NOTES FROM THE ANGLO-RUSSIAN HOSPITALS.

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We returned some months ago from Russia after respectively eleven, eleven and a half, and six and a half months of service with the Anglo-Russian hospitals. In the hope that a record, brief and imperfect as it must be, of our work among the Russian soldiers may be of interest to our surgical colleagues in this country and on the Western front, we venture to direct attention to certain of the results of our experience, trusting that here and there a hint of importance may be gleaned by them.

We would at the outset draw attention to the fact that, owing to the stupidity of a Russian customs official on the Russo-Finnish frontier, who, in spite of our strenuous protest, couched in very indifferent Russian, tore up the manuscript of our notes of several cases, under the notion that they contained treasonable matter, this communication necessarily lacks many details of statistical importance, and that its value is impaired by the loss of these notes, because we have had to rely, in their absence, partly upon memory instead of on manuscript. Fortunately one of us (C. J. M.) was lucky in meeting with no such obstacle in his journey to England, and his notes have enabled us to fill up many blanks and to check our memory regarding many details.

The Anglo-Russian Hospital, which owes its inception largely to the energy and devotion of Lady Muriel Paget, was divided into four sections: (1) The hospital in Petrograd, in the Dmitri Palace on the Nevsky Prospect, the main street of Petrograd, an excellently equipped institution of 200 beds with a complete staff and an admirably arranged x-ray department and bacteriological laboratory, all the necessary plant having been brought from London. (2) The field hospital, a mobile unit in tents, with 42 ambulance and transport carts, 125 Russian sanitars (orderlies), and 8 British nurses, was attached to the Russian Guards and moved with them. The Russian Guards should be considered rather as an army than as a regiment, as we were informed that they numbered 120,000 men. (3) A hospital in a large barracks at Lutsik, under the care of Mr. Geoffrey Jefferson, M.S.Lond., F.R.C.S. Eng. In this hospital a vast amount of surgical work was most efficiently performed, but we had no direct connexion with it except that two of us visited it occasionally as consulting surgeons. (4) A fleet of 22 motor ambulances, which proved of the greatest value. The main roads in Russia are, in general, excellent, though in summer terribly dusty. The side roads are very bad. It was our practice to keep the motor ambulances on the main roads and to trust to horse transport to bring the wounded from the dressing stations to the main roads, where they were transferred to our admirable motor ambulances. During the eleven months November, 1915, to October, 1916, more than 6,000 patients received treatment in the Anglo-Russian hospitals. The time that the patients remained under treatment was widely different in the various hospitals. At the front it rarely exceeded one week; in Petrograd, owing to the lack of convalescent homes in Russia, the patients had to remain in hospital until their wounds were completely healed.

I. The Treatment of Infected Gunshot Wounds, with Special Reference to Compound Fractures.

As so many gunshot wounds are associated with a compound fracture of a bone it is advisable to consider their treatment together. Surgical opinion is divided on the question whether antiseptics should be employed or not. We confess that we can give no definite answer. We are convinced that strong antiseptics, such as pure carbolic acid, while they are distinctly harmful to the tissues, do not sterilize the wound; their employment we unhesitatingly condemn. It is more difficult to dogmatize as

regards the comparative value of eusol, prepared according to the formula of Professor Lorrain Smith, and the hypertonic saline solution of Sir Almroth Wright. We have treated hundreds of infected wounds and of infected compound fractures both with eusol and with hypertonic saline solution; we are not yet convinced which method presents the greater advantages. We can only state that both are, in our opinion, a great advance on older methods of treatment.

II. Tetanus.

From this scourge we were favoured with an extraordinary immunity, notwithstanding the fact that for many months we could very rarely obtain antitetanic serum. So far as we were able to ascertain only three of our patients suffered from tetanus. One patient, under the care of W. D. H., developed the disease on the fifth day after admission and died two days later. In the two other cases the incubation period was long (nineteen and twenty-two days respectively). In the absence of antitetanic serum we had to fall back upon the carbolic acid treatment. We employed far larger doses of carbolic acid than are generally recommended; thus for the first three days we administered hypodermically 1 oz. of a 5 per cent. solution of carbolic acid every four hours. In neither case was carboloria produced and both made excellent recoveries. Our experience is in striking contrast to that gained by us in the R.A.M.C.T. hospitals, where we, in the earlier days of the war, treated patients from the Western front who had not, as is now invariably the case, received a prophylactic injection of antitetanic serum. We can only attribute the difference in the incidence of tetanus to the contrast between the dusty, comparatively uncultivated soil of Volhynia and the highly-manured fields of Flanders.

Immediately on admission every gunshot wound was freely opened under anaesthesia, and finely powdered potassium permanganate (about 1 oz.) was rubbed into all the wound surface. This caused a considerable development of heat, the wound "smoked" and assumed a blackened appearance. The superficial necrosis of the tissues cleared away in four to five days, at the end of which time the wound had a healthy granulating aspect and union by second intention rapidly followed. This treatment, which we carried out in hundreds of cases of infected wounds (including compound fractures), was attended with the happiest results. It did not appear to retard the healing of the wounds, and, so far as we are aware, in no case did tetanus subsequently result. We consider the rubbing into the wound of powdered potassium permanganate an admirable method of treatment of gunshot wounds, especially in cases in which antitetanic serum is not available, and we recommend it with confidence.

III. Bullet Wounds of the Brain and Hernia Cerebri.

Of these injuries we had a large experience. Thus, in one convoy of wounded, we admitted fourteen patients suffering from rifle or shrapnel wounds of the brain. We learnt to employ the freest possible drainage, for it soon became apparent to us that the chief mortality was due to septic infection, and that the only way to avoid it was to establish the most complete drainage of the wound secretions. We therefore opened the wound widely, removed all loose fragments of bone, and, after securing efficient drainage, covered the open wound with gauze moistened with formalin lotion (2 per cent.). It is noteworthy that of these fourteen cases in this one convoy twelve left the field hospital apparently well on the road to recovery at the end of seven days from admission, and that only two died in hospital. Attention should be drawn to the difference in prognosis between cases in which the bullet perforates the skull and those in which it remains embedded in the brain. In our experience the vast majority of the former recover, of the latter die. In the base hospital in Petrograd we had a large number of cases of hernia cerebri, the result of gunshot wound of the brain. The routine treatment was to cover the hernia cerebri with gauze soaked in formalin solution (2 per cent.) for three days. At the end of this period the hernial protrusion was covered by a brownish membranous slough, and bacteriological examination proved that it was practically sterile. The protrusion was then shaved off level with the opening in the skull and the formalin dressing reapplied. As soon

as the wound was healed an operation for closure of the gap in the skull was undertaken. This was effected by turning into the opening fragments chiselled from the outer table of the skull (pericranial surface inwards) while still maintaining their connexion with the pericranium at the margin of the aperture. In other cases thin layers of costal cartilage were employed for this purpose. In every case Cargill membrane or egg membrane was inserted between the brain substance and the bone or cartilage. With the exception of one case, in which an abscess of the brain was situated underneath the hernia cerebri (this abscess was diagnosed and drained, but subsequently burst into the lateral ventricle with fatal result), this procedure secured excellent results in every instance.

IV. Compound (Gunshot) Fractures of the Lower Ends of the Tibia and Fibula.

We were amazed to find how frequent such injuries were. On one occasion we found no fewer than eleven patients suffering from gunshot compound fractures situated a few inches above the ankle-joint in successive beds in the Petrograd hospital. We are unable to account for the frequency of such injuries. We were informed by the Russian military authorities that the reason of their common occurrence was that the German and Austrian soldiers were ordered to fire at the feet of the troops opposed to them. As we have, in our experience in the 1st and 4th London General Hospitals, met with no such preponderance of similar injuries, we are not convinced that the above explanation suffices to explain the enormous number of cases we had to deal with in Russia. We refer to the matter chiefly to draw attention to the advantage to be obtained in the treatment of such injuries, especially in cases in which the deformity is marked, by subcutaneous tenotomy of the tendo Achillis, a procedure we carried out in a large number of instances with most satisfactory results.

V. Suppurative Arthritis.

It is essential to distinguish between suppurative arthritis due to a wound of the joint and those cases that are due to metastatic infection from a pyogenic focus, whether due to a wound or not. In the treatment of metastatic pyogenic arthritis we invariably adopted the plan laid down by the late John B. Murphy of Chicago, to which attention was directed by one of us (H. F. W.) in a contribution to the BRITISH MEDICAL JOURNAL, February 6th, 1915, entitled "The employment of ether in surgical therapeutics." In every case of metastatic pyogenic arthritis that came under our care we refrained from incision into the joint and drainage, as we knew from past painful experience that such treatment almost invariably resulted in bony ankylosis. Convinced converts to the Murphy theory, we aspirated the pus from the joint cavity, injected ether or a 2 per cent. solution of formalin in glycerin and applied adequate extension; by this we mean 20 lb. for the knee-joint; twenty-four hours later we reaspirated the joint and reinjected ether or formalin glycerin (2 oz. for the knee-joint), and continued this treatment daily until the joint recovered. So far as we are aware, in no case did ankylosis result. The results obtained in suppurative arthritis due to a wound of the joint were far less favourable. In such cases ether was inadmissible, as its vapour forced its way through the opening into the joint. Formalin glycerin was no more satisfactory, and we were driven therefore to employ free drainage combined with continuous eusol irrigation. In many such cases osseous ankylosis resulted, and in two instances amputation had to be resorted to.

VI. Bone Grafting.

This measure was employed to secure osseous union in several cases in which the loss of bone caused by a gunshot wound was too great to permit of union of the fragments. In no case was it attempted until the wound in the soft parts had completely healed. Then the fractured ends of the bone were sawn off and an intramedullary splint, obtained from the opposite tibia (the tibia was the bone affected in the majority of instances), was inserted into both revived ends of the fractured bone and fixed securely with screws or nails. All these cases yielded a satisfactory result.

VII. Intestinal Worms.

The Russian soldier is a very frequent host of the *Ascaris lumbricoides*. In the large majority of patients proved to be infested by this worm no symptoms of ill health could be traced to its presence. The number of soldiers who vomited these worms after operation was truly amazing. One day, out of four patients who had been operated upon three vomited one or more ascarides. During our service at the field hospital a Siberian soldier was admitted nearly moribund from general peritonitis. On opening the abdomen much pus and gas escaped. In the peritoneal cavity were five ascarides, which had found their way out of the small intestine through three circular perforations of the ileum, all situated in a segment of bowel $1\frac{1}{2}$ in. in length. We were unable to discover the cause of these intestinal perforations. The patient died a few hours after resection of the affected segment of the ileum.

VIII. Gas Gangrene.

This terrible condition was the cause of the majority of the deaths at the field hospital. Many of our patients had lain, after being wounded, in No Man's Land for four or even five days, and on admission were suffering from virulent gas gangrene, with its vilely putrescent odour and grave toxæmic symptoms. Immediate amputation, wherever feasible, was performed, and, owing to the splendid vitality of the Russian, and more especially the Siberian soldier, in a large majority of cases proved to be life-saving. In cases in which amputation was not possible—for example, in infected wounds of buttock and back—the freest incisions, combined with rubbing into the opened-up wound surfaces of powdered potassium permanganate, secured, in a considerable number of instances, an unexpectedly favourable result. Two things we learnt definitely about the treatment of gas gangrene: (a) That injection of hydrogen peroxide into the infected tissues, warmly recommended in some quarters in the expectation that the nascent oxygen will have an inhibitory effect on the development of the infecting anaerobic microbes, is entirely harmful, as it increases the tension in the affected part, whereas the desideratum is the relief of tension; and (b) that when gas gangrene affects a muscle the entire muscle should be extirpated from its insertion to its origin. This procedure we carried out in a large number of instances with very satisfactory results. A case successfully treated by W. D. H. may here be mentioned.

A Russian colonel, who had been left for five days in the open after being wounded, was admitted with extensive gas gangrene involving the whole of the upper extremity, and spreading for several inches on to the chest wall. Although there seemed to be small hope of saving life, as the patient's condition appeared desperate in the extreme, disarticulation at the shoulder-joint was performed and an intravenous injection of normal saline solution given on the operating table. Despite the extension of the gas gangrene to the subcutaneous tissue of the chest, the patient made a rapid recovery.

Isolated instances of the development of gas gangrene twenty, thirty, or even forty days subsequent to the infliction of the wound, came under our care at various times. The following case shows that the infecting microbe may remain dormant for sixty-seven days and then produce gas gangrene:

A Siberian soldier was admitted into the Petrograd hospital suffering from a comminuted fracture of the upper end of the right femur. The limb was three inches shorter than the left leg. His papers proved that he had been wounded by a fragment of a bomb sixty-six days prior to admission. X-ray examination revealed the presence of a fragment of metal the size of a filbert, wedged in between the overlapping fragments of the femur. The day after admission the edges of the wound became black and the discharge was characteristically putrid. Gas crepitation was made out around the wound, and Dr. Rosher, bacteriologist to the hospital, demonstrated *B. perfringens* in the discharge from the sinus. The patient's condition was grave in the extreme; the pulse was 140 and the temperature 103.6°. The sinus was opened widely, the bomb fragment extracted, and all the gangrenous tissue removed with scissors. The entire wound was rubbed with powdered potassium permanganate and constant irrigation with a strong solution of the same chemical was instituted. The disease was thus promptly checked and in five days the pulse and temperature fell to normal. It is of great interest to record that, a few days later, the patient developed bilateral suppurative mastoiditis and that from the gas-containing pus of the abscess on the left side *B. perfringens* was isolated.

IX. Gas Gangrene Pyaemia.

We know of no case in which gas gangrene pyaemia has been recorded, but as we were many months in Russia and unable to obtain the medical journals, we may readily have missed a notice of this condition. That there is such a thing as gas gangrene pyaemia is, we think, proved by three cases.

1. The patient just mentioned in whom the *B. perfringens* was discovered in the pus evacuated from an acute mastoiditis.

2. A young Siberian soldier was wounded near Riga, January 30th, 1916, and admitted into the Petrograd hospital on February 3rd, suffering from a fracture of the body of the left scapula caused by a bomb. There was no wound of exit. On February 4th his condition was grave, the pulse was 135, and the temperature 103.5°; there was a brawny swelling just behind the left clavicle. An incision into this swelling evacuated much stinking gaseous pus in which the *B. aerogenes capsulatus* was discovered by Dr. Rosher. The following day two small abscesses were incised, of which one, over the left tibia, contained a tiny fragment of metal and the pus evacuated contained the *B. aerogenes capsulatus*; the other, situated on the right thigh, contained the same organism. This patient, under treatment by eusol intravenously, made an excellent recovery. Naturally, as the former of the two small abscesses was the result of a wound, we lay no claim to its being of pyaemic origin. The second of the two abscesses, which was unassociated with any wound and contained the *B. aerogenes capsulatus*, appears to us to sustain our contention that it was pyaemic in origin. It must be admitted that blood cultures made by Dr. Rosher proved negative, but this is not surprising as, prior to the abstraction of the blood for the purpose of obtaining a culture, intravenous infusion of eusol solution had been employed.

3. Late one night a soldier was admitted into the field hospital suffering from gunshot wounds of the head, of the left humerus, and of the soft parts of the right thigh. The wounds were clean perforations, and the patient's condition appeared to us in no way serious. At 2 p.m. the next day he was almost pulseless. Examination revealed a large area of gas gangrene situated over the right lower chest and upper abdomen. Incision into this crepitant area gave exit to a large quantity of gas-containing fluid, and the subcutaneous and muscular tissues showed the typical appearance of gas gangrene. As we were at the field hospital and, at the time, overwhelmed with work, no bacteriological examination was made, but the two of us (H. F. W. and C. J. M.) who saw the case are convinced that it was one of pyaemic gas gangrene. The area of the gangrenous patch was at least twelve inches from the nearer of the two wounds. It is difficult to avoid the conclusion that the microbes were conveyed to the part by the blood stream.

X. Intravenous Infusion of Eusol Solution.

This method of therapeutics was employed by us in a large number of cases, and we entertain the highest opinion of its value as a life-saving method in many apparently hopeless cases of septicaemia and pyaemia. A striking example of its efficiency was afforded by Case 2 recorded above. Several of our colleagues who saw this patient were convinced that the young man must die, yet, thanks to intravenous eusol infusion, he made an excellent recovery. In many instances in which, for some reason not discoverable, the patient appeared to be steadily going from bad to worse from some form of septic infection, a single intravenous infusion of eusol turned the scale in favour of recovery, and this improvement was, as a rule, rapid. We may mention that in these intravenous injections we used a large dose of eusol. Almost invariably, in cases that appeared to call for its employment, 100 c.cm. of Lorrain Smith's solution of eusol were given intravenously, and we had no hesitation in repeating this dose daily for several days. No toxic symptoms were ever noticed. So far as our memory serves, our results in cases of streptococcal septicaemia were, in general, disappointing. In three such cases the intravenous injection apparently had no good effect, and a similar failure has recently been observed by one of us (H. F. W.) at the 4th London General Hospital. We can offer no explanation of the comparative inefficiency of the treatment in infections due to streptococci in contradistinction to its sterling value in other bacterial septicaemias.

XI. Tendon Transplantation in Cases in which too long a Segment of a Motor Nerve has been Destroyed to allow of its Ends being Sutured.

Two such cases came under our care, and were operated upon with very satisfactory results.

(a) A large splinter of shell had carried away the upper four inches of the fibula, together with the external popliteal nerve and a considerable mass of muscular tissue. There was complete paralysis of motion and sensation in the distribution of the external popliteal nerve. The limb below the knee was useless, the ankle-joint fully extended, and the toes flexed. The

following operation was carried out by H. F. W.: A vertical incision, five inches in length, was made over the tendo Achillis, which was divided by two longitudinal incisions into three equal segments—an inner, middle, and outer. The three strips of tendon were divided transversely just above their attachment to the os calcis. An incision just above the external malleolus exposed the tendons of the peroneus longus and brevis. By tunnelling through the subcutaneous tissue the outer segment of the divided tendo Achillis was brought into contact with the two peroneal tendons, and a small perforation having been made into each of these tendons the cut end of the outer segment of the tendo Achillis was brought through each perforation and fixed securely by means of chromicized catgut sutures. In a similar manner the inner segment of the tendo Achillis was brought through perforations in the tendons of the tibialis anticus, the extensor longus digitorum, and the extensor proprius hallucis, just above the internal malleolus, and fixed by means of sutures. The middle segment of the tendo Achillis was left unattached in the hope, which was justified, that it would unite with the short distal fragment of the tendon. The foot could now be brought to a right angle with the leg. The after progress of the case was excellent, the patient being able to walk satisfactorily and to extend his toes.

As the method gave so excellent a result, it was repeated in the case of a girl, aged 8 years, admitted into the Victoria Hospital for Children early in February, 1917, suffering from paralysis of all the muscles supplied by the external popliteal nerve, the result of infantile paralysis. In this case we were also much gratified by the result obtained, and we venture to recommend the method in similar cases.

Since the above was written we have obtained a third equally satisfactory result.

One of us (H. F. W.) has since returning from Russia had under his care two patients suffering from paralysis of the quadriceps extensor crureus muscle, the result of acute anterior poliomyelitis. In one case the tendons of the biceps flexor cruris and of the gracilis were inserted into the suprapatellar tendon of the quadriceps with excellent result, the patient being now able to extend the knee satisfactorily. The second case has been operated upon too recently to permit of any report as to the results.

(b) As the result of a gunshot wound of the right humerus a considerable comminution of the middle third of the humerus had occurred, with much callus formation and paralysis of the musculo-spiral nerve. An extensive dissection failed to reveal the distal end of the musculo-spiral nerve. It was then decided by H. F. W. to divide the tendon of the flexor carpi radialis, under the anterior annular ligament, and to insert it into the extensor tendons of the thumb and fingers three inches above the level of the wrist. This operation was easily performed, and the patient was well satisfied with the result, as he could extend the thumb and fingers completely, though, naturally, all the digits had to be extended at the same time.

XII. Surgery of Arteries.

Simultaneous Ligation of Common Femoral, Superficial Femoral and Deep Femoral Arteries.—This remarkable case, abstracted from notes by C. J. M., appears worthy of record from the fact that no gangrene followed the simultaneous ligation of all the above arteries.

The patient was admitted into the field hospital three days after he had been wounded by a fragment of shell which entered just below the left anterior superior spine of the ilium. There was no wound of exit. Scarpa's triangle was occupied by a brawny mass, the skin was discoloured, and distinct pulsation was readily made out. As the skin was threatening to rupture, an incision was made over the line of the main artery. The cavity of the false aneurysm was opened, and some 10 oz. of recent clot were turned out of the wound; furious haemorrhage occurred from the depth of the wound. Owing to the staining and infiltration of the tissues it was difficult to recognize the landmarks. The superficial femoral artery was ligated (by H. F. W.) 2 in. below Poupart's ligament. This had no effect in diminishing the bleeding. The common femoral artery was then ligated. This almost completely arrested the haemorrhage and allowed inspection of the wound. It was then clearly demonstrated that the shell fragment had torn the profunda artery completely across, exactly at the site of its origin from the parent trunk, and had thus left a hole in the latter which involved the lowest part of the common femoral and the uppermost portion of the superficial femoral arteries; the divided end of the deep femoral artery was then ligated.

The operator (H. F. W.) desires to express his thanks to his colleague, Professor Graham Aspland, for his valued help under very trying circumstances.

We, naturally, felt certain that gangrene must supervene, and the only question in our minds was as to its extent. Fortunately the circulation was completely restored, and when the patient left the hospital, ten days after the operation, the circulation, even in the toes, appeared normal. C. J. M. in his note on this case lays stress on the fact that the gradually increasing pressure on the vessels may for some time have allowed a certain amount of blood to run through the superficial femoral artery, and thus have given time for the anastomosing circulation to have been fully restored in sufficient degree to maintain the vitality of the limb.

Syme's Amputation Performed after Ligature of Posterior Tibial and Plantar Arteries.—A volunteer had been excused military duty owing to osteomyelitis of the tarsus eight years previously, with resulting ankylosis of the ankle-joint. He had, however, insisted on serving as a volunteer.

His patriotism was ill rewarded, as marching caused a recurrence of his tarsal osteomyelitis with abscess formation in the foot and numerous secondary abscesses. One of these, situated midway between the internal malleolus and the heel, had been incised in such a way that the posterior tibial artery had been severed at its point of bifurcation into the two plantar arteries. Secondary haemorrhage occurred in the train and on admission to the Petrograd hospital bleeding was still going on. The three vessels were ligated. The next day much carious bone was removed from the tarsus, but, in spite of free drainage, it was found necessary to amputate the foot. After consultation it was decided to attempt a Syme's amputation in spite of the fact that the above vessels had been ligated. The amputation was skilfully performed by our colleague, Captain Gardner, and as some sloughing was anticipated larger flaps than usual were made. Union by second intention was secured and an excellent, though somewhat bulky, stump was obtained.

An interesting case under the care of W. D. H. deserves mention:

Fracture of Base of Skull, Rupture of Both Branches of the Middle Meningeal Artery, and Laceration of Intracranial Venous Sinuses from Shell Concussion without External Wound: Recovery.

The patient could only remember that a large shell burst near him and that after this he lost consciousness. He had no wound and no bruising was discovered. Typical symptoms of intracranial haemorrhage supervened. On trephining, a long fracture was discovered running from the parietal region towards the base of the skull. Both the anterior and posterior branches of the middle meningeal artery were ruptured and had to be ligated. Much bleeding from the basal intracranial sinuses (petrosal?) necessitated firm plugging for its control. The patient made a rapid recovery.

XIII. Aeroplane Bombs and Bomb Wounds.

One of us (H. F. W.), prior to visiting Russia, had a terrible experience of the wounds caused by bombs dropped from Zeppelins, as he had been surgeon for the day at Charing Cross Hospital when the Zeppelin raid took place in September, 1915. On this occasion 100 patients were admitted into Charing Cross Hospital, of whom fourteen were dead on admission, and nine others died within twelve hours. In every wound examined bacteriologically the *Bacillus aerogenes capsulatus* was identified. The same organism was found in every case of wound caused by a bomb dropped from an aeroplane admitted into the Petrograd hospital. At the field hospital we had no opportunity of making bacteriological examinations, but, warned by previous experience, we freely opened every such wound and rubbed into the tissues the powdered potassium permanganate as mentioned above. The fact that in every Zeppelin and aeroplane bomb wound examined at Charing Cross Hospital and the Petrograd hospital the *B. aerogenes capsulatus* was demonstrated, makes us suspect that the outer casing of the bomb must have been infected with a culture of this micro-organism. If such be the case, science has surely never before been made to serve so fiendish a purpose.

On the Russian front we were greatly pestered with visits from German aeroplanes that dropped bombs with annoying frequency and regularity. Generally our unwelcome visitors appeared at about 7 a.m. and 6 p.m. Two of us were knocked down by the concussion of the air, but fortunately the bomb fragments missed us. The wounds caused by the bombs were truly terrible. Wounds of the limbs generally called for immediate amputation. Wounds of the abdomen were almost invariably fatal. Thus, on one day in which 140 bombs were dropped in our village, seven of which fell in our hospital grounds, six patients were admitted suffering from laceration of the intestines, and death resulted in every instance. In our own hospital there was fortunately no fatality from aeroplane bombs, and we attribute this immunity largely to the fact that we had surrounded our tent wards with walls of sandbags 4 ft. high. Although every tent was perforated by bomb fragments repeatedly, none of our patients received any injury.

XIV. Bipp.

Professor Rutherford Morison was good enough to send to one of us (H. F. W.) a reprint of his contribution on the

treatment of infected suppurating war wounds.¹ Unfortunately by the time we received this reprint we had already left the Russian front, and had therefore no opportunity of making trial of bipp in recent wounds. We, however, employed it in several cases at the Petrograd hospital, and have since used it largely at the 1st and 4th London General Hospitals R.A.M.C.(T.) and at Charing Cross Hospital. Bipp, which is composed of bismuth subnitrate 1 part (by weight), iodoform 2 parts, and soft paraffin in sufficient quantity to make a stiff paste, has proved entirely satisfactory in our hands and has yielded results equalling those described by Professor Rutherford Morison. We have formed the opinion that, in extensive gunshot compound fractures, free opening of the wound, cleansing it with ether or alcohol, and then packing the cavity firmly with bipp, will, in the great majority of cases, ensure the safe and painless healing of the fracture, and that this method of treatment is a distinct advance in surgical therapeutics. Our best results have been obtained with bipp in wounds that were non-perforating, as in such the paste can be more thoroughly packed away into the recesses of the wound than with a perforating wound. We have been greatly impressed with the fact that splinters of bone of considerable size, completely detached from their surroundings, can be removed from the wound, washed with ether, replaced in the gap in the bone, and there help to consolidate the fracture in the presence of bipp. We can also confirm the statements of Professor Morison (1) that when bipp is employed "all infected discharge comes from the surface of the wound in the neighbourhood of the skin. The paste in the depths is clean and should not be disturbed." (2) That a weekly dressing is all that is required; and (3) that no symptoms of iodoform poisoning need be feared.

The sole objection we have noticed in cases treated by bipp has been the occurrence of a dermatitis in the skin surrounding the wound. This, which we believe to be due to the action of nascent iodine, has been noticed in six cases. Captain J. A. Willett, R.A.M.C.(T.), has demonstrated to us that, in the presence of this dermatitis, the correct treatment is to remove the iodoform and employ only the bismuth subnitrate in the paste. Recently we have been making use of bipp in which the bismuth subnitrate and iodoform are employed in equal parts, and we have found that, while the efficiency of the paste is in no way impaired, the tendency to cause dermatitis is distinctly lessened.

XV. Powers of Resistance of the Russian Soldier.

The Russian soldier is an ideal patient. His powers of resistance are indeed marvellous. Practically every patient who came under our care was a countryman, accustomed to live in the open air, inured to extremes of heat and cold, and able to undergo major operations with a minimum of shock. One instance will illustrate the above.

At 6 o'clock one evening, one of us (H. F. W.) amputated in the middle of the thigh for gas gangrene of the leg and knee regions in the case of a Siberian soldier. The next morning, at 7 o'clock, we were awakened by the sound of the anti-aircraft guns and took refuge in one of the dug-outs. This was a necessary precaution, as every tent in the hospital was perforated by bomb fragments. Seated in the dug-out we found our patient of the previous evening quietly smoking a cigarette! In response to our inquiry how he had got there, he informed us that he had placed his arm round the neck of a fellow-patient and had hopped to the dug-out on his sound leg!

It is well known that wounds received in very cold climates tend to heal slowly, and this was noticeable during the winter months in some of our patients. The protracted healing of the wounds appeared to be due to a sluggish circulation in the part affected, but we think that a contributing factor was to be found in the poor condition of many of the patients, who were often ill-nourished and anaemic. The Russian peasant seems to be able to sustain life on a minimum of food. Weak tea, black bread, soup, and "kasha," a kind of porridge made chiefly of millet seed, with meat twice a week, make up for him what he considers a generous dietary, though a patient in a London hospital would think this a starvation allowance. Probably also the difficulty in securing adequate ventilation of the wards was a considerable factor in the difficulty in securing normal healing of wounds in winter. A temperature of

50° or 60° below freezing point does not encourage the ward sister to open the windows. The lowest temperature we experienced was 67½° below freezing point (Fahrenheit)—that is, -30° Réaumur.

XVI. Frostbite and Trench Feet.

After our experience in the 1st and 4th London General Hospitals R.A.M.C.(T.) of frostbite and trench feet occurring in British, Colonial, and Belgian soldiers, we expected to meet with numerous examples of these troubles owing to the extreme cold of the Russian winter. To our astonishment, we saw far fewer cases than we encountered in the various London hospitals. The Russian soldier knows nothing about socks or stockings. He wraps his foot in a square piece of flannel and then puts on an excellent loose-fitting top-boot. Despite the fact that he has to face a temperature 30° to 40° lower than that encountered by his British comrade, he is far less liable to suffer from frostbite or trench feet. Admittedly he is more inured to extremes of cold, but as the result of our experience we recommend, as the best way to prevent frostbite and trench feet, a flannel wrap around the foot and a loosely-fitting top-boot.

XVII. Mortality.

On the question of the percentage of deaths we regret that, owing to the loss of many of our records, we can make no authoritative statement as to the exact percentage of deaths that occurred in our hospitals. It is, of course, obvious that no comparison can be made between the Petrograd base hospital and the field hospital in this respect. In the former institution we met with much the same type of case that finds its way into the big London general hospitals R.A.M.C.(T.), and the death-rate was low, certainly under 1 per cent., and probably nearer ½ per cent. The cases admitted into the field hospital were, naturally, in general, suffering from far graver injuries. The majority of them were not sent to us direct, but were transferred, by the courtesy of our Russian colleagues, from neighbouring hospitals for treatment because of the gravity of their injuries. Thus during our time at Cherukoff, with the sanction of the General of the Russian Red Cross, our admissions were confined to cases sent to us by the surgeons of the various Russian field hospitals, and every patient admitted was in a serious condition. W. D. H. can testify that during the time that he had charge of the field hospital the mortality was 4 per cent. Later on, as our hospital became better known and only the gravest cases were sent to us, it rose to nearly 5 per cent., the most frequent cause of death being gas gangrene.

REFERENCE.

1 *Lancet*, August 12th, 1916.

A METHOD OF EARLY CLOSURE OF RECENT GUNSHOT WOUNDS.

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EARLY closure of the gunshot wound has been for nearly three years the ambition of the surgeon and the pathologist, and although several methods have stood the tests of time and practice and have proved extraordinarily efficient, no apology is needed for making further suggestions. This paper is written to bring forward the use of a mechanical aid to excision of the wound—namely, the staining of the track of the missile, and, secondly, the use of a paste as the method of sterilization.

Excision of the Wound.

Ever since the possibility of an early closure of the wound was demonstrated by Gray and Carrel, it has been my custom in quiet times to examine and consider and operate on the wounds handed over to us in the casualty clearing station from the point of view of an early suture. In these later days the surgical organization of the armies has become so efficient that a surgical "push" in the old sense does not exist, and incisions of the fresh wound for the sole purpose of preventing spreading sepsis have been replaced for ever on the Western front by full and often final excisions. Hence this view now can be, and ought to

be, the universal one. And this outlook is the secret of success.

To the surgeon who so looks on the virgin wound which nature and the host are really anxious to close, asepsis is even more of a god than it was in his theatre at home. His operation is planned beforehand with the care and thought requisite for a possibly difficult procedure. The skin, on which rests the final visible proof of his good workmanship, is in the secondary suture preserved with the jealousy of the miser, and in a primary closure is removed with the thoroughness that eradicates rodent ulcer, so nice and so accurate becomes the generous but parsimonious balance. The incision is nowhere useless; its centre corresponds with the centre of the work, but as reckoned by ordinary war standards, it is almost appallingly long. Every part and pocket of the track is offered to his vision, and as his confidence in the certainty of early suture increases, so and at the same pace the number and length of his incisions grow and the exposure becomes automatically greater. Thought having been given to the blood supply cut off by the passing missile, the track disappears before the knife to a depth that is living and will live—it bleeds. Obstructing bridges of tissues are divided unhesitatingly with this knowledge of quick reunion, and the old operation of "removal of the foreign body" develops into an operation of some magnitude. The missile and the clothing come away buried in the tissues which surround them. Haemorrhage is arrested with more thoroughness than of old, and the toilet is as fairly finished as if the operator himself had broken the undamaged skin. Then, and only then, will all be well. Even if suture be impossible, a greater saving of life and limb will result. This is grandiose but not impossibly Utopian; it is a practical everyday affair to the surgeon who steadily preserves that outlook.

Depth of excision has always been cultivated, and after excising wounds in the usual way for nearly two years I attempted to stain the track. Since that first attempt, I have been of the opinion that formerly a complete surface excision of a deep and complicated muscle wound must have been for me a rare and happy event. Of course, by reason of important structures and the impossibility of invariably staining the whole track, complete excision is often impracticable, but the staining makes a more thorough removal possible, and also it indicates the points to which simple mechanical cleansing must be more particularly directed. When staining has been thought unnecessary, the final results have become immediately worse. In every case it is a help. It is never a hindrance, and the time expended on the actual staining is negligible. Certainly the operation is somewhat more prolonged, because the stain insists on a more thorough surface excision, and consequently multiple wounds demand multiple surgeons. At first I used a 1 per cent. watery solution of methylene blue, but later a ½ per cent. watery solution of brilliant green, for the sake of uniformity of material and its antiseptic action.

Wound Sterilization.

After complete excision, the problem resolves itself into the sterilization of a freshly infected surface. Here the first question was that of the antiseptic. Almost all available were tried, but the work of the Middlesex School in showing its peculiar antiseptic properties, its particular selective potency over the special organisms found in these war wounds, and more especially its fulfilment of practical requirements, has made me give whole-hearted support to brilliant green. But this is not all. I found that instillation of a watery solution of brilliant green through Carrel's tubes in wounds possibly incompletely excised sometimes resulted in a thin creamy yellow pus containing cocci; at this stage brilliant green, however applied, did no good; strong or weak solutions would neither sterilize nor affect the stationary condition of the wound. Dakin's solution, eusol, and other antiseptics would clear this up, suggesting the false inference that brilliant green was of inferior potency; and the simplest and one of the most effective of these complementary antiseptics was boric acid. And this might suggest that antiseptics suitably combined according to their predilection for the special organisms to be attacked might be of more value than the single antiseptic on which we commonly rely. However that may be, a combination of brilliant green and boric acid, suitably