

line has the greater value. This not only provides the required amount of fluid, but also stimulates the heart and supplies an extra number of calories in the food. During the first three days milk should not be given in any form. Suitable diet in the beginning consists of albumen water, gruels, and clear tea sweetened with lactose. Lactose is of great value not only for its supply of food calories, but also for its favourable action on the bacterial flora of the intestine. This diet should be gradually changed to one of arrowroot, Benger's food, malted milk, sour milk, or diluted ordinary milk, lactose diluted in some fluid being continued. It is very important to keep the mouth clean by washes and the chewing of some solid substance while the patient is on liquid diet. When mucus has disappeared soft poached eggs and a couple of biscuits may be given, the inclusion in the dietary of custards, pudding, and dry toast being made gradually. Later a solid diet of chicken, stews, mashed potatoes, peas, and beans may be tried, followed by beef, vegetables, and bread. Untoasted bread is a very disturbing factor and should not be given until the patient is accustomed to a solid diet. Where patients remain long enough in hospital dietetic treatment should be completed by giving them the Army ration of bully beef and biscuits, besides putting them on moderate exercise.

A competent nurse is a great asset to a dysentery ward. Careful nursing is most essential for the early treatment of dysentery cases. Without her coöperation the administration of fixed dietetic measures is impossible in a ward, where Tommy on solid diet will innocently share his last crust of bread with his less fortunate neighbour on liquids, these dietetic indiscretions being usually the undiscovered cause of the medical officer's disappointment in the progress of his cases.

General Conclusions.

1. Ninety-five per cent. of the dysentery occurring in the British Salonika Force is of the bacillary type.
2. Stools in the blood and mucus stage of bacillary dysentery are sufficiently characteristic to diagnose the case "clinical bacillary dysentery" and treat it as such.
3. In faecal stools the presence of cellular mucus in which pus cells predominate or of small groups of pus cells is sufficient to warrant the diagnosis of "clinical bacillary dysentery."
4. A mild form of bacillary dysentery which in this paper has been called "mild recurrent bacillary dysentery" is the cause of the diarrhoea in a very fair percentage of the cases admitted to hospital as simple diarrhoea.
5. There is no evidence that the intestinal flagellates produce a dysentery, and that they are causal agents in simple diarrhoea more proof is necessary.
6. The prevention of dehydration of the tissues by the injection of normal saline is of primary importance in the treatment of severe bacillary dysentery.
7. Intravenous injection of antidysenteric serum in doses of 60 to 80 c.cm. once or twice daily the first three days of treatment gives the best results.

WESTMINSTER HOSPITAL APPEAL.—A special committee, of which Sir J. Wolf Barry, K.C.B., is chairman, has issued an appeal for £20,000 on behalf of Westminster Hospital, and the Prince of Wales, as President of the hospital, has contributed £1000 towards the required amount. The unsatisfactory position of the hospital finances, in spite of the utmost care and economy, is in the main due to war conditions, among them being the treatment of wounded sailors and soldiers, the War Office payment for the 100 beds set apart for this purpose falling far short of the actual expenditure.

THE MENTAL AFTER-CARE ASSOCIATION.—This is the only charity of the kind in the United Kingdom, and the committee make an earnest appeal for further funds to carry on and extend the work of assisting poor persons convalescent or recovered from institutions for the insane. Applications for aid during the past two years have increased by about 60 per cent., many of the unfortunate subjects being almost destitute and unable to get the fresh start in life necessary to become self-supporting. The association is well deserving of the support for which it asks, and subscriptions should be sent to the Secretary, Church House, Westminster, S.W., or to the bankers, the Union of London and Smiths Bank, Limited, Victoria-street Branch, Westminster, London, S.W.

WOUNDS OF THE CHEST AS SEEN AT AN ADVANCED OPERATING CENTRE.

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THE following notes on chest injuries have been compiled from observations made at an Advanced Operating Centre. The cases were seen early, generally within a few hours of the patient being wounded. The centre was intended primarily for wounds of the abdomen, and only the severer cases of chest injuries were received. In a large number of the patients admitted both abdomen and chest were involved, but these have been omitted from this series, as they have been dealt with in a previous paper by us.¹

Some 500 cases of chest injury have passed through our hands. Of these we have full notes of 140 consecutive cases treated during a comparatively quiet period of six months, and the figures and analyses in this paper are based on this latter series.

Classification.—Chest wounds may be classified into two main groups—"leaking" and "closed"—the two groups depending ultimately on the size of the wound. A leaking wound causes a "leaking pneumothorax," whereas a closed wound may produce either a simple hæmothorax or a closed pneumothorax. In addition to these main groups there is a miscellaneous number of cases in which the missile, penetrating the chest, causes other complications such as bronchitis, broncho-pneumonia, collapse, &c., with or without a hæmothorax. These will be considered towards the end of this article.

Definition of the terms "closed" and "open."—In all cases at the moment of wounding there must be a communication between the pleural cavity and the exterior. If, however, the wound is only small or is valvular, the track closes sufficiently to prevent the air passing in and out of the pleural cavity with the movements of respiration; this is called a "closed" lesion. If, on the other hand, air or bubbles escape from the wound on respiration when the patient is examined or when he coughs or is rolled over, we are dealing with a "leaking" wound. Blood escapes from any recent wound of the chest, but if it is excessive and dark in colour, it means that the communication with the pleural cavity is patent and air will be detected as well.

The earlier the patients are seen after wounding the larger will be the proportion of leaking to closed cases, since many of the former tend to close spontaneously during the first 24 hours.

Primary hæmorrhage into pleural cavity.—Before discussing each class separately, there is one complication which is common to both and which ought to be considered—viz., primary hæmorrhage into the pleural cavity. The hæmorrhage is internal in a closed, and both internal and external in a leaking lesion.

Primary hæmorrhage is the chief cause of death during the first few hours after the receipt of a wound of the chest. When severe, the patients are brought in blanched, restless, and with a rapid pulse. The restlessness is the most marked feature of the case, and in the worst cases morphia may fail to control it, because it is not absorbed on account of the failure of the circulation. We had 12 fatal cases; 9 of these were pulseless on admission, and of the remainder the pulses recorded were 132, 136, and 140 beats per minute respectively. In addition to these there were 7 fatal cases in which the primary hæmorrhage was complicated by other injuries to spine or limbs. The 12 uncomplicated fatal cases survived their wounds on an average 24 hours. After death an examination was made to try to find the source of the hæmorrhage in one or two cases, but it was unsuccessful.

The treatment for these bad cases is mainly expectant, and our chief aim is to keep them as quiet as possible and to ease their pain by the use of morphia or heroin. They require very careful handling, rolling them over on to their sound side to dress the wound being sometimes sufficient to cause death. For this reason, in some cases it may be

¹ THE LANCET, April 28th, 1917.

advisable to leave the patient 24 hours or more with the wound unattended to. Even patients who have a readily perceptible pulse may die suddenly if rolled on to their sound side in the first 12 hours after being wounded. The bleeding does not usually continue after 24 hours, and we have had at least two cases of recovery in patients who arrived blanched and pulseless. In only one patient was it noted that, arriving in fair condition, he died within 48 hours from the internal hæmorrhage continuing. In this case the continuance of the bleeding was associated with adhesions which prevented the lung from collapsing.

The blood usually comes from the deeper blood-vessels in the lung, and Nature's method of arresting it is to cause collapse of the lung. The pressure on the lung exerted by the accumulation of fluid in the pleural cavity will not, by itself, assist much in the arrest of hæmorrhage, for the patient will bleed to death into the pleural cavity before the intrapleural pressure is sufficiently raised to produce this effect. We have not seen a single case in which severe hæmorrhage came from an intercostal artery, and therefore plugging of the wound is of no real benefit, and, moreover, it prevents the entrance of air into the pleural cavity, which is the most rapid way of causing collapse of the lung. In a large wound, where complete collapse of the lung is almost instantaneous, a plug may be beneficially employed in the early stage; not for the purpose of arresting hæmorrhage, but to assist the embarrassed respiration of the unwounded lung by preventing the air entering the chest more freely through the wound than through the normal air-passages. Patients are not usually transfused as the bleeding may be still continuing. They are given frequent small cold drinks and calcium lactate gr. 5 every two hours.

While on the subject of bleeding, the question of hæmoptysis deserves mention. It was found to be present in 65 cases out of 100 undoubted penetrations of the chest in which its presence or absence was noted, but in none of our cases was it severe enough to cause any anxiety. In most cases it only continued for a day or two, and in only one patient was it still noted on the tenth day. Hæmoptysis points to bruising or laceration of the lung, but it may be absent in cases where the lung has been traversed by a missile from end to end.

In our series there were 44 cases of leaking pneumo-hæmothorax and 72 cases of hæmothorax or closed pneumo-hæmothorax.

A. Leaking Pneumo-hæmothorax.

44 cases, with 27 deaths, giving a mortality of 61 per cent.

The most interesting points for discussion with regard to these cases are: (1) How many become infected, and (2) the treatment which experience recommends for the condition.

1. In ascertaining the number which become septic we must exclude all those cases which die before the pleura has had time to become grossly infected—i.e., within 48 hours of being wounded. Of these latter we had 18 fatal cases who died from primary hæmorrhage, shock, or complicating wounds. We had 26 patients who lived long enough for infection to occur, and of these 15 became septic, of whom 9 died. The proportion of leaking pneumo-hæmothorax cases which became infected is therefore 57 per cent., which we shall see later is five times as high as in cases of simple hæmothorax. The question of sepsis, therefore, is a very important one, and is directly dependent on the size of the opening into the pleura. In the 11 cases which recovered without becoming infected, the leakage of air soon ceased of itself or was stopped by operation, and the escape of blood was reduced to a mere staining of the dressing within 48 hours. Any wound which leaks air, or blood and pleural fluid freely after 48 hours will become septic. This question of sepsis is important, not only on account of the number of deaths it causes, but also from the prolonged convalescence and invalidism resulting in those who recover after drainage of the pleura. In a few of the cases a record was kept with regard to the nature of the missile associated with infection with the following results:—Bullet wounds—remained aseptic 4; became infected 4. Shell wounds—remained aseptic 5; became infected 11.

The patients who died from sepsis succumbed from the fourth day onwards in spite of operations for drainage of the pleura. Several cases of interest occurred in the series.

One man, in addition to a large wound over the chest had a wound in the lumbar region on the same side and developed localised tetanic spasms in the arm and leg and lumbar

muscles on the same side as the injury. This commenced on the sixth day in spite of the usual prophylactic dose of serum. He never had any rigidity of the jaw muscles, but died on the fourteenth day from septic absorption.

A second patient had an arterio-venous aneurysm of the third part of the subclavian artery, which was caused by the bullet as it entered the chest. He had a very marked thrill to be felt all over the front of the chest, with a loud humming murmur on auscultation and pain down his arm.

A third man was wounded in the first left intercostal space by a shell fragment which passed downwards and inwards, behind the manubrium. The wound discharged a little brown sanious fluid and air bubbles. He had a rigor on the third and fourth days, and death occurred on the fifth day after two severe hæmorrhages. It was found that a piece of shell with clothing round it was lodged in the upper part of the pericardium. An edge of the fragment was embedded in the wall of the ascending aorta, making an opening half an inch long. No leaking of blood took place from the aorta till ulceration of the vessel wall commenced. Fibrinous pericarditis was present.

2. *Treatment of leaking cases.*—There are four methods of treatment which suggest themselves for dealing with these cases.

(a) *Simple dressing.*—The wound is swabbed over with an alcoholic solution of picric acid or iodine, and dry gauze applied. After 24 or 48 hours if the wound is small, the leakage of air will cease, and the escape of blood will be reduced to a mere staining of the dressing. It is important to use a dry dressing and to get the wound to dry up as soon as possible. A little experience will show in which cases this treatment is likely to be sufficient. If the discharge continues free for more than 48 hours, or if, after having ceased for a few days, it begins to come away freely again, so that the wound requires packing and repacking, sepsis is almost certainly present, and resection and drainage may be performed without waiting for the bacteriologist's report.

(b) *Plugging the wound.*—This has been done with two objects—to arrest hæmorrhage and also to hinder the entrance of germ-laden air. It has been shown earlier in this article how useless the gauze plug is for arresting hæmorrhage, and that it is only recommended as a temporary measure where there is so free an opening that respiration is seriously embarrassed. It is very difficult to render a large wound airtight with gauze, and a small wound will usually close of itself. There is also always the great danger of introducing germs from the edge of the wound. After being plugged the track of the wound acquires a white sodden surface in which organisms readily flourish. In most cases, therefore, we do not advocate this method of treatment. The pleura can often deal with the germs carried in with the missile, but the mixed infection caused by germs which enter with the air or grow in along the track will inevitably lead to trouble.

(c) *Sewing up the wound, with or without the removal of the foreign body.*—The removal of the foreign body from the lung is only justifiable in a few selected cases, but the sewing up of the wound is advisable in all cases of leaking chest wounds, since it is by this means we can prevent the pleural cavity from becoming infected in more than half the cases. Actual figures give: uninfected, 18; infected, 11; and doubtful, 2. Before this treatment was adopted all wounds which leaked for 48 hours became infected. The following points should be considered.

Time for operation.—It is best to wait till the shock has passed off, but about 12 hours from being wounded is perhaps the time for choice. Every hour that the leak continues increases the risk of pleural infection. In 2 severe cases where shock was prolonged even operation at 36 hours prevented sepsis recurring. Primary hæmorrhage should have ceased before the operation is undertaken.

Size of the wound.—A small hole will close of itself, and experience soon teaches us which will close and which will remain open.

Bullet wounds.—Sometimes an explosive type of wound is caused by a bullet striking a rib, either at its entrance or exit from the chest. These cases are very suitable for operation.

Position of the wound.—If the wound is high up towards the apex of the lung, sewing up is especially indicated as this position is very bad for drainage of the pleural cavity. The weight of a patient, as he lies in bed on his back, will help to keep some wounds closed over the lower part of the chest posteriorly, so that suture of these wounds may be sometimes postponed for a little if it be necessary.

Anæsthetic.—In our experience chloroform and warmed oxygen is the most suitable anæsthetic, a preliminary dose of morphia and atropine having been given. The patient should be in a very light state of anæsthesia, just "grunting."

² We first tried closing "leaking" chest wounds in November, 1916, and ten months' experience of the operation has confirmed us in recommending it.

A contour wound of the chest wall, where the pleural cavity is laid open without the missile being retained inside, is also very suitable for operation.

The operation of sewing up only takes a few minutes. A complete excision of the wound, down to and including the pleura, is made; any jagged ends of fractured ribs are trimmed off and any loose pieces of bone removed. We do not attempt in most cases to sew up the pleura by itself, but the muscular tissue and pleura are drawn over the opening with catgut, the last suture being tied at the end of an act of expiration; the skin is sewn up with silkworm-gut sutures passed deeply through the tissues. No harm is done by this little operation. If the pleural contents do become infected the wound will become moist in 48 hours and discharge; the stitches are in this latter case removed and a tube inserted for drainage. Infection of the subcutaneous tissues is often encouraged by tension and may be relieved by cutting the skin sutures only.

Removal of the foreign body from the lung itself is a serious operation which should not be at the present time undertaken as a routine, but should be reserved for wounds leaking badly and when the foreign body, located by the X rays, is larger than a "filbert." Bits of bone driven in are, perhaps, more liable to give rise to trouble than is metal. Further experience will teach us the chief indications for this operation which, when successful, is the most satisfactory form of treatment.

In wounds of the lower part of the chest, wounds of the diaphragm must not be overlooked, and if found accessible must be sewn up before the chest wall is closed.

A word of warning is, perhaps, necessary in discussing operations on the chest. There is a great temptation to try to do more than is justifiable for these cases. They will not stand a long operation, and it is often necessary to allow minor injuries to go unattended in order to make certain of the main object of this procedure—namely, the closing of the pleura from contamination from the external air or from the surface of the skin. Extensive resections of ribs or even very extensive skin incisions are not justified unless the patient is in exceptional good condition. No object is gained by spending time in sewing up holes in the lung or tears of its surface.

B. *Hæmothorax and Closed Pneumohæmothorax.*

The treatment of the cases of closed pneumohæmothorax differs in no way from that of an ordinary hæmothorax, although there is a greater danger of raised intrathoracic pressure and excessive cardiac displacement. The air comes from the injured lung. Blood, when extravasated into the pleura, causes irritation and the outpouring of a certain amount of pleural effusion.

Some amount of hæmothorax must be present in every penetrating wound of the chest, but in this series only those are included in which there was enough blood extravasated into the pleura to give rise to physical signs and to be proved by an exploring syringe.

We had 72 cases of hæmothorax and closed pneumohæmothorax with 14 deaths, giving a mortality rate of 19.3 per cent. Of the fatal cases, 5 died from primary internal hæmorrhage. Of the 67 cases that survived 48 hours, 8 became infected (11.9 per cent.) while under our care, and 5 died from this cause—a mortality rate of 7 per cent. The average stay of our hæmothorax cases at the Advanced Centre was seven days.

The three patients who recovered after rib resection and drainage had shown signs of infection on the fifth, tenth, and thirteenth days respectively. The last two were examples of late anaerobic infection, in which the germs are surrounded by blood clot, and no gas is found till the organisms become dislodged from aspiration or any other cause. There are one or two signs that act as danger signals indicating that the hæmothorax is becoming infected. (a) The pulse-rate remains rapid. (b) The temperature does not begin to fall as it should do after three or four days in an uninfected hæmothorax. (c) The patient complains of pain and tenderness on percussion over the affected part of the chest, signifying an inflamed pleura or raised intrathoracic pressure at this spot.

The five fatal cases of infected hæmothorax were:—

The first patient was wounded by the casing of a bullet. He had no leakage from his wound on admission, but it commenced to discharge freely dark fluid blood on the seventh day—a sure sign of septic infection. He was drained, and after death it was found that the pleural cavity was localized, being divided up by adhesions into large cavities, only one of which was being drained. The pleura was found to be covered by a layer of lymph nearly one inch thick.

The second patient was an example of the rapid infection of the pleura which sometimes occurs. He was admitted with a perforating bullet wound towards the periphery of the chest, a case that one would regard as of the most hopeful kind. Within 48 hours of being wounded he became delirious, and from the wound, which had been nearly dry, a large amount of dark fluid escaped. The chest was immediately opened up, washed out with eusol, and drained, but he died three days later with increasing signs of septic absorption.

The third patient showed signs of infection on the day after he was wounded, with rapid pulse, profuse sweating, delirium, and, finally, unconsciousness, and died on the fourth day. A few hours after death the subcutaneous tissues were found to be distended and all the solid organs of the body honeycombed with bubbles of an inflammable gas. The left lung was partially collapsed, but only a few ounces of dark fluid were found in the pleural cavity. There was, however, a thick layer of fibrin deposited on the pleura.

The fourth case sustained a severe glancing wound of the chest wall without actual penetration. He died ten days later from sepsis. It was found that he had several localized cavities in the left pleura containing fluid blood and clot, and also extensive hæmorrhage in the left upper lobe of the lung and in the interlobar fissure.

The fifth case left us apparently convalescent, but died at the base.

Of the fatal cases of hæmothorax which did not die of sepsis, broncho-pneumonia caused the fatal result in one case, and heart failure in the other two. Both the latter cases were admitted in good condition, but on the third day the pulse-rate increased by about 40 beats per minute. Aspiration was performed, but afforded no alleviation of the symptoms; the expectoration completely ceased, though mucus accumulated in the tubes and death ensued. Examination after death proved the absence of sepsis and showed death to be due to heart failure rather than to the state of lungs or pleura.

In these cases of hæmothorax a record was also kept in regard to the missile, giving the following figures:—

Shell fragments (including bombs, rifle grenades, &c.) caused 36 cases, of which 4 became infected.

Bullets caused 12 cases, of which 2 became infected.

Bullet casing was found in 1 infected case.

Shrapnel balls caused 8 cases, and not one became infected. Shrapnel balls, on account of their roundness and smooth surface, are not so liable to carry fragments of clothing into the wound.

Treatment of hæmothorax.—It is most essential to examine all chest cases every day, especial attention being paid to the position of the cardiac apex-beat. It often happens, if surgical emphysema is present, that the superficial cardiac dullness cannot be made out and the apex beat may not be palpable. The position of the heart must then be made out by auscultation and by determining where the heart's sounds are heard the loudest. Every case of hæmothorax should be explored with a small needle once or twice while under observation and the condition of the fluid noted.

One case in five of our cases had aspiration performed before evacuation. After the second day it should be done whenever there is effusion enough to cause cardiac displacement of an inch or more. The tendency was, as one's experience increased, to perform it on more and more cases and at an earlier and earlier date. All the fluid that will run off easily is removed, but it should be drawn off very slowly; thus an hour may be taken to draw off three pints, which gives a rate of one ounce per minute. The largest amount we have drawn off at once was 74 ounces, which was taken from a patient wounded four days previously. In none of our cases did aspiration cause a recurrence of hæmorrhage into the pleura.

Practically every case of closed pneumohæmothorax requires early aspiration. Those cases in which there was a considerable amount of air in the pleura occurred in the proportion of one to ten simple hæmothorax cases. A specimen of the fluid drawn off should invariably be sent to the laboratory for a report, but if it has any offensive smell resection and drainage should be performed without waiting for the report.

Miscellaneous Complications.

Collapse.—The usual effect of a penetrating wound is collapse of the wounded lung of greater or less extent, and occasionally the same occurs in the unwounded lung. Collapse of the wounded lung is most marked in cases of pneumohæmothorax or very large effusions, and the lung is then often contracted down to the size of two fists, and the

condition is explainable by the raised intrathoracic pressure. Collapse, as it has been insisted on earlier in the article, is far and away the most potent method Nature has of arresting pulmonary hæmorrhage, and where it does not or cannot occur the patient will bleed to death from a relatively small pulmonary vessel being cut across. But massive collapse will occur on the wounded side when there is very little hæmothorax and no raised intrathoracic pressure, and it also is fairly common on the unwounded side. There are two factors which may assist in the process:—

1. Cessation of movements of the diaphragm on the wounded side. This leads to absorption of air from the pulmonary alveoli, and no more entering to replace the absorbed air the lung collapses.

2. Blood-clot completely blocking a main bronchus. This may occur on the wounded or unwounded side and causes the same sequence of events. The clot also may have a valvular action, allowing the air to escape with expiration, but preventing fresh air entering to take its place.

The following case gives a fairly typical picture of the signs and symptoms of the condition.

A man was admitted with a wound in the first right intercostal space two inches from the sternum and the missile, which was a shell fragment, was removed from over the centre of the spine of the scapula on the same side. His general condition was good and pulse only 84. On the third day he had these physical signs: Heart displaced to left, with apex beat at level of fourth rib, two inches outside nipple line. Impaired resonance and tubular breath sounds, anteriorly over upper lobe of left lung, posteriorly over left lung, with crepitations at left base. Breath sounds increased everywhere over right lung. The stomach note reached to the level of the nipple in the axilla.

The diagnosis is made on the position of the apex beat, which is pulled over to the side of the collapsed lung since there is nothing on the wounded side to push it over. The diaphragm is raised as is shown by the apex beat being on the level of the fourth rib and the stomach note being made out at a high level in the axilla. Supplementary signs are the increased area over which the cardiac pulsation can be felt and also the immobility of the left side of the chest. The reduction of the total functioning lung tissue increases the number of respirations, and this is particularly noticeable on any movement of the patient, so that he readily becomes cyanosed on exertion. The patient whose case is described above had a pulse-rate of only 84, but often had a respiratory rate of 48 or over. Tubular breath sounds and impaired resonance over the lower lobe of the unwounded lung commonly occur on the second or third day and point to collapse or congestion. The presence of many rhonchi and râles indicate congestion and call for energetic stimulation.

Bronchitis and bronchopneumonia.—These occur in both the wounded and unwounded lungs, more especially in cold weather, and they are serious complications. Two deaths occurred in our series from them. The physical signs were high fever, many râles and rhonchi over both lungs, with patches of tubular breath sounds, and the expectoration of a purulent or muco-purulent sputum. Some of the patients gave a history of bronchial catarrh previous to being wounded, but in others the condition is directly attributable to the wound. We had no case of lobar pneumonia.

Pleurisy is very common and requires no especial notice except to remark that a transient rise of temperature is sometimes associated with it. Surgical emphysema, when extensive, is often associated with the severe types of chest wound, and if it spreads to the mediastinum it may directly lead to a fatal result. We had one such case in which no other cause of death could be found.

Secondary hæmorrhage from the lung.—This is another way in which infection may prove fatal—it is very rare in chest wounds compared with other wounds. One such case occurred.

It was in a man who had been wounded in the right upper arm by a bullet which passed directly inwards across the front of the chest, making a large exit wound below the right sterno-clavicular joint, without actually penetrating the chest. The wound became infected in spite of being cleaned up under an anæsthetic. He died on the eighth day after two very severe hæmorrhages from the inner end of the wound for which plugging was tried without avail. It was found that the upper part of the lung was adherent to the chest wall and on its anterior margin was an area the size of a Tangerine orange into which hæmorrhage had occurred. The bullet had not penetrated the pleural cavity,

but the lung had been bruised, become infected and had broken down, forming a cavity. In the wall of this cavity a vessel had ulcerated and been the source of the bleeding. There was a minute tear of the parietal pleura which had allowed the blood to escape externally.

Cardiac complications.—We have had no case of wound of the heart to treat, but several patients have had the track of the missile in close proximity to the heart; two of these developed a transient pericardial friction comparable to the transient pleural friction so frequently heard. Patients wounded in the chest occasionally die of simple heart failure on the second or third day, which may be associated with congestion of the unwounded lung.

We should like to call attention to loud "tapping" sounds which we have heard over the cardiac area in nine cases of wounds penetrating the left chest, where the missile had lodged near the heart, or where the track of the missile had passed in its close proximity. These sounds were quite distinctive and similar in each case, only varying in intensity. They were most marked when the patient was first examined after wounding and persisted for a variable time, occasionally for only 24 hours, but in one patient they were still present on evacuation a fortnight later. The sound continued even when the breath was held, although the intensity varied with respiration, increasing during inspiration and diminishing during expiration in all cases. It was synchronous with the heart beats, and when loud rendered the heart sounds inaudible. In four patients the sound could be heard with the ear held some inches away from the chest, and the patients were even conscious of it. The sound had no resemblance to pericardial friction, and in the cases referred to there was no suspicion of any gas being present in the pericardium, which has been described as giving rise to very extraordinary noises.

In one case examined by us under the X rays the missile could be seen at the end of the upward movement due to inspiration to give a distinct side-to-side oscillation due to the cardiac contraction, and this corresponded in point of time to the maximum intensity of the sound, although in this particular case there was a distinct area of normal lung transillumination an inch and a half wide between the shadow due to the heart and that of the foreign body.

It is difficult to account for the origin of the sound, since it is associated with so many differing conditions. The foreign body may not even be in the chest at all, or it may be embedded in the substance of the heart itself. One possible explanation is that a small column of air, confined in a bronchus either by the missile or by blood clot, is set in vibration by the cardiac contractions and produces the sound. The following two cases exemplify the condition, and attached to each is the X ray report as received from the base.

Private D. was admitted seven hours after being wounded by a shell fragment in the left chest; wound of entry in the eighth interspace in mid-scapular line. He had the tapping sounds in a wide area radiating from the position of the apex beat. These sounds had gone when examined on the second day, but a pericardial friction rub was then present. The physical signs on the second day were as follows: Heart's apex beat in fourth interspace in nipple line. Dullness over left upper and lower lobe, with tubular breath sounds over the upper lobe. Right lung normal. He developed some collapse of the left lung, as shown by the position of the apex beat and by the stomach note reaching the level of the nipple in the mid-axillary line. He was decidedly dyspnoic from the first, especially on movement. A report from the base one month after being wounded stated: "X ray shows the missile lying on a level with the under surface of the head of the eighth left rib (depth not localised). There is also an opacity of the left chest, with retraction of the heart to the same side. No tapping sounds or pericardial rub to be heard. Temperature has been normal while here; there is still dullness over the three upper interspaces in front. Diagnosis: Collapse of left lung, possibly some fluid at the base."

Private E. was admitted eight hours after being wounded in the left chest; wound of entry in ninth interspace in mid-scapular line, involving tenth rib. He complained of pain in the pericardium and was rather dyspnoic. The physical signs on second day were as follows: Heart's apex beat in normal position. Tubular breath sounds external to inferior angle of left scapula. Surgical emphysema present over large area on left side, in front below third rib, and behind below scapula. Diminished breath sounds locally in second and fourth left interspaces in anterior axillary line. Tapping

sounds heard best to left of sternum in fourth interspace. A week later exploration in the left axilla showed normal hæmothorax fluid. A report from the base four weeks after being wounded stated: "Treatment expectant. The X ray shows shrapnel ball in left lung which moves laterally with the pulsations of the heart."

In publishing these observations we feel we must again thank Surgeon-General Bruce Skinner for the help he has given the Advanced Operating Centre, and we should also like to thank Colonel Sir Wilmot Herringham for his advice and assistance. We are conscious of the lack of many scientific details in our notes, but it must be borne in mind that the work has been carried on at the front and under active service conditions. We have purposely omitted the discussion in detail of the removal of foreign bodies from the chest, as we consider this operation is still *sub judice*.

Medical Societies.

HUNTERIAN SOCIETY OF LONDON.

*Hunterian Lecture on War-time Orthopædic Surgery.*¹

AT a meeting of this society on Jan. 2nd the Hunterian Lecture on War-time Orthopædic Surgery was delivered by Sir ROBERT JONES, C.B., who introduced the subject by insisting that the wider application of the term orthopædic surgery made the aim of the orthopædic surgeon preventive and educational as well as curative. The orthopædic mind, he said, thought in terms of function and had to deal with a pre-operative and post-operative stage as well as an operative stage, which, although it may be essential, has only a proportional value. He defined the conditions roughly, which, taken together, create an orthopædic case under the following heads: 1. The mechanical injury to bone, joint, muscle, or nerve. 2. The atrophy and disease of these structures primarily due to the injury. 3. Incoördination of movement due to disease of the brain—a result of atrophy and disease of peripheral structures. 4. Psychological conditions which can be overcome by re-educational processes.

Speaking of the *number of orthopædic cases* and their hospital accommodation, and the necessity for *orthopædic centres*, he said that about 50 per cent. of the wounded of this war have received injuries resulting in impairment of locomotor function, the number of wounded men being so great as to form an economic problem for the present and future. The present problem is how most rapidly to make the wounded man fit for military service; or failing fitness for military service, how to make him an independent self-supporting citizen. The future problem is how the partially disabled man is to be kept as fit as possible after he has left the Army, which is left to the Ministry of Pensions to solve. In the early stages of the war, the sudden influx of large numbers of wounded men demanded a sudden expansion of hospital accommodation, while the terrible sepsis of wounds from the battlefields of France presented a difficulty for which surgeons had not been prepared by previous experience.

The pressure on hospital accommodation became such that men were discharged from the Army and from hospital with their wounds healed, but not cured of physical disability and unable to earn their living. Among these cases were those of malunited, ununited fractures requiring operative treatment and bone grafting, old cases of nerve injuries requiring suture, ankylosed joints, and contractures. Sir Alfred Keogh, said the lecturer, instructed him to start the first orthopædic centre in Liverpool with a view of concentrating under one roof the practice of orthopædic principles and the equipment necessary for the restoration of function—continued treatment. Every orthopædic centre, he said, consisted of (1) a staff of surgeons of special experience in orthopædic work, operative, manipulative, and educational; (2) surgeons with experience in operative surgery, who, though not specialising in the work, only need experience to fit them to take charge of wards in new centres; (3) younger surgeons who, before going abroad, will have the advantages of special training; (4) auxiliary departments—neurological,

electric, massage and re-education, hydrological, gymnastic, and the curative workshops—each under a medical man who has experience of the particular methods of the treatment he directs.

The *workshops*, Sir Robert Jones said, had proved of considerable value in the orthopædic centres, acting directly as a curative agent when the work done gives exercise to the injured limb, and indirectly through the result to the patients of being put to useful work. For the initiation and equipment of the workshops Sir Robert Jones acknowledged a deep debt to King Manuel and the British Red Cross Society.

The orthopædic problem, he said, could be divided into two distinct parts, preventive orthopædics and corrective orthopædics, the latter being more especially the department of the trained orthopædic surgeon, the preventive requiring the help of every surgeon who has to treat wounded men at any stage, especially the early stage.

Concerning *gunshot injuries of the femur*, he said: "Gunshot injuries of the femur constitute, in my opinion, the tragedy of the war, not only by reason of the fatality by which they are attended, but also because of the deformity and shortening which are so often associated with them. Recent convoys show a marked improvement upon earlier ones, but much more remains to be done and the question is very urgent. From abroad I have received bitter complaints of the want of continuity of treatment in this country; and, from our experience here, we are forced to the conclusion that while cases arrive from certain hospitals abroad most admirably fixed, they arrive from other places leaving much to be desired. The question of fractures of the femur is essentially one of *preventive orthopædics*. Our centres are constantly dealing with deformities following this injury. Many cases come with four or five inches of shortening and with every variety of the classical deflections. Is there no way in which the better results could be multiplied and the bad results avoided?"

The remedy, Sir Robert Jones continued, consisted in leaving these fractures in the hands of specially trained men retained for the work and proceeding in association on a common plan. The plan he defined as, first, the concentration of all fractured femurs in special and large hospitals at each base, staffed by keen, well-trained surgeons with mechanical aptitude and with security of tenure, for experience would constantly increase the rapidity and efficiency of their work. They should have selected and more or less permanent nurses and orderlies to help them in team work. The hospitals should be visited by an inspector of fractures, acting in conjunction with the consulting surgeons of the various districts, and no case should be evacuated in opposition to his instructions, while he should have a deciding voice in the selection or removal of any member of the surgical staff. One or more of these hospitals should be chosen as an educational centre, and all young surgeons who can be spared from time to time should undergo a training. Certain nurses and orderlies should also be trained, and in this way teams can be prepared to do rapid and efficient work at the casualty clearing station.

Two fundamental principles must be sacredly adhered to, said the lecturer, (1) efficient fixation in correct alignment at the earliest possible moment, (2) continuity of treatment. "Death," he pointed out, "usually occurs from shock, the result of direct injury, the shock being often increased by exposure and the movement of injured tissues during transport. Fixation, therefore, should not be delayed a moment. For the purpose of rapid, simple, and efficient fixation, there is no splint to compare with a Thomas. Since November, I learn that in many divisions these splints have been supplied to the regimental aid-posts. They should be supplied to all. These splints can be rapidly applied over the trousers, and extension made by a pull on the boot. Twenty or thirty cases can be dealt with in an hour by a trained team of orderlies; I allude, of course, merely to the mechanical fixation of the fracture. The wound is next thoroughly overhauled in the casualty clearing station. When this can be done with the limb well extended in the splint it is an advantage. This extension of the limb undoes all kinks and folds wherein discharges may collect. When the wound is thoroughly dealt with and the limb fixed for permanent treatment the case is sent down the line whenever it is safe. Experience has proved that, since such cases cannot be kept indefinitely at the casualty clearing stations,

¹ This address will appear in full in the British Medical Journal.