, such as the upper or lower end of the femur, the fragile structure yields and breaks before it, is partly carried forward, and partly crushed against the walls of the track. A moiety of what is crushed laterally is destroyed, while the remainder is saved by the elasticity of the tissue. The latter por-

tion returns to its place, and a tunnel is left, less in diameter than the bullet which formed it. There is no fissuring, but the exit opening has a bevelled margin.

In the bones of the horse there is, immediately under the articular cartilage, a layer of dense brittle bone, which, when struck, breaks into cuboid fragments, and becomes traversed by wide gaping fissures, which destroy the joint. There is a similar material in some of the human bones, and I have seen a fracture of the astragalus with all the characteristics described.

When the bullet strikes the compact shaft of a long bone, it produces, as a rule, extensive fissuring and little comminution. Many and large unremoved splinters, but few and small displaced and free ones result. Fissures from fractures of the shafts of bones frequently run into the neighbouring joints, and their courses may be either direct from the point struck, or from the point of junction of two intervening fissures. From what is here stated, it will be seen that a joint is less likely to be invaded by fissures when the injury is in the true cancellous tissue, than when it is in the compact shaft.

If, now, the foregoing descriptions of the injuries produced by rifle-bullets are correct, it must be admitted that its wounds represent comparatively little destruction of tissue, and are, from their nature, prone to heal with comparative ease and rapidity.

This conclusion was borne out by what I saw at Netley of rifle-wounds received in South Africa; and, as far as I have been able to learn among the wounded in Egypt, there have been observed more cases of rapid and uncomplicated healing of even severe gunshot wounds than took place before the rifle-bullet was in use.

At Port Said three gunshot-wounds came under my notice, which showed some of the points to which I have referred. At the same time two Egyptians and a mule were wounded by rifle-bullets, and, curiously enough, in each case the wound was in one or other thigh. In the cases of the men, the bullets struck their limbs somewhat obliquely, did not penetrate deeply, and, on account of involving chiefly the skin and subcutaneous cellular tissue, produced a good deal of laceration, and left open wounds. In the case of the mule, however, the bullet struck perpendicularly on the muscular mass of the thigh in front of the bone, and the animal attracted attention on account of lameness; but it was only after a good deal of searching that the very small entrance and exit-openings of the wound, from which there was no hæmorrhage, were found. The mule shared in the attention bestowed on the men, and pieces of lint and carbolic oil were applied, and bandaged on its wounds. The dressings did not remain on long, and were never reapplied, but in two or three days the animal was at its work, only showing slight lameness, and the wounds were not observable.

These cases showed that, in oblique superficial wounds, the rifle-bullet may produce much destruction of tissue; while, when it strikes a muscular mass fairly, though it penetrates deeply, its wound soon heals.

Now, with regard to the early treatment of rifle-bullet wounds, the principles which should be followed are already being recognised in military surgery, and in reference to them I make no pretension of originality. I believe, however, that it will further their acceptance to show how the practice which is being found most successful is in harmony with a knowledge of the nature of the wounds.

There should be no opening up or examination with finger or probe of these wounds. Many superficial flesh-wounds and compound fractures, where the bone is near the surface, are open after being produced; but, as a rule, where the bullet traverses muscle, with or without fracture of bone, its track closes after it, and the injury becomes practically subcutaneous.

When in wounds of the extremities there is injury of bone, the fracture should be fixed at the earliest opportunity. In such injuries, I believe, the importance of this principle cannot be overstated; and it would be well if not only the medical officers who treat, but the sailors and soldiers who suffer, were impressed with the same belief. The latter should be instructed, on having a leg or arm broken by a bullet, to keep it if possible completely at rest until they come under medical care. Remember what I have shown to be the character of rifle-bullet fractures. They are extensively fissured, but slightly comminuted. The fragments are held together by periosteum, a far from strong membrane, which probably at every movement, even the most gentle, is partly rent. With want of attention or recognition of this principle, it is easily seen, how these fractures, through rough or careless handling, become most serious injuries, and so have acquired the bad character which they possess.

These two principles I consider by far the most important in the treatment of rifle-bullet wounds, which are the immense majority of those received in modern warfare; but the kind of dressing that is

first applied is not a matter of indifference, or the system of treatment which is subsequently adopted. At the present time, it is the general opinion of military surgeons that the Listerian antiseptic system cannot, in its entirety, be carried out at the front. I am one of those who are not deeply dejected at the fact, and who do not see that the advancement of the early treatment of gunshot-wounds is inseparably bound up with the successful working of Listerism in the field. In my opinion, all that is required of a first dressing is that it shall support and protect without irritating; and the dry absorbent pads, now gaining great favour in surgical practice, when properly applied, seem to satisfy these conditions. I should rather labour to perfect a means of quickly and effectually immobilising gunshot-fractures, than one of carrying carbolic acid spray at the butts of the rifles.

Great success, which has been attributed to antiseptic treatment, followed the practice of certain surgeons, most notably Dr. C. Réyher, when attending to the Russian wounded in the late Russo-Turkish war. That much praise is due to these gentlemen for the splendid work which they did, no one will for a moment deny. They have extended our view of the range of the possibilities of military surgery; but that their exceptional results depended altogether on a more thorough application of the antiseptic system, is questionable.

In the first place, the wounds which they treated were produced by the Peabody-Martini rifle-bullet, the projectile with the smallest wounding diameter of any which up to that time had been used in war.

In the second place, Dr. Réyher, owing to exceptionally favourable circumstances, appears to have been able to observe both the principles which I have mentioned, as the most important in the treatment of the wounds with which he had to deal.

In the third place, with regard to a series of wounded knee-joints, which were most successfully treated by Dr. Réyher, as far as I am aware, no details of the exact position of the wounds have been published. I think I am justified in saying that, from the fact that rifle-bullets generally penetrate the cancellous ends of bones without producing fissures, and from the great difficulty there would be, in the absence of inflammatory symptoms in the joints, of telling whether or not they were really injured, there is a possibility that errors in diagnosis may have been made. This possibility may be very faint; but it must be considered, unless in every case the bullet traversed some part of the plain of articulation, or of the bone close to it.

I wish again to express my admiration of the work done by the surgeons to whom I have referred, and also to submit that, before their exceptional success can be altogether ascribed to antisepticism, the three considerations I have mentioned must be shown to have had no influence in it.

I have had considerable diffidence in bringing forward views which differ somewhat from those held by others, before this section, whose members represent so much learning and experience in surgery, and before its President, Sir William Mac Cormac, himself well skilled in military surgery, to whom, I wish also to add, I chiefly owe the opportunities I have had for gaining any experience I may possess.

Surgeon-Major GRIBBON said there could be no doubt that what the President of the Section had remarked, as to the necessity for having the very simplest form of first dressing on the field, was unquestionable. In Afghanistan he used lint, soaked in tr. benzoin. co. with the best effect. He agreed with Dr. Kirker that the speedy immobilising of gunshot-fractures was the first condition of their successful treatment.

TWO CASES OF PHLEGMASIA DOLENS IN THE RIGHT LOWER EXTREMITY.

Read in the Section of Obstetric Medicine.

By ROBERT ESLE, M.D.

Senior Surgeon to the Ulster Hospital for Women and Children, Belfast.

THE interest attaching to the two cases of phlegmasia dolens I am about to bring under your notice, consists mainly in both being in the right lower extremity; in both occurring in the same hospital and nearly together; and in the additional fact, that both may be accounted for by position, as both patients lay on the right side during and after labour.

It is not my intention to make any reference to the disease in its general symptoms or treatment.

CASE 1.—On October 30th, 1883, Mrs. C., aged 30, was admitted into the wards of the Ulster Hospital for Women and Children. Her