Letters and reports re gas gangrene and the use of casualty clearing stations

Publication/Creation

1914-1918

Persistent URL

https://wellcomecollection.org/works/s2urkkmr

wellcome collection

Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org

A NOTE ON THE SURGERY OF THE CASUALTY CLEARING STATIONS WITHIN THE FOURTH AND RESERVE ARMIES DURING JULY 1916.

In the following notes no attempt has been made to discriminate between those arrangements which were made by the D.M.S. of each of the respective Armies and those which originated at G.H.Q.

But it must be evident that the favourable conditions under which the Surgeons did their work were dependent upon provisions made before July 1st in the area of the Fourth Army.

It must first be noted that the Casualty Clearing Stations numbered 16 and that, in addition, there were two "Emergency Hospitals" one at WARLOY with 62 beds and one at AUTHIE with 36 beds for cases urgently requiring treatment, as well as two Hospitals for officers at CORBIE and GEZAINCOURT.

The Medical Staff of each Casualty Clearing Station numbered 12 to 16 Surgeons. The Nurses were increased from 7 to a number varying from 12 to 18.

The capacity of the Casualty Clearing Stations varied; some would take in only about 600, while many of them had accommodation for 1200 or more.

The arrangements provided that most of the slightly wounded men were dressed at once in tents or huts set apart for the purpose. More serious cases were separated from the rest and were if necessary, sent to the Operating Theatres for complete treatment. The worst cases were provided with beds to the number of from 100 to 200 in each Casualty Clearing Station.

The Operating Theatres of almost all the hutted or tented Cas--ualty Clearing Stations were in huts, 60 ft in length, which accommo--dated four Operating Tables, and each was sufficiently equipped to allow of 4 operations proceeding simultaneously. The provision of abundant space in the theatres and in the departments for dressing the less serious wounds enabled the whole staff to work at once, so that, with the aid of Nurses and Nursing Orderlies, as many as a dozen or more patients were being attended to at the same time. In this way all delay in preparing patients for evacuation to the base was avoided.

The total wounded in the Fourth Army in July was 103,867. In the Reserve Army between July 7th and July 31st, 13,105,
making a total of 116,972

Operations under anaesthetics were performed on 11,000 patients or nearly 10% of the whole.

A large majority of the operations consisted of the excision of damaged or dead tissues, the drainage of wounds, the arrest of haemorrhage and the treating of bad fractures. Many amputations were also performed.

Abdominal operations were, as was expected, only a small propor--tion of the whole. They numbered 839 and of these 380 were saved, 45 per cent.

Except in patients who could not be brought in for one or more days "gas gangrene" was neither of frequent occurrence nor of a bad type.

Tetanus was almost entirely absent. Only one case occurred at the front and six were reported at the base. The case at the front was not a gunshot wound, so that the average was only about one case in 20,000 wounded.

In briefly reviewing the work done, it may be pointed out that the object which had been aimed at was to take the fullest advantage of the supply of Casualty Clearing Stations, and to provide such space and equipment as would enable an increased staff to work simultaneously on a large number of patients. It was hoped that in this way, much might be done to prevent wounds from going wrong, for experience has shown that if a lacerated or contaminated wound is left without com--plete treatment for any length of time the danger to life or limb is greatly increased. Such operations cannot usually be postponed until arrival at the Base.

The arrangements for the performance of Abdominal operations provided that these should be spread over a large number of Casualty Clearing Stations and Surgeons, and would thus not be so concentrated at any one place that the staff were swamped by the numbers. The

results were very good and reflected much credit on the operators.

The proportion of all patients subjected to operations of various kinds show that a very large percentage of the whole of the wounded were able to be dealt with, for, in spite of the great numbers admitted one patient out of every ten was operated upon or treated surgically under a general anaesthetic.

It is, of course, certain that even more might have been similarly treated with advantage, but, while evacuation by frequent trains did not permit of everyone being retained who might have been benefited by operation, it is satisfactory to know that all really urgent cases were thoroughly dealt with, and that at no time were the staff unable to operate on any such patient because there were more cases than they could deal with.

At this fight, for the first time, the reinforcements for the medical staffs of the Casualty Clearing Stations were not drawn from the base, but from Casualty Clearing Stations of the First and Second Armies. In addition, each Casualty Clearing Station of the Fourth and Reserve Armies had three other officers drawn from Field Ambulances. The Officers drawn from the other Casualty Clearing Stations were especially valuable, as they were all quite familiar with the work they had to do and required no supervision. Where it appeared necessary to increase the Surgical Staffs one or more additional Surgeons were supplied from front Units.

The success obtained in dealing with an unprecedented number of wounded may be attributed to the following conditions.

(1) A sufficient number of Casualty Clearing Stations.

(2) A Staff of about 14 Medical Officers.

(3) A Staff ofabout 14 Nurses.

(4) Additional stretcher bearers.

(5) Large Operating Theatres and sufficiently numerous departments for dressing slight wounds.

(6) The drawing from other Casualty Clearing Stations of Medical Officers as reinforcements.

It should be noted that the drafting into the area of the Fourth and Reserve Armies of new Divisions from other Armies caused a very excessive demand on the supplies of the local Advanced Depots of Medical Stores, and called for an extra supply of some thousands of splints and other Surgical Stores from the Base. All that was required was forthcoming.

In conclusion, it may be noted that, although the whole staffs of the Casualty Clearing Stations were called upon for very hard work in the first week of July, they were quite able to cope with it without excessive strain.

August 12th,1916.

NOTES ON THE SURGERY OF THE FOURTH AND RESERVE ARMIES DURING THE MONTHS OF AUGUST AND SEPTEMBER, 1916.

---

1. During these months the Casualty Clearing Stations at the Front were increased in the Fourth Army by the addition of two, and in the Reserve Army by the addition of one, making a total of twelve in the Fourth Army and nine in the Reserve Army. Various C.C.Ss. were moved forward so that the distance the wounded were carried by Motor Ambulance became lessened.

2. The staffs of M.Os. and Nursing Sisters were diminished in those C.C.Ss. which were not so busy as formerly. But in those where work was heavy, they were kept up to 14 M.Os. and not less than 14 Nurses.

3; Experience has shown that if an increased staff includes three good "surgical specialists" the work is best done by dividing the M.Os. into three groups, each of which has an operating surgeon at the head. It is then easy to arrange the groups so that two are always on duty while one is resting, and thus at least eight surgeons are always available for work at dressing patients and performing operations day and night.

Each enlarged C.C.S. in active work requires not less than three good operating surgeons.

4. In the original instructions of the D.M.S. Fourth Army for the operations of July 1st, it was ordered that when any C.C.S. had admitted 400 patients, the wounded should then be sent to another C.C.S., so that each should take in patients alternatively. This plan was also adopted in the Reserve Army. In the event of 24 hours passing before the number of 400 was reached, then also the patients were to be deflected to the other C.C.Ss. This arrangement has worked out to the great advantage of both patients and staff.

It should, however, be noted that the number of 400 is too large unless the staff be as many as 14, and should be proportionately diminished. Also, that if slight cases are sent to another C.C.S. then the taking in of as many as 400 lying-down serious cases may overtax the surgical and nursing staff.

It is however, of the greatest advantage to adopt the general principle of not admitting without an interruption more than a limited number, and of working C.C.Ss. alternately, for, when the taking-in period ceases, the staff know that they will not be disturbed by the arrival of other fresh cases, and they can give the whole of their united services to the treatment of those already admitted. On the other hand, when the taking-in period comes round again, then the great majority of the staff on duty can give all their attention to examining and dressing the new patients. In this way a very large number of dressings can be done in a very short time, and evacuation is facilitated.

5. It has also been found that it is most advisable to dress and examine the patients as they arrive and before they are sent to the wards. If this is done, it is then quite easy to at once separate patients into three classes :-

(I) Those ready for evacuation.

(II) Those unfit to be moved at once.

(III) Those requiring operation.

Suitable tents or huts are allotted to each class. In this way much time is saved, for the patients for evacuation call for no further treatment, and the time of M.Os. and nurses can be given to those most requiring it. Further, by at once separating all cases requiring operation, no one can be overlooked, as he may be if all are sent indiscriminately to various wards before being dressed. This method also greatly facilitates the selection of cases for operation in order of their needs; for when all are thus collected it is easy to decide the order in which they should be taken to the theatre.

Very large reception accommodation is required in order to carry out this principle satisfactorily, and all C.O's who are pitching new C.C.Ss. should be reminded of the necessity of providing ample space, so that no delay is caused in moving patients from the motor ambulances into the reception or dressing area.

6. The total number of wounded in the two months was less than that in July alone.

7. This diminution in numbers allowed of more time being given to the treatment of the patients, and an even larger proportion of cases was treated under anaesthetics than in the month of July.

Abdominal operations show about the same satisfactory proportion of recoveries, i.e. about 45 per cent.

~~8. Tetanus cases were [illegible] very rare, only being reported at the front, [illegible] base.~~

8. Gas gangrene occurred rather more frequently than in July. This was due to two facts: First. The proportion of bad shell wounds was higher, and of bullet wounds lower; and the wounds on the whole were of a worse type on this account. Second. As our Armies moved on and passed into more open country, evacuation of the wounded became more difficult, and many cases occurred in which men had been left lying out for long periods before they could be rescued. It is probable that the cold and wet weather and the consequent mud had also a bad effect.

9. The wounds of German prisoners did not differ materially from similar wounds in our own men. There was a small percentage of bayonet wounds amongst them, but only seven of these were found in rather more than four hundred wounded prisoners on a given date.

Anthony A. Bowlby
Surg. Gen.

6.11.16.

WOUNDS OF THE ABDOMEN. Résumé

At the beginning of the war neither the military situation nor the equipment of the Medical Service permitted of the successful performance of large numbers of abdominal operations at the front. Before many months, however, the fixed line of trenches permitted of the establishment and equipment of the Casualty Clearing Stations in such a way as to provide the opportunity for all operations that might be required.

It soon became evident that the great majority of those who were wounded in the intestines died, and it also became clear from postmortem examinations both that the injuries inflicted by either bullets or shells were so extensive that repair and recovery could not be expected without operation, and also that very many patients died from haemorrhage, which might have been arrested by the Surgeon. The result was that the treatment of gastro-intestinal injuries by rest, opium and abstinence from food was abandoned, and operation became the rule. This development of abdominal operations was largely the result of the work and advocacy of Colonel Cuthbert Wallace C.M.G., one of the Consulting Surgeons at the Front.

As has already been stated at the first session of this Congress, operations on the abdomen are performed in the British Army either at the Casualty Clearing Stations nearest to the front, or if necessary, in small special Hospitals, for it has been found that it is necessary both to keep the patient at the place where he is operated on for at least a week and also to ensure good nursing and good beds. These conditions cannot certainly be obtained at a Field Ambulance and consequently it is considered better to remove the patients to the advanced Clearing Stations at once. Arrangements have therefore been made that all patients with wounds of the abdomen shall be sent direct to the Clearing Stations by special ambulance cars and not to the tent section of the Field Ambulances. In this way much time is saved.

The Nature of the Injuries in Abdominal Wounds.

(1) It is possible for a missile to pass across the intestinal area without opening the bowel, but such an occurrence is quite unusual. This has happened with shrapnel bullets more often than with fragments of shell or rifle bullets.

(2) In some injuries of the abdominal wall and especially when caused by large fragments of shells or bombs, the intestine may be severely injured, or even torn completely across, without the peritoneal cavity being opened.

(3) The small intestine is seldom wounded in one place alone; there are generally several or many wounds, and both the large and small intestines are often injured by the same missile.

The Mesentery is often injured, and it bleeds more profusely than the intestine. It is sometimes torn away from the bowel for several inches so that a loop of gut subsequently becomes gangrenous as a result of arrest of its blood supply.

(4) The liver is frequently wounded without other viscera being hurt and fragments of shell are often left buried in its substance. If the kidney or spleen are injured the colon is often injured also.

(5) Abdominal wounds are often complicated by wounds of the lung and sometimes by injury to the spinal cord. When the diaphragm is torn, hernia of the stomach and intestine into the pleura is frequently seen.

(6) The site of entry of a missile is frequently at a distance from the abdominal wall. e.g. in the shoulder, the chest or the buttock. The entry wound may be extremely minute, for the very smallest fragments of metal may be driven through the abdominal wall into the intestine and may leave a wound of the skin so small that it looks like a superficial abrasion and is very liable to be overlooked. If the entry wound is through the buttock there is often a very dangerous compound fracture of the pelvic bones in addition and these wounds are especially liable to be affected by gas gangrene.

The intraperitoneal injury caused by missiles passing through the buttock is often very extensive and may involve the rectum, the bladder and the small intestine. Buttock wounds penetrating the abdominal cavity are therefore very frequently fatal in spite of operations.

(7) Haemorrhage is the cause of nearly all deaths which occur within twelve hours of the wound but it is also true that if a patient has lost much blood, and yet does not die of bleeding, he is very liable to die from the shock of an operation or else from a sepsis which he has not the vitality to resist. The patients who have lost very little blood show a much higher rate of recovery than those who have bled profusely, even though they may have severe intestinal injuries.

(8) Peritonitis does not occur early in wounds of the small intestine or the stomach unless the latter is full of food which escapes. The contents of the small intestine often do not escape for six or eight hours after the injury. The contents of the large intestine escape quickly; they are much more septic, and cause a more early and severe peritonitis. They are also very liable to set up a dangerous sepsis in the sub-peritoneal cellular tissue which is often fatal.

Diagnosis.

It has been found that many of the injuries of the solid viscera do very well without operation and that the most important question to decide is whether the stomach or the intestines have been injured. In through and through penetrating wounds this question can generally be settled by anatomical knowledge, on the assumption that the hollow viscera are almost always wounded if the area of the abdomen containing them is traversed by a missile. All such cases require operation. When the missile has entered through the thorax or lumbar region and is retained the case is less clear and the Surgeon is much assisted by an

X-Ray examination, although he must rely mainly upon the symptoms exhibited by the patient, and this is especially the case when the entry wound is at a distance from the abdominal wall Severe and diffuse abdominal pain and tenderness are almost always present if morphia has not been given and they are more important signs of intestinal injury than any others. Rigidity of the abdominal wall is commonly found, but it is often quite as well marked in cases where the lung and the diaphragm have been wounded and the abdomen is not injured at all. Vomiting is often absent in the early hours after an intestinal wound and is often present when the hollow viscera are uninjured and there is only blood in the peritoneum; its presence or absence is therefore of little value.

The pulse is often quiet, but it generally rises quickly within a few hours of the injury. The facial expression is often very characteristic and is rarely free from an appearance of anxiety or distress.

If a diagnosis of probable injury to the gastro-intestinal tract is made the custom in the British Army is to operate, and this is contraindicated in those cases alone where the patient is either obviously dying or else where he is not brought to Hospital until 36 hours or more have elapsed since the wound was received. It has been found that if so long a time as 36 hours has elapsed the chances of recovery are better without operation. If operation is required, the sooner it is done the better, but in wounds of the small intestines or stomach the results of operation are good if not more than 8 or 9 hours have passed since the receipt of the injury. It is only after 10 hours have passed that the mortality rapidly increases, and after a delay of 18 hours the percentage of recoveries becomes very small.

If the pulse is as much as 120 to the minute, the chances of recovery are slight.

If a patient is cold and collapsed on admission it is generally right to put him to bed and rest him and apply warmth

for an hour before operation. The limbs and the chest should be kept well covered during the operation itself and the operating theatre should be well warmed.

We have found that the best anaesthetic is warmed ether vapour and if the patient is suffering from shock this should be combined with oxygen.

The chances of recovery from an abdominal wound are much less in winter than in summer. This is partly due to the effects of cold and wet upon a patient who has lost much blood, and partly to the greater prevalence in winter of bronchial catarrh; for many patients die after operation from bronchitis and broncho-pneumonia.

The following rules are generally observed in operating on the stomach or intestines.

(A) The operation should be performed as quickly as possible.

(B) The incision should therefore be sufficiently large to permit of easy examination of the viscera.

(C) A para-central incision is usually the best, but in lateral wounds a parcostal incision may give better access to the flexures of the colon or to the diaphragm.

(D) The Intestines should be kept inside the abdomen as much as possible. They should be examined in their whole length before suture or resection is decided upon. Resection should never be done if it can be avoided, and it is better to suture many holes in the intestines than to resect the unjoined coils. Thin silk and linen thread are the best materials to use, and a single continuous suture which invests the peritoneum is quite sufficient and secure. If resection is necessary, end to end joining is better and quicker than lateral apposition.

(E) Blood should be gently sponged out, and abdominal lavage should not be employed. The Abdominal incision should be very carefully and firmly closed in its whole length. Drainage

should not be employed except that a tube may be placed in the pelvis for the first 24 or 36 hours if the peritoneum is badly soiled.

(F) Injuries of the lumbar colon should generally be operated upon by a lumbar incision so as to avoid spreading infection over the peritoneum. The cellular tissue around the colon should always be drained.

(G) Wounds of the Rectum, if intraperitoneal, should be treated by suture. If they are extraperitoneal they always require free drainage and in some of them colotomy is necessary.

(H) Wounds of the Bladder opening the peritoneum are generally complicated by injuries of the rectum or the small intestine. They should be sutured with catgut and the bladder should not be drained by a Catheter.

Extraperitoneal wounds of the bladder may be sutured or drained according to the absence or presence of other injuries. Missiles in the bladder should be always removed.

(I) If the diaphragm is badly torn, it must be carefully sutured for if this is not done, few patients recover.

(J) If the patient has a wound in the back which requires that he should be turned on to his face in order that it may be opened up and cleaned this should always be done before the abdomen is opened as it causes much collapse to do this at the end of an abdominal operation.

(K) If it seems advisable to give intravenous saline infusion this should be done towards the end of the operation and not before it. Intravenous injections are much more useful than subcutaneous infusion of fluid.

The Solid Viscera.

As injury to the solid viscera is chiefly dangerous on account of haemorrhage there is generally no object in operating, unless it is believed that bleeding is still progressing. This is compar-atively rarely the case, so that operations on the spleen, kidney and liver are not usually to be undertaken in wounds of these organs. If operation is required on the kidney or the spleen the

the opening up of the wound and packing it with gauze will usually arrest haemorrhage. If it does not do so, or if the main vessels are torn or the organ smashed, excision is required. Secondary haemorrhage from the kidney is not uncommon and is generally due to sepsis. In such cases nephrectomy is generally necessary. Bleeding from the liver is difficult to arrest by operation, but in some few cases packing with gauze may be of use. If large fragments of shells or bombs are lodged in the liver they are likely to set up a very dangerous suppurative hepatitis and should be removed after they have been located by X-Rays.

Most wounds of the liver do not require treatment by operation.

Wounds of the Pancreas are generally complicated by other injuries and are commonly fatal.

Post Operative Treatment

After operation the patient should at first be kept lying down in bed and be warmed as much as possible. After six to twelve hours he may be propped up in a sitting position. Saline with a little brandy should be given frequently per rectum from the first. Distention of the bowels is usually treated by the intra-muscular injection of pituitary extract and the use of half an ounce of glycerine per rectum.

Results

The results of operations on the abdomen have improved and this is no doubt due to the increased experience of the surgeons at the front.

It is not yet possible to give statistics for the whole Army but the following figures will show the results obtained in certain areas.

Colonel Cuthbert Wallace has published the statistics of the whole of the abdominal cases in a certain area during a period of eighteen months, and these show that

Of 965 operations 46.1% recovered.

The published statistics of two hospitals in another area for a period of active fighting show that out of 856 patients treated by operations 416 recovered and 450 died, i.e. about 49% recovered.

It is thus evident that it is quite possible, even in heavy fighting to save the lives of many men, and it is satisfactory to observe that the recoveries during a battle are as numerous in proportion as during quieter periods, a result which must be attributed to good and quick evacuation as much as to good surgery.

RAMC 365/1

No. C.

A MEMORANDUM ON THE SURGICAL WORK OF THE CASUALTY CLEARING STATIONS OF THE SECOND AND FIFTH ARMIES BETWEEN 31st JULY and 16th NOVEMBER, 1917.

---

(1) A "Note on the operative Surgery of the Fifth Army for July 31st and August 1st, 2nd, and 3rd, and a second Note "on the condition of the wounded after the fighting of Sept. 20th to 26th" have already been submitted. The present memorandum should be read in connection with these Notes.

(2) The battle may be said to have ended on the 16th Nov., at the time when the Fifth Army left the area.

(3) During the period beginning on July 31st and ending on Nov.16th there were admitted into the Casualty Clearing Stations of the Second and Fifth Armies 199,864 wounded.

(4) During the same period 61,225 patients were operated upon under anaesthetics. (I am indebted to the Officers Commanding for these figures), i.e., 30.6 per cent of the wounded passed through the operating theatres.

(5) Even during the most active periods, when the wounded were most numerous, the percentage operated upon did not fall below 16.5% and an analysis of figures supplied by Surgeon General Skinner, D.M.S., Fifth Army shows that of the total number of wounded admitted from nine separate attacks in the Passchendaele Area, namely 56,040, 12,705 were operated on, i.e. 22.6 per cent.

(6) The list enclosed shows the incidence of the work, and it may be noted that in the Bailleul group, the number of cases was the smallest and the proportion of operations the highest, as a result of absence of severe pressure. The work was heaviest in the Remy Siding group, yet an average of nearly 30 per cent of operations was maintained, a result which was due in great measure to the long experience, efficiency, and training of the staffs.

In all the groups of Casualty Clearing Stations it was the custom not to take in more than 150 cases before switching off to the next Casualty Clearing Station, and it is only by this means that large numbers of patients can be adequately treated. The number of 150 should not be exceeded.

(7) During the later stages of the battle much assistance was given by an increase in the number of orderlies attached for stretcher carrying, and it should be noted that this work is very much increased by the number of operations performed.

(8) During this battle special wards were set apart for the resuscitation of patients suffering from "Shock", and blood transfusion was practised on a large scale, for the first time, with very good results.

(9) Allusion has already been made (in the two notes above referred to) to the number and origin of the "Surgical Teams" sent as reinforce--ments, and to the number of Nursing Sisters supplied. It only remains to add that the "Teams" from the L. of C. Units were very largely composed of Medical Officers from our own Colonies and Dominions and from the United States of America. As this was the first occasion on which American Surgeons were appointed to serve at our Casualty Clearing Stations, I should like it to be noted that they rendered the most valuable assistance.

(10) The reports I have received from time to time from all the

Consulting Surgeons and the General Hospitals of the different bases are to the effect that the wounded have arrived in better condition as a whole, than they ever have done before from any previous battle. The incidence of gas-gangrene has been very low indeed, in spite of the worst possible contamination of wounds by mud; very few amputations were required at the Base, and mortality rates were unusually low.

(11) I attribute these satisfactory results to the great increase of staff and personnel, and to the additional operating theatre accommodation and extra operating equipment.

(12) It should be noted for future guidance that the maximum number of operations which could be perfomed in 24 hours in a Casualty Clearing Station with a staff of 24 Medical Officers was about 160, and this total was only exceeded on a very few occasions. The average reached was about 120.

(13) The staff alluded to (i.e. 24 M.Os.) is sufficient only if there are a large number of Clearing Stations in the area of heavy fighting. Even then it is not sufficient if wounded arrive in excessive numbers, and it was sometimes necessary to divert wounded to a Casualty Clearing Station which was less heavily worked.

(14) The performance of operations on 30 per cent of all wounded must not be considered sufficient, for, when work is quiet, it is found advisable to operate on not less than 50 per cent of all wounded. It consequently follows that even largernumbers of surgeons should be supplied to Casualty Clearing Stations in heavy fighting whenever this is possible.

(15) Twenty-five Nursing Sisters is the minimum required in a Casualty Clearing Station in active work. Where many patients have to be retained this number should always be increased.

(16). It should be noted:-

(1) That the manufacture and supply of Oxygen and Nitrous Oxide for anaesthetic work should be increased to the greatest possible extent, as should also the apparatus for administering it. It is, further, most important that as many anaesthetists as possible should be carefully trained in quiet times in the use of this method of anaesthesia.

(2) It is desirable to send additional X-Ray Officers to Casualty Clearing Stations taking in large numbers of wounded over a prolonged period. No one man can do all the X-Ray work day and night, and operations go on all the 24 hours.. More orderlies should also be trained for the same reason.

(Sd) Anthony A. Bowlby.

Surg.Gen.

18/12/17.

SECOND AND FIFTH ARMIES.

July 31 t to November 16th, 1917.

	Unit.	Admissions of wounded.	Operations performed.	Percentage of operations to wounded.
Remy)	2 Can. C.C.Stn.	20,497	6,016	29.6
Siding)	3 Can. C.C.Stn.	18.721	4,673	25.
Group.)	10 C, C. Stn.	17.343	5,002	29.
73,922.)	17 C. C. Stn.	17.361	5,618	30.2
Brandhoek)				
and	)3 Aust.C.C.Stn.	7,073	2,107	30.
Nine Elm	)44 C. C. Stn.	8,234	2,377	29.
Group.	)32 C. C. Stn.	5,349	1,253	23.5
20,658	)			
Godewaer--	)37 C. C. Stn.	6,572.	1,373	22.5
-svelde	)11 C. C. Stn.	6,883.	2,000	30.
Group	)41 C. C. Stn.	6,823	2,028	30.
20,278.	)			
Bailleul)	2 C. C. Stn.	3,267	878	27.
Group,)	53 C. C. Stn.	3,026	1,212	40.
)	1st Aust.C.C.S.	4,011	2,111	51.
13,471)	2nd Aust.C.C.S.	3,167	1,474	46.
Dozingham)	4 C. C. Stn.	11,447	3,811	35.
Group,)	47 C. C. Stn.	12,233	4,464	36.
34,612.)	61 C. C. Stn.	10,932	4,183	38.
Mendingham)	12 C. C. Stn.	13,109	3,603	28.
Group,)	64 C. C. Stn.	11,179	3,490	30.3
36,925.)	46 C. C. Stn.	12,637	3,552	27.5
	Total	199,864	Total. 61,225.	30.6

See pages

Sp. 917

The work of the C.C.S's at the beginning of the war was very limited in its scope, for they were not originally intended to do more than "clear" the Field Ambulances & forward patients to the base hospitals. They were only created a short time before the war and had never functioned in actual warfare. The surgical equipment was very limited in every way, and as they were intended for work in conjunction with troops on the move, their equipment of all kinds was small, all patients had stretchers to lie on, and the equipment was for 200 cases.

As soon as the war of movement gave way to a war of trenches, it became possible to further equip and develop the work of the C.C.S's, and it was soon apparent that it was necessary to provide for both the performance at the front of many operations which could not be undertaken by the Field Ambulances, and also to retain and nurse many of the worst cases in the C.C.S's. A certain number of bedsteads were therefore supplied and nursing sisters were appointed. The medical officers however, were not increased, and the establishment of a C.O. and a Quartermaster with 6 medical officers remains unaltered. It should be noted however, that from the past two years, in addition to the "Surgical Specialist" each C.C.S. has a "Second Surgeon".

Since the beginning of the year 1915 the C.C.S's have increased in number as the Army has grown, and at the present time there are 59 of them. In addition, they have increased very greatly in size so that the majority of them accommodate from 800 to 1200 patients.

They are chiefly placed at a distance of about 7 to 10 miles from the actual fighting line, & are so distributed along the whole front that one or other of them is easily accessible fromevery part of the line. A few are placed further behind the front, in the billeting areas, for they

serve not only the sick and wounded from the trench area but also the needs of all men who are taken suddenly ill, or meet with serious accidents apart from fighting, e.g., cases of acute apendicitis, perforated gastric ulcer, strangulated hernia, acute pneumonia, or bronchitis, are all taken to the nearest C.C.S.

In order that their patients may be evacuated quickly and without unnecessary risk, all the C.C.S's. are placed as near as possible to a railway, and many of them have a railway siding in immediate proximity to their tents. The positions of the C.C.S's. are however, determined not only by the requirements of surgeons and physicians, but also of the Army Commander, who decides whether a railway which is primarily devoted to the transport of military stores can also serve the needs of a group of C.C.S's. It has been found by experience that it is best to put two, three, or even four C.C.S's. at one centre.

The operating work of the front has grown with great rapidity. It is still growing and will continue to grow. This increase is based on the knowledge acquired by experience that by far the most important treatment is this early mechanical cleansing of the wound and the excision of all badly torn tissues under an anaesthetic. Nothing that can subsequently be done can compensate for the want of this, and if this treatment is thoroughly carried out any subsequent line of treatment is simplified, for early excision and cleansing is the necessary basis for all methods yet devised in order to obviate sepsis.

It is also absolutely essential for success that this excision should be done as soon as possible after the infliction of an extensive wound because in such cases gas-gangrene may become widely spread within 24 hours. It is

therefore necessary to operate on such cases before the patient is sent by train to the base, as he will seldom be surgically treated there until more than 24 hours has elapsed since the time at which he was wounded. This method of treatment has entirely supplemented the application of strong antiseptics to a recent wound, or the use of continued saline infusions. It is a method whose value is agreed upon by the Surgeons of all the Allies, and has recently been unanimously approved by the Meeting of the Surgeons of the Allied Armies in Paris.

In what are called "quiet times" the nominal surgical staffs of a group of C.C.S's are able to deal with the wounded who arrive from day to day, and when there is no pressure, each Casualty Clearing Station of a group takes in for 24 hours at a time, and is so able to look after the patients who have to be retained after the "Take in" is over. It must be remembered that, when there are no large numbers of sick and wounded arriving, the C.C.S's may only be emptied by Ambulance Trains once or twice a week, and under these circumstances, some hundred or two of patients may be accumulated before the trains arrive.

When, however, a battle on a large scale is expected much more extensive preparations are required and staffs have to be increased. Up till the time of the Battle of Loos reinforcements were drawn from the Base alone, but in the next year and notably in the Somme fight, when the Army was very greatly increased almost all the surgeons sent to reinforce the C.C.S's were drawn from C.C.S's outside the battle area or from Field Ambulances.

The same method was adopted this year in the Battle of Arras in April and in that of Messines in June, but the reinforcements were on a larger scale. Still more recently //

in the fighting which began on July 31st yet more reinforcements were supplied because the experiences of increasing staffs, & consequently operations, had shown that the more operations that could be done at the front, the better were the results in the saving of limbs and lives and in the absence of gas-gangrene.

The arrangements in the C.C.Stns. at the present time may be briefly described in order to show how the work is done and what staff is required when heavy fighting is in progress:-

"Teams".

A Team consists of a Surgeon who is a Surgical Specialist or a Second Surgeon, his Anaesthetist, and his Operating Theatre Sister, and Orderly.

(a) At the Battle of Arras of April 9th, each of 10 Cas. Clg. Stations engaged was reinforced by 3 "Teams" from other Cas. Clg. Stations and by 3 or 4 M.O's from Field Ambulances.

(b) At the Battle of Messines on June 7th, each of 12 Cas. Clg. Stations was reinforced by 3 teams from other Cas. Clg. Stations, and by 3 to 6 additional M.O's either from Cas. Clg. Stations or Field Ambulances.

(c) For the 3rd Battle of Ypres, on July 31st last, each of 10 Cas. Clg. Stations was reinforced by 3 teams from other Cas. Clg. Stations, and also by 3 Teams from Hospitals on L. of C. as well as by 6 M.O's to bring the staff up to a total of 24.

Besides Medical Officers, and the Sisters, & orderlies with teams additional Sisters have been added to bring up the numbers from the normal of 7 to 25.

Additional orderlies and stretcher bearers are also supplied.

The number of surgeons employed at the Front during heavy fighting has been increased, and good results have been obtained, but it must be observed that it is skilled Operating Surgeons experienced in this special work who are required, and that the average practitioner is of little use as an Operator at the Front.

In order to enable more operations to be done by the

increased staffs, additional operating theatres have been erected and additional operating tables and equipment provided for a total of 8 tables in each C.C.S. where heavy casualties are anticipated.

The operations performed in C.C.Ss during heavy fighting in the most important recent battles are as follows:

(a) The Somme, 11,000 operations in the month of July 1916 and 35,000 between July 1st and Nov.15th.

(b) Arras. 10,785 in the month between April 9th & May 9th.

(c) Messines. 2,417 in the 3 days of June 7th,8th & 9th.

(d) 3rd Battle of Ypres: 3,306 in the 3 days of July 31st Aug.1st & 2nd.
2,352 in the 2 days Aug.16/17th.
An average of over 1,000 a day.

During a battle arrangements are made for operations to proceed continuously day and night and each team for the first 24 hours usually work 16 hours on and 8 hours off. After that, 12 hours on and 12 hours off. This enables a minimum of 4 tables and a maximum of 8 to be kept employed in each C.C.S. with 10 C.C.Ss - about 50 or 60 operations are simultaneously in progress. Each C.C.S. during a battle takes in not more than 150 "lying" cases before switching off to the neighbouring C.C.S. This in its turn takes in another 150 before switching off to the next C.C.S. Two "Sitting" cases are counted as one 'lying' case. During heavy fighting 150 patients may be admitted within an hour but more usually in two or three hours. In addition to those patients who require operation there are many more who only need to have their wounds dressed, and others who require to be resuscitated before they are fit to be treated surgically at all.

The good results obtained by increased facilities for early operation are well seen by following operations to the base hospitals and ascertaining there how they have progressed. The unanimous report has been that patients

have done well in proportion as they have been operated upon early and that, as each battle has shown, an increased proportion of cases operated upon, so the results have improved and continue to improve.

It will be obeerved that in the most recent fighting 30 "Teams" had to be drawn from Base Hospitals in order to supplement those drawn from other C.C.S's so that it is evident that if the maximum good is to be obtained by the early treatment of wounds, the staffs of the C.C.S's require to be materially supplemented from the Base. To what extent the Base can meet these demands it is difficult to know. It will have been noticed that the normal staff of 6 M.O's (beside the O.C. and Quartermaster) requires to be trebled or quadrupled for heavy fighting, and it has been evident that even when fighting is not very heavy, the staff of 6 is often insuffcient. The experience of the last year tends to the conclusion that in the near future, the staffs of all C.C.S's will require to be materially increased if the patients are to be treated as well as one would wish. In this connection, it has to be constantly kept in mind that while we can deliberately make arrangements for our own attacks, our C.C.S's on every part of the line have always to be ready to deal with large numbers of wounded caused by an unexpected enemy attack. Such attacks as those at Bullecourt in April or at the Ypres Salient in 1916 have resulted in several thousand wounded arriving at the C.C.S's without any warning.

(signed) Anthony A. Bowlby,

7:9:17. Surgeon General.

Presented to Committee of Enquiry

RAMC 365/1

204 C.C.S.

26:11:17

Dear General,

In answer to your letter, my numbers read as follows.

31st July — 16th Nov: 1917

Total wounded admitted 11,447

Total number of operations 3,811

I have unfortunately had to send Oliver down to the base with a bad thumb, but he should be alright again shortly. I should be very sorry to part with him, if you could

possibly get him back to my
unit on his recovery. He is now
in No 1 Gen Hospital.

Yours sincerely

J. McRabbie

Reprinted from the BRITISH MEDICAL JOURNAL, *March 23rd, 1918.*

GUNSHOT WOUNDS OF THE ABDOMEN AT A CASUALTY CLEARING STATION.

150 CONSECUTIVE OPERATIONS FOR PENETRATING ABDOMINAL WOUNDS.

BY

CAPTAIN R. CHARLES, R.A.M.C.(T.C.).

SINCE November, 1914, I have had the opportunity of observing and treating a large number of gunshot wounds of the abdomen. I cannot lay claim to breaking fresh ground, yet in my series many of the cases present points of great interest, and illustrate the difficulties and the wide field of this type of surgery. It is not proposed to describe minutely or discuss either the various kinds of injuries produced by various missiles, or the signs and symptoms associated with the lesions of the different abdominal viscera.

DIAGNOSIS.

Difference of opinion sometimes arises as to whether a gunshot wound of the abdomen involves the peritoneal cavity or not; indeed it is sometimes impossible to tell without a laparotomy, for the signs and symptoms usually associated with these cases are not constant. Experience will usually settle the point in each particular case.

The following points taken collectively are important:

1. *Position of the Injury.*—It is first necessary to determine if possible the direction of the track. The entrance and exit wounds give an idea of the path of the missile and the structures likely to be involved. The absence of an exit wound does not necessarily mean that the foreign body is lodged in the abdomen. The possibility of its being buried in the parietes must be excluded.

2. *The facial expression* is usually one of anxiety.

3. *Pain* is not of great value, and may or may not be present. At first it is often diffuse, and afterwards becomes more localized, while the various reflected pains are occasionally complained of—a wound in the hepatic region accompanied with pain in the right shoulder; a wound in the lower costal region, with pain and rigidity in the epigastrium, and that often without any involvement of the abdominal cavity.

4. *Tenderness* is a very constant and reliable sign. I do not refer to the zone of hyperaesthesia of the skin in a certain segmented area corresponding to the deep-seated injury, but to the tenderness elicited on moderate pressure over the injured viscus. It is necessary to exclude the muscular tenderness along the path of the wound and the contused area in its immediate vicinity. This tenderness will indicate the seat of the injured viscus, thus giving some idea as to what incision will best meet the requirements of the case.

5. *Rigidity*, or the absence of it, is often most misleading. I have seen a flaccid abdominal wall in a case of multiple perforations of the bowel. On the other hand, board-like rigidity is frequently met with in a purely parietal wound.

6. *The pulse* varies in rate; it increases directly with the gravity of the intraperitoneal lesion, and gives an important basis for prognosis.

7. *Vomiting* is usually present, but not necessarily. Thirst is a most distressing symptom.

X-ray localization affords the most useful guide to the diagnosis of penetrating wounds of the abdomen. Without it there must often be a large element of doubt. I always advise the radiologist to curtail his examination as far as possible, even to the neglect of foreign bodies situated elsewhere in multiple wounding; and every effort should be made to keep the patient warm throughout the examination.

TREATMENT.

The cases on their arrival at a casualty clearing station may be classified for the purpose of treatment, according to their general condition and irrespective of the class of wound, as follows:

1. In a dying condition, when nothing can be done except to relieve pain and thirst.
2. Showing varied degrees of collapse, but capable of resuscitation.
3. In good condition and operable.

Pre-operative Treatment.

This principally consists in treatment for shock. It is usually necessary to begin by raising the body heat, and for this purpose the radiant electric bath is the best. Saline, two pints, with brandy, is given subcutaneously prior to and not during operation, as formerly practised. For extreme cases intravenous saline with 3 per cent. sodium bicarbonate has lately been recommended, and is apparently more effective. If pain is present to any extent morphine is given; rest and absolute quietness are essential.

When to Operate.

In my opinion operation should not be undertaken before the patient has recovered from shock. Two arguments may be put forward in favour of immediate operation:

(*a*) Internal haemorrhage; (*b*) danger of delay allowing peritonitis to supervene. Against these, however, it may be stated that almost every case of severe intraperitoneal haemorrhage, on its arrival at a casualty clearing station, is either in a dying condition or suffering from an extreme degree of collapse and has for the time being ceased to bleed. Except when there is only one perforation no serious infection of the peritoneum from the small intestines takes place until the lapse of about six hours from the time of being wounded. It is therefore in the best interests of the patient to delay operation pending his recovery from the initial shock before subjecting him to the further shock of operation. Indeed, in cases suffering from shock and haemorrhage I have often waited six hours or more, taking the risk of further haemorrhage, with results that have justified my delay.

Provided the patient is warm, operation is done at once. Saline is given on the table during the operation. The anaesthetic now used is warm ether and oxygen given by Shipway's apparatus.

Operation.

I attach great importance to the element of shock, and in operative manipulation endeavour in every way to avoid any aggravation of it. The first essential is speed; the prognosis of the case varies inversely as the length of the operation. If the operation is not completed inside one hour the prognosis is not good. To do this, very free access to the peritoneal cavity is necessary. Another difficult problem in war surgery is the maintenance of a constant warm temperature in the theatre. In winter the table should be kept warm, and draughts from doors opening direct to the open air must be avoided.

Incision.

The abdomen is opened by a paramedian or, in some cases, a transverse incision. The skin is covered with tetra towels wrung out of hot saline, and over these a sheet of oiled silk is placed. On opening the peritoneum, owing to the sudden relief of tension, in many cases bleeding commences again. It is therefore necessary to mop up any blood quickly, and to attend to the bleeding point first. A large abdominal swab is next placed into the pouch of Douglas, and a systematic search made for injuries; by this means alone maximum speed and efficiency are secured. The small intestine is examined first, and any perforation covered with gauze, clamped, and left outside the abdomen; uninjured gut is returned immediately, as far as possible. Wounds of the colon are then looked for and dealt with, or packed off and dealt with later through a separate incision if free access cannot be obtained by the original opening. In wounds of the stomach the anterior and posterior walls are examined, while those of the solid viscera can be felt.

Treatment of Hollow Viscera.

I have very little to add to what has already been written on this subject. When wounds of both the small and large gut are present I deal, if possible, with the large bowel first, and always discard soiled instruments and gloves before proceeding to repair the small gut. With regard to the respective advantages of the lateral and end-to-end anastomosis, I have experienced so few recoveries in these cases that I am not in a position to express a definite opinion. End-to-end union takes less time if done by a single invaginating suture, and this method obviates the need for a second layer, involving a further reduction of the lumen of the bowel.

Injuries of the colon do best if operated upon at the earliest possible moment, and as these cases are usually admitted in good condition, delay is seldom necessary for the treatment of shock. X-ray localization is invaluable as a guide both to diagnosis and to the subsequent transverse incision. This gives direct approach, and if the colon injury is uncomplicated the field of operation is localized; moreover, there is little handling of the small bowel or unnecessary soiling of the peritoneum, and a retroperitoneal wound can be dealt with at the same time. Colon wounds are always closed by suture if possible, and I usually risk the faecal fistula which occasionally follows suture and drainage, in preference to making an artificial anus.

Wounds of the Solid Viscera.

Owing to the inability of the solid organs in the abdomen to overcome sepsis, the question arises whether wounds of them ought to be treated by excision of the infected tissue and suture.

Liver.

In many of my cases the treatment has been conservative. Sometimes laparotomy has been done for progressive haemorrhage, and packing the wound with gauze. In a few cases where the missile was retained sepsis has supervened, causing death. If the missile is moderately large and when accessible, it is now removed by resecting a rib above the costal margin, usually including the wound of entrance, thereby obtaining direct approach. Certain superficial wounds allow of excision of the track, removal of the foreign body, and suture. Failing this, a thorough mechanical cleansing of the wound is carried out; a packing of gauze is inserted to stop fresh haemorrhage, and removed within twenty-four to forty-eight hours; the peritoneal cavity by this time is shut off, and Carrel-Dakin treatment is substituted.

Pancreas.

Wounds of this organ often occur with other abdominal injuries, so that the pancreatic wound is overlooked. In two cases I removed the missile from the body along with

lacerated tissue, and sutured it up. Drainage was obtained through the transverse mesocolon, which had been previously anchored to the anterior abdominal wall. In another case good drainage was obtained through a wound of exit directly behind.

Kidney.

For exposure, the transverse kidney incision is used. If it is found necessary to deal with an intraperitoneal lesion as well, the line of incision is extended towards the middle line in front. Complete removal of the kidney is only done for gross destruction or torn vessels. Previously, in less severe cases, where an operation was warranted either for a retained foreign body or for haemorrhage, operative procedure was confined to removal of the missile and arrest of the bleeding by packing with gauze. Lately, with a view to minimizing sepsis, I have tried a more thorough operation, where only the body of the kidney was involved. Infected and damaged kidney was excised and the renal wound sutured, with drainage down to it. This has proved more satisfactory and can be carried out in the majority of the cases, the renal vessels being compressed by a rubber-guarded clamp throughout.

Closure of the Abdomen.

Having dealt with the various intraperitoneal injuries the operation is completed by removing swabs and mopping up any fluid in the abdominal cavity with gauze wrung out of hot saline. Finally the incision is closed in layers.

The question of drainage is often raised. Should it be practised at all, and if so, what are the indications? I favour drainage in certain cases. The factors which influence my decision in any particular case are, primarily, the relative infectivity of the parts injured, and secondarily, the time which has elapsed since the wound was inflicted. In wounds of the small intestine operated on within twelve hours the abdomen may be closed with safety. As regards colon wounds, whenever possible I supply free drainage, usually by rubber dam, direct to the site of suture; in my series the majority were treated in this way. Retroperitoneal wounds of the colon are always very freely drained.

The superficial wound is excised according to indications, no attempt having been made to enter the abdomen by enlarging it, a practice I avoid if possible. When the wound is in the back it is dealt with previous to performing laparotomy, as recommended by Marshall.

Abdomino-Thoracic Injuries.

It is generally accepted that gunshot wounds including both the chest and abdomen have proved fatal in the large majority of cases. This state of affairs was not improved by the active surgical treatment undertaken earlier in the war; nor did treatment on conservative lines tend to give

any better results. Recently, however, a different type of operation has yielded results which have encouraged me to persist in it.

Respiratory distress is the outstanding feature on admission. It is often so severe that immediate operation is out of the question. The patient is placed in a recumbent position, morphine is given for pain and restlessness, and, when the wound in the thorax is a blowing one, a few temporary skin sutures often bring a marked relief to the breathing. Time is allowed for shock to pass off and dyspnoea to diminish before operating.

Abdomino-thoracic wounds may be classified for the purpose of treatment into four types, as follows:

(1) *Where there are separate entrance wounds in the chest and abdomen.*

Provided the chest wound is not a blowing one, the abdomen is dealt with first, and only if the condition of the patient permits is the chest wound attended to.

(2) *On the left side with the entrance wound about the level of the sixth to the eighth rib, with a high up abdominal lesion.*

A few cases of this class do well on conservative treatment, especially where a rifle bullet has gone clean through antero-posteriorly or vice versa. What probably happens is that omentum protrudes through one or two small holes in the diaphragm and, becoming adherent, acts as a plug. Unfortunately the damage is often more extensive, and some idea of this may be ganged by considering the nature and position of the missile as shown by *x* rays and the appearance of the chest wound. If the metal has travelled down into the lower part of the abdomen it is treated as in (1). More often, however, the abdominal injury is limited to the upper abdomen, and it is for this type of case that I use a purely transdiaphragmatic route, because (*a*) it saves time; (*b*) access to the upper abdomen is much easier than by laparotomy; and (*c*) it avoids the combined laparotomy and thoracotomy, which is highly fatal.

Operation.—The chest wound, with all infected tissue, is completely excised and enlarged backwards and forwards until about five inches of the affected rib has been removed altogether. With fresh instruments the pleura is opened widely, the haemothorax swabbed dry, and the chest cavity protected by large abdominal swabs. Having placed a self-retaining retractor in the wound, the rent in the diaphragm is found and enlarged up to four or five inches. The abdominal injury is reached in this way, and, when it has been dealt with, gloves and soiled instruments are changed, and closure of the diaphragm is accomplished by a continuous suture of chromic gut. Next, the lung is examined, and, where necessary, treated according to present-day methods. Suture of the parietal pleura may present difficulty. When it cannot be sutured completely and a large gap is left, the lung is brought up and fixed by suture to the edges of the hole. This gives an airtight

closure to the cavity, and also acts as a barrier to any superficial sepsis which may subsequently develop. Closure of the wound in layers completes the operation.

(3) *On the left side, with the wound of entrance below the eighth rib.*

In this type the abdominal condition is often much more serious. Frequently the chest escapes altogether, or is so slightly injured that it can be left out of consideration, in which case the abdomen is dealt with by laparotomy. When, however, both chest and abdomen require attention, the following operation can often be employed, bearing in mind the position of the missile: The chest is opened as described under (2), and the incision carried forward on to the abdominal wall. By prolonging the wound in the diaphragm the parietal peritoneum may be opened to any required extent. The chest condition is dealt with, and the pleural cavity shut off by suture of the diaphragm to the chest wall just above the wound. The intraperitoneal injury can then be treated and the incision closed.

(4) *When the Entrance Wound is on the Right Side.*

It is usually found that the metal having penetrated the diaphragm is lodged in the liver. If operation is indicated by the condition and size of the chest wound or the retention of a large foreign body, it is practically the same as for the left side. Having opened the pleural cavity the rent in the diaphragm is then sought for and the metal removed from the liver by passing a forceps down the track. When, as frequently happens, the diaphragm is pierced near its attachment, the operation is to suture the edges of the hole in the diaphragm to the parietal pleura, and so effect direct drainage of the liver track with a completely closed pleural cavity. If injury to the abdominal viscera is suspected it is treated as in (1).

Post-operative Complications and Treatment.

Shock is the commonest and one of the most serious complications that may follow operation for penetrating abdominal wounds, and the means usually adopted to combat it are as described under pre-operative treatment, with the additional use of rectal saline, or brandy and coffee when the degree of collapse is not extreme; cases with severe shock derive very little benefit from this method as it is seldom absorbed. Much more useful is the intravenous injection of a solution of 4 per cent. sodium bicarbonate or a 6 per cent. solution of gum acacia in normal salt solution. But where the loss of blood has been severe blood transfusion is the best remedy.

The Fowler position is adopted as soon as the patient has got over the shock of operation, and for twenty-four to forty-eight hours rectal saline with glucose is given. Bland fluid is the only thing given by the mouth for the first few days. Early in the war I prescribed a purgative almost

immediately after operation, but I discontinued that in favour of a glycerin enema with pituitrin hypodermically on the third day.

Dilatation of the Stomach.

This occurred in several cases; the chief symptoms were a feeling of tightness in the epigastrium, restlessness, and, in the beginning, the vomiting of a small quantity of dark brownish fluid. Relief is afforded if a stomach wash of sodium bicarbonate is done early.

Paralytic Ileus.

This condition may arise in two ways: (1) It may be nervous in origin—that is, there has been primary inhibition of the nervous mechanism in the bowel due to trauma (see Case I, page 9); or (2) it may be secondary to peritonitis. The symptoms are almost identical, whatever the cause, and simulate those of progressive peritonitis.

In my earlier cases operations were done to prevent or alleviate this complication. In every instance quoted there was present some degree of peritonitis, and paralytic ileus seemed imminent. In two cases, having dealt with severe wounds of the lower part of the ileum by suture, a prophylactic anastomosis was made between the parts of the bowel above the injured area and the transverse colon. Both patients were suffering from shock at the end of the operation, and neither of them recovered. It is obvious that the operation was prolonged by the anastomosis, and in view of this delay I doubt whether I was well advised, but the prognosis in both cases was not good from the start.

In one case only, occurring in December, 1915, where the upper part of the ileum had to be sutured in nine places over a length of three feet, a short circuit above and below the injured area was done. This case did remarkably well until the twelfth day, when peritonitis became marked in the short-circuited portion, and the patient subsequently died from general peritonitis. In deciding to perform this operation I was influenced by a desire to avoid the risk of resection.

In six others, comprising perforations sutured at various levels of the small intestine, ileostomy was performed—a large catheter or half-inch tubing was inserted several inches above the first perforation either at the original operation or secondary to it. This met with little success. I experienced great difficulty in getting the catheter to act, and when once started the intestinal drainage was very limited. Consequently the peritonitis was not stayed. Possibly the addition of a second catheter inserted below the last intestinal perforation would have given more encouraging results. Latterly, however, several bad cases of paralytic ileus have recovered, the treatment consisting of frequent gastric lavage, intramuscular injections of pituitrin, appropriate saline, and the administration of enemata as required. Morphine was not withheld.

Gas Gangrene.

In this series one case developed gas infection of the anterior abdominal wall in which the deep epigastric artery had been severed. As a precautionary measure, where the wound of the abdominal wall was extensive and had to be freely excised, the peritoneum alone was sutured and a few tension stitches of strong silk, protected by capillary tubing, were inserted. I am unable to state accurately the number of cases in which retroperitoneal sepsis—gaseous or non-gaseous—became a prominent feature, but in most of them it proved fatal. One bad case, however, recovered. In this case the gas had extended from one side to the other, lifting the peritoneum from the posterior abdominal wall. A very large incision was made, resembling that employed for exposing the ureter; infected and gangrenous muscle was removed; Carrel's tubes were placed in all directions and hourly injections of Dakin's solution given.

The following are notes on a few interesting cases.

CASE I.

Lce.-Cpl. S.; admitted February 12th, 1916. The missile had entered from behind at close range, explosive in action, carrying away a portion of the right rectus below the umbilicus; two feet of intestine lying on the abdominal wall. Bowel outside showed evidence of plastic peritonitis; four large holes in it and the mesentery torn; general condition fair. Laparotomy: Abdomen full of blood; no further bowel injury discovered; resection of two and a half feet with lateral anastomosis; abdomen closed without drainage; pulse 120. Twenty-four hours later: vomited a large amount of blackish fluid; under local anaesthesia a large catheter was inserted high up in the jejunum; stomach washed out. Second day, evening: About 5 oz. of yellowish odourless fluid came away. Third day: Catheter acting well after being syringed and siphoned with saline; patient felt and looked ever so much better. Fourth day, early morning: Catheter not draining, patient very ill indeed, looking moribund; catheter syringed out and siphoned; large quantity of foul-smelling fluid came away; improved beyond all expectation—pulse returned with good volume. This carried him through to the fourth night and he died in the morning. If the catheter was not siphoned every few hours he vomited, though very little. *Post mortem:* No evidence of peritonitis, serosa shiny, no adhesions even in pelvis or over anastomosis, bowel at and below the union collapsed—for two feet it contained a little fluid, while the last fourteen inches of the ileum was absolutely collapsed.

CASE II.

Pte. S.; admitted August 31st, 1916. Wound of entrance only, left groin; severe shock, pulse thready and of poor volume. Operation: Left paramedian incision; found twelve holes in the ileum and two in caecum, with considerable plastic peritonitis; resection of five feet with lateral anastomosis; holes in caecum sutured; foreign body removed and abdomen closed without drainage. Recovery. Base September 10th.

CASE III.

Pte. C.; admitted May 25th, 1916. Wound of entrance only, to the left and at the level of the umbilicus, omentum protruding. Operation: Right paramedian incision; enormous

quantity of blood; eight holes in upper ileum, four of them necessitating a resection with end-to-end union; remainder sutured, abdomen swabbed dry and closed. Recovery. Base June 18th.

Case iv.

Pte. F.; wounded March 7th, 1916, 11.30 p.m.; admitted March 8th, 8 a.m. A rifle bullet entered in the epigastric region and emerged at a corresponding point behind. Patient cold, collapsed, and pulseless; abdomen distended, rigid, and motionless. At the end of seven hours' rest and treatment he began to rally. 5 p.m.: Pulse 150. Operation, 5.30 p.m.: Left median incision—abdomen full of blood; two holes in the liver and two in stomach, the missile having then passed through the tail of the pancreas and emerged as stated. Visceral wounds sutured, abdomen swabbed dry and closed. Exit wound enlarged and the pancreas drained from behind. March 9th, developed bronchitis. March 12th, death—acute bronchitis.

Case v.

Private S.; wounded September 10th, 11 p.m. Cause, bayonet. Admitted 6.30 a.m. Wound of entrance only, in the left groin, deep to Poupart's ligament. Patient collapsed, pulse thready and irregular; abdomen distended, but very little rigidity or pain. After four hours' rest and warmth he improved wonderfully. Operation, 10.30 a.m.: Left paramedian incision—abdomen full of blood, external iliac vein severed, two holes in the ileum. Ligation of vein, perforations sutured, abdomen swabbed dry and closed. Recovery. Evacuated to base September 19th.

Case vi.

Pte. A.; admitted April 10th, 1917. Entrance wound right buttock, exit below and to the left of the umbilicus. Operation: Right paramedian incision; fourteen holes in the ileum, two in caecum; eleven of them treated by suture, remainder necessitating a resection of fourteen inches with lateral anastomosis; peritonitis present; abdomen swabbed dry and closed. Recovery. Base April 22nd, 1917.

Case vii.

Lce.-Cpl. B.; admitted March 31st, 1917. A large piece of shell fragment hit the abdominal wall, carrying away portion of the oblique muscles. Several feet of intestine lying on the abdominal wall with many perforations; a small amount of mucoid and faecal material stained the serosa of the bowel. General condition very bad, but responded well to treatment. After five hours' rest, operation. Original opening enlarged; plastic peritonitis and perforations confined to the prolapsed portion of bowel. Resection of three feet; end-to-end union by a single invaginating layer; peritoneum only closed, using a few tension stitches for the skin. Developed pneumonia. Recovery. Base April 24th, 1917.

Case viii.

Pte. S.; admitted April 28th, 1917. Wound of entrance only, left buttock; signs of much shock and loss of blood; pulse 130; rigidity and tenderness confined to the lower abdomen. After three and a half hours' rest, marked improvement. Operation: Left paramedian incision—abdomen full of blood; internal iliac vein perforated—clamped with forceps; one hole in ileum sutured; patient became very collapsed, so the abdomen was

closed, with forceps left in position. Transfusion of blood by the sodium citrate method; left the table much improved. Four days later forceps removed. Recovery. Evacuated to base May 18th, 1917.

Case ix.

This is one of interest, as it is the only case of recovery I have had with an abdominal patient admitted pulseless who remained so for many hours. Pte. H., wounded July 21st, 1917, 12 midnight. Shell fragment. Admitted July 22nd, 7 a.m. Entrance wound only, mid-abdomen. Complications: Penetrating wound of chest and multiple wounds of both legs. 10 a.m.: Intravenous saline with 4 per cent. sodium bicarbonate and glucose given. 1 p.m.: Pulse for the first time felt at wrist. 4 p.m.: Warmer, and much improved generally; pulse 150. 5 p.m.: Pulse of fair volume. Operation, 5.30 p.m.: Right paramedian incision—abdomen full of muco-purulent fluid; one perforation in ileum with missile lodged there; removed and hole closed; abdomen swabbed clean, and a pint of warm eusol left in it, with drainage down to pelvis; the incision closed in one layer. Subsequent treatment: Repeated stomach lavage, saline, pituitrin, etc. August 1st, second operation: Resection of rib for septic haemothorax. Evacuated to the base August 10th, in good general condition.

Case x.

Spr. F.; admitted April 30th, 1917. Entrance wound epigastric region, no exit; in fair condition; pulse 120. Operation: Left paramedian incision—abdomen full of blood; two holes in the liver; two in stomach; coronary artery severed. Visceral wounds treated by suture, artery ligatured; foreign body removed from the body of the pancreas, lacerated tissue removed, wound sutured and drained through the transverse mesocolon; abdomen swabbed dry and closed. Developed a pancreatic fistula, which gradually got less daily. Evacuated to base May 16th, 1917.

Case xi.

Pte. H.; admitted October 1st, 1917. Shell fragment entering left side over sixth rib in mid-axillary line, penetrating abdomen; large haemothorax; severe dyspnoea; general condition good. Operation: Trans-diaphragmatic route; five inches of rib resected after excision of wound; pleural opening enlarged and cavity swabbed dry; omentum seen protruding through rent in diaphragm—this opening freely enlarged and abdominal viscera examined. The only visceral wound was a hole in anterior stomach wall with foreign body embedded in it; treated. Diaphragm closed, wound of lung sutured, and incision closed. Recovery. Base October 12th, 1917.

Case xii.

Pte. D.; admitted October 10th, 1917. Shell fragment; entrance wound only, over eighth rib, left side; abdomen penetrated; general condition good; severe dyspnoea. Operation: Trans-diaphragmatic route—rib resected and blood swabbed from thorax; omentum found protruding through a wound in the diaphragm, size of a half a crown—enlarged this opening and found injury to spleen and kidney; foreign body removed from kidney, the wound being excised and sutured—no treatment of spleen; diaphragm closed; sudden cardiac failure then necessitated massage of the heart, which responded immediately; operation completed. Recovery uneventful. Base October 20th.

Case xiii.

Lce.-Cpl. W.; admitted October 15th, 1917. Entrance wound close to spine, with exit wound at tenth rib in mid-axillary line, from which omentum protruded; patient badly shocked, but apparently had not lost much blood. After four hours' rest and treatment, operation: wound of exit (with omentum) excised and enlarged forwards and backwards; rib resected; wound laid widely open; rent in diaphragm sutured to chest wall above the wound; spleen found severely lacerated and therefore removed; no other visceral lesion present; wound closed. Died suddenly twenty-six hours later, when apparently doing well.

Case xiv.

Gnr. G.; wounded October 26th, 1917. Shell fragment. On admission same day a large blowing wound in the chest wall at the level of the ninth rib, right side; *x* rays showed a very large foreign body in the liver. Operation: Trans-diaphragmatic route—rib resected, including excision of entrance wound; pleural opening further enlarged; blood removed from pleural cavity; foreign body removed from the liver through the rent in the diaphragm; edges of rent sutured to parietal pleura; wound of liver packed with gauze surrounded with rubber dam; rest of the wound carefully stitched. Following day, gauze removed and replaced by Carrel's tube. Dakin's solution used. Recovery. Base fourteen days later.

I take this opportunity to express my gratitude to Surgeon-General Sir Anthony Bowlby, K.C.M.G., for his encouragement and advice throughout this period. My best thanks are due to Surgeon-General Cuthbert Wallace, C.M.G., and to Lieut.-Colonel H. Rogers, D.S.O., and Lieut.-Colonel W. D. Kelly, D.S.O., for permission to publish these cases.

References.

[1] Sampson Handley, *British Journal of Surgery*, 1916. [2] Bonney, British Medical Journal, 1916.

The following table shows the results of 150 consecutive operations for penetrating wounds of the abdomen. As regards mortality, shock played the largest part, peritonitis was next in importance, and pulmonary complications accounted for several deaths.

Viscus Injured.	No. of Cases.	Recoveries.	Deaths.
Small intestine only: sutured ..	28	17	11
Small intestine only: resection ...	13	4	9
Small intestine and colon (2 resections of small intestine, 1 died)	28	16	12
Small intestine, colon, and stomach	1	0	1
Small intestine, colon, and liver (1 resection)	2	0	2
Small intestine, colon, and kidney...	1	0	1
Small intestine, colon, and bladder	1	0	1
Stomach	3	0	3
Stomach and liver	6	3	3
Stomach, liver, and pancreas ..	3	1	2
Stomach, colon, and kidney	1	0	1
Colon	10	5	5
Liver	14	6	8
Liver and colon	5	1	4
Spleen (2 splenectomies; both died)	6	3	3
Spleen and diaphragm	2	1	1
Spleen and kidney	1	1	0
Abdomino-thoracic Wounds.			
Thorax and diaphragm (missile in lesser sac, no visceral lesion)	1	0	1
Thorax, diaphragm, and stomach .	2	2	0
Thorax, diaphragm, and spleen ...	1	0	1
Thorax, diaphragm, spleen, and kidney	1	1	0
Thorax, diaphragm, and liver (lung in two cases)	4	3	1
Kidney (3 nephrectomies, 1 death) ...	9	8	1
Intraperitoneal lesion, no viscus injured	5	4	1
Total	150	76	74

RAMC 365/11

June 24
1917

(1). The "Record" for number of operations done in 24 hours is held by No. 3 Casualty Clearing Station, who did 103 in August last, but the actual maximum attained either by No. 3 or any other Casualty Clearing Station is seldom over 80 operations in the 24 hours.

1916

It follows, therefore, that even with eight "Teams" the maximum number of operations will not exceed about 160 in 24 hours in any one Casualty Clearing Station. If the Casualty Clearing Station admitted in one day one thousand wounded, some seven or eight hundred would be merely dressed and sent down by train to the Base.

(2). The successful treatment of abdominal cases is quite as much a question of nursing and after treatment as of operation.

If 1000 men were wounded, there would be admitted about 20 cases for operation; if 10,000, the operations would be about 200. Wherever the operations were done, each twenty men would require about 8 nurses for the day and night work. All the survivors would remain at least a week, and, if more abdominal operations were being performed daily, the survivors of seven days operations would all be in the Casualty Clearing Station at the end of the week, and would need a corresponding number of nurses, and would occupy a good deal of the time of the surgical staffs. Published statistics show that there is no material difference between the results obtained by experienced Casualty Clearing Stations, such as those at Remy Siding, and by Advanced Operating Centres, so long as neither are swamped by more cases than they can both operate upon and nurse. The experience of recent battles shows that two or three hundred abdominal operations are more easily and better treated, the more good Casualty Clearing Stations and the more Operating Centres that can

be engaged upon them.

(3). Fractured Femurs and wounds of the Knee-joint each constitute about 2% of the total wounded, but as they do not generally come in till after the first five or six hours of a fight, they form a rather large percentage of the wounded when they do begin to arrive.

(4). Wounds of the lungs constitute about 2% of the total wounded, but as they all require to be retained in a Casualty Clearing Station till the fourth day, they occupy a good many beds. If 2000 wounded have passed through a Casualty Clearing Station in three days, about 35 "chest cases" will be under treatment at the end of that time.

(5). Head cases form not less than 2% of the total wounded, but they vary and are sometimes much more numerous than this. They occupy a great deal of the time of orderlies in shaving and cleaning, and of surgeons in operating, so that if some at least can be sent back to a Stationary Hospital it is of great advantage to the Casualty Clearing Station Staffs during heavy fighting. About 80 cases were sent down by road during the recent fighting at Messines, and they travelled without hurt.

ADB
June 29

To Gen Staff

June 1917

A Note on the Results of early operations at the Front.

In February last I pointed out in a memorandum on the Treatment of Wounds in Casualty Clearing Stations that "the most important treatment is the early mechanical cleansing of the wound and the excision of all badly torn tissues"..... "This should be done before the patient is sent by train to the base".

This principle of treatment had been already carried into practice by the various Casualty Clearing Stations in quiet times for more than a year, but it had been difficult to operate on the majority of the patients during heavy fighting.

At a Meeting of Surgical Consultants to the Armies at the front held by the Director General on February 28th, it was agreed that arrangements should be made to extend this practice of early operations at the Casualty Clearing Stations by adding still further to their Staffs before heavy fighting, and this has been done in the Battle of Arras and Vimy, and more recently in the Messines fight. The consequence is that many more patients than formally have been operated upon before being sent to the base, and the present time seems opportune for considering the results obtained.

In order to ascertain these I have recently visited most of the General Hospitals at Le Treport, Etaples, Camiers, Boulogne and Wimereux, and have seen the Surgical Specialists and some of the Surgical Consultants as well as many of the patients. The Hospitals which I visited had treated about 9000 patients during the week of June 7th to June 14th and these may be taken as representative of the whole of the wounded from the Messines fight.

It is quite evident that the surgical results obtained have been extremely satisfactory and this is made clear by the following facts.

(1) Out of 5271 patients admitted to seven hospitals only 58 died between June 7th and June 18th, i.e. a little over one per cent

(2). Out of the same number only 22 patients had "massive" gas gangrene; i.e. less than one half per cent.

(3). There were hardly any cases of secondary haemorrhage.

(4). There were extremely few amputations.

Out of three other hospitals which had admitted between three and four thousand cases, in two hospitals there has been no patients with serious gas gangrene and the remaining hospital had had only three. In these Hospitals also the death rate was very low and few limbs had been amputated.

I attribute these very favourable results to several causes.

(1) The weather was very fine and dry.

(2) There was a continuous advance, and wounded were consequently not left lying out.

(3) Evacuation to the Field Ambulances and Clearing Stations was very rapid and uninterrupted by the enemy. There was also a very good supply of trains and patients generally arrived quickly at the base.

(4) The staffs of the Casualty Clearing Stations were able to deal without material delay with the great majority of the wounded and especially with all the most serious cases.

I found that the surgeons whom I saw at the base hospitals were all of one opinion, namely that the wounded had arrived in much better condition during the fighting of the Spring than formerly; that complications had been much fewer; that their own operating work had been much lightened; and that patients had done so well because of early operation at the front.

They said that almost the only wounds that had not done well, were those which had not been operated on at the front or had not been satisfactorily dealt with, and I think it may be concluded that the policy of doing more operations in the Casualty Clearing Stations during heavy fighting has been very fully justified.

A few other facts of practical interest may be noted.

(1) No less than six of the 22 cases of Gas gangrene originated during one long train journey of 17 hours.

(2) The patients treated by the "Carrel method" arrived in very good condition.

(3) The treatment by "B.I.P." was approved by all the surgeons at the Base, but with the caution that the wounds should not be completely closed by suture, unless they are quite small and uncomplicated by fracture.

I quite sympathise with Colonel Gray in his desire that as many wounded men as possible should be operated upon early. With this object in view it is certainly desirable, on general principles, to have as large a Staff and as large operating theatres as can be supplied, but it is doubtful whether, with many thousands of wounded to deal with in a single day, it can even be possible to operate at the Casualty Clearing Stations on every slight case which may require it.

If this ideal is to be realised it will require not only that Col.Gray's proposals for more surgeons and more theatres must be accepted but also that there must be a corresponding increase of nurses and orderlies as well. Whether these are available is a matter on which I cannot express an opinion, but I do not think that Colonel Gray's proposals would so lighten the work at the Base as to permit of all or many of the proposed additional staff for Casualty Clearing Stations being drawn from the General Hospitals there. If, as Colonel Gray states "very few wounded are operated upon within 18 or 24 hours of their arrival ... at a Base Hospital" it would appear that the Staffs there are already insufficient to deal with the work, and it must always be remembered that, wherever the patients are operated upon, they will still require to be dressed at the General Hospitals, and that this necessitates a staff of competent surgeons at the Base as well as at the front. The after care of bad fractures of the lower limbs alone makes great demands on a staff.

The distribution of the Surgeons between the General Hospitals at the Base and the Casualty Clearing Stations at the front is not a matter which can be settled by a Surgeon at either one or the other, and I do not believe that Colonel Gray is right in assuming that there are many surgeons to spare at the Base.

It does not need Colonel Gray's advocacy to form the opinion that when heavy fighting is in progress we cannot have too many surgeons at the front, and his opinion that operations should as far as possible be performed at the C.C.S's is in full agreement with the opinions already expressed by the Consulting Surgeons at their last Meeting with the Director General, and conveyed by him to the Ds.M.S. of Armies.

I believe that in the recent fighting near ARRAS the wounded were extremely well cared for, and I am fortified in this opinion by the statements of the various surgical specialists to whom I have spoken, and who have assured me that practically all urgent cases were satisfactorily dealt with.

I quite sympathise with Colonel Gray in his desire that as many wounded men as possible should be operated upon early. With this object in view it is certainly desirable, on general principles, to have as large a Staff and as large operating theatres as can be supplied, but it is doubtful whether, with many thousands of wounded to deal with in a single day, it can even be possible to operate at the Casualty Clearing Stations on every slight case which may require it.

If this ideal is to be realised it will require not only that Col.Gray's proposals for more surgeons and more theatres must be accepted but also that there must be a corresponding increase of nurses and orderlies as well. Whether these are available is a matter on which I cannot express an opinion, but I do not think that Colonel Gray's proposals would so lighten the work at the Base as to permit of all or many of the proposed additional staff for Casualty Clearing Stations being drawn from the General Hospitals there. If, as Colonel Gray states "very few wounded are operated upon within 18 or 24 hours of their arrival ... at a Base Hospital" it would appear that the Staffs there are already insufficient to deal with the work, and it must always be remembered that, wherever the patients are operated upon, they will still require to be dressed at the General Hospitals, and that this necessitates a staff of competent surgeons at the Base as well as at the front. The after care of bad fractures of the lower limbs alone makes great demands on a staff.

The distribution of the Surgeons between the General Hospitals at the Base and the Casualty Clearing Stations at the front is not a matter which can be settled by a Surgeon at either one or the other, and I do not believe that Colonel Gray is right in assuming that there are many surgeons to spare at the Base.

It does not need Colonel Gray's advocacy to form the opinion that when heavy fighting is in progress we cannot have too many surgeons at the front, and his opinion that operations should as far as possible be performed at the C.C.S's is in full agreement with the opinions already expressed by the Consulting Surgeons at their last Meeting with the Director General, and conveyed by him to the Ds.M.S. of Armies.

I believe that in the recent fighting near ARRAS the wounded were extremely well cared for, and I am fortified in this opinion by the statements of the various surgical specialists to whom I have spoken, and who have assured me that practically all urgent cases were satisfactorily dealt with.

A Report on Gas Gangrene.

It seems advisable to briefly record the conclusions at which we have so far arrived on the spreading Gangrene which has occurred amongst the wounded of all the armies now in France.

One of us (S.R.) has examined the condition bacteriologically, and this examination was carried out in the "Mobile Field Laboratory." In a typical case affecting the hand, a bacillus was found which was isolated for examination. A culture of this, when inoculated into a guinea pig, caused its death in 18 hours. Post-mortem there was found a gangrenous cellulitis from which the inoculated organism was recovered. A second guinea pig inoculated from this culture was sent to the Lister Institute. It arrived safely and died within a few hours of its arrival, thus affording abundance of fresh material for a more detailed examination than was possible under field conditions. An examination of the culture was meanwhile made in the field laboratory and the conclusion arrived at, was, that it was probably the specific organism of malignant oedema. Further examination made at the Lister Institute by Dr. C. J. Martin, F.R.S. and Dr. Arkwright inclined these observers to the view that the organism in question was identical with one that for some time was confused with that of malignant oedema, known as the bacillus of Ghon and Sach. This organism was originally obtained from a case of Gangrene in the human subject. There are some ten different organisms that have been isolated from cases of Gas Gangrene in man, all of which are closely allied and have the common characteristic of being anærobic spore bearers. From other cases in the clearing hospitals at the front several more organisms of this group have been isolated and have been sent to the Lister Institute for confirmatory diagnosis.

A sample of earth from a trench was also examined. The inoculation of a few drops of water, in which this earth had been shaken up, into a guinea pig, killed the animal in 18 hours. Post-mortem, a similar gangrenous cellulitis was found. The animal was also found, like the guinea pig inoculated from the gangrenous hand culture, to be infected thoughout with a spore-bearing anærobic organism belonging to the same group. It is reasonable to conclude, therefore, that the Gangrene found amongst our wounded soldiers, is directly due to infection introduced at the time of the wound, and this is especially likely to occur if muddy clothing has been carried in by the projectile or if earth has been carried in by the explosion. We are, therefore, of the opinion that the Gangrene that occurs amongst the wounded is a "Traumatic Infection" and dates from the moment of the injury. It is solely due to infection from the soil, and is in no way related to sloughing phagedena, or so called "Hospital Gangrene."

Clinical Picture of Gas Gangrene.

In the cases we have seen the Gangrene has always occurred in connection with wounds of the extremities. We have not seen it in the head, neck, thorax, or abdomen.

Nature of Projectile.

We have seen it in wounds from rifle, shrapnel, and fragments of shell.

Nature of Wound.

We have seen it in both slight and very serious wounds, but a larger proportion of the serious wounds are affected by it, especially when large bones have been shattered and muscles extensively torn and extruded. We have seen it with and without fractures, and in a relatively large number of fractures of the femur.

Period of Onset.

It is most noticeable that it always shows itself within the first few days or even hours following the infliction of the injury.

In two cases we have seen it well marked within 36 hours, and in several others already extensive on the third and fourth day.

Several patients have died of it on the third day following that of the injury, and in other patients it has progressed so far that amputation has been performed on the third day.

Onset.

This is characterised by swelling of the injured part, and the Gangrene seems especially liable to occur in connection with that swelling of a limb which is due to extravasation of blood in the subcutaneous tissues and intermuscular planes. It seems to us that interference with the circulation either by extravasation of blood or by tight bandages has a marked influence.

In the early stages the patient complains of severe pain which is perhaps due to tension, the result of the swelling, but in the later stages the affected area becomes completely numbed and insensitive. The edges of the wound are generally ragged and sloughy, and a considerable quantity of blood-stained serum constantly exudes and soaks the dressings. This discharge emits a characteristic and most offensive odour which is so marked as to be almost diagnostic. The skin, if not previously discoloured by extravasated blood, assumes a dark purplish or slate-coloured hue.

In the vicinity of the wound it changes subsequently to a more green colour. The swelling extends coincidently with the change of colour, and a few hours later the skin becomes nearly black, and finally forms a black, leathery slough. Beyond the area of discolouration the limb is swollen with gas and fluid exudation, and an emphysematous crackling can be elicited on pressure with the hand. This may spread to a distance of as much as a foot above and below the actually gangrenous area, and so rapid is the extension of the Gangrene that we have seen the whole of the lower extremity completely mortified before the end of the third day after the infliction of the wound.

Condition of Patient.

Temperature is not materially affected in many cases, and high fever is rare. A temperature of 99--100 is usual. Respiration is not materially quickened; headache is not complained of. The mind is perfectly clear till near the end. The pulse is not greatly quickened, but rapidly loses power, so that several of the patients we have seen have had no perceptible radial pulse. The heart's action is greatly weakened so that it's beat is quite difficult to feel.

Vomiting is common and in many cases is frequent. Diarrhœa is rare. Sweating is not generally present, and before death the skin is cold. The tongue is usually covered with a dirty fur, but the mouth is not exceptionally dry. Death appears to be due to cardiac failure, and we have been struck by the extraordinary clearness of the mind of a patient, almost pulseless, and within an hour or two of his death. In the worst cases the Gangrene may spread with such rapidity that the whole limb may be cold, of a purple or black colour, immensely swollen and quite devoid of all sense of touch and power of motion within 36 hours of the onset of the Gangrene. The smell of such a limb is over-powering, and almost precludes a careful post-mortem examination. If incisions are made before or after death, gas and sanious fluid bubble up.

Pus is confined to the edges of the wound and is very little in proportion to the sanious discharge.

The practical conclusions we would draw from these observations are as follows:—

1. All tight bandages and especially those applied at the first field dressing should be avoided. Shell wounds are so often followed by so much interstitial hemorrhage that the part swells and the bandage rapidly becomes tighter and interferes with the circulation. Consequently many bandages require to be cut within a few hours of their application.

2. In many cases the tension requires to be relieved by incisions and drainage, and the opportunity should be taken to wash the wounds thoroughly with an antiseptic. Peroxyde of hydrogen is one of the best. Great care should be taken to remove portions of clothing, as these contain the infective agent. Shattered fragments of bone and pieces of shell or gravel should be taken out.

3. Amputation may often be successfully performed through tissues made emphysematous by gas but not yet gangrenous.

4. The group of anaerobes causing Gangrene are spore-bearers, and spores (especially of this group of anaerobes) are especially difficult to kill by any antiseptic solution or even by boiling. Consequently in order to sterilise instruments and other things that have been infected, other measures are required.

(a) Destruction of blankets and clothing soaked by the discharge.

(b) Heating in an Autoclave at a temperature of 120 Centigrade.

(c) Boiling for an hour in a solution of 1/20 carbolic acid or Lysol (1 in 10).

It should be remembered that the mud on the clothes of wounded soldiers is almost certainly infected, and care should be exercised to see that the area in which operations or dressing of wounds are performed should be kept free from possible contamination from such a source.

5. Where possible it is advisable to isolate patients under treatment in hospitals, and this is all the more necessary on account of the bad smell which is inseparable from the condition.

The above is a copy of a report sent to the Director of Medical Services on Nov. 9th, and is mainly the result of work done at the Clearing Hospitals at the front to which patients are taken within a few hours of being wounded. Many of the conclusions and practical recommendations, however, have been conveyed to the hospitals verbally or by official communication, and attempts are being made at the Lister Institute to provide an antitoxin.

(Sgd.) ANTHONY A. BOWLBY.
SYDNEY ROWLAND.

Field Laboratory, G.H.Q.
Nov. 11th, 1914.

1st Printing Co., R.E. "G.H.Q." 236.

RAMC 365/1
J — 17. cy. 8

The incidence of Gas Gangrene and the numbers of Operations necessitated by it in France and other seats of war.

The number of operations performed at the Casualty Clearing Stations has increased with each year of the war. The following are approximate estimates.

In 1914, less than one per cent of the wounded were operated on.

In 1915, the numbers increased as the year went on, so that by the end of that year, about 15 per cent of wounded were operated upon in "quiet times" and about 5 per cent during heavy fighting.

In 1916, the numbers increased to about 25 per cent in quiet times, and, during the Battle of the Somme, 30,000 operations were done in about 300,000 cases, i.e., 10 per cent.

In 1917, Operations in "quiet times" have risen to about 50 per cent, and in severe fighting from 24 per cent in the earlier part of the year to 30·6 per cent in the "Third Battle of Ypres", in spite of the large number of casualties in the latter fight. This is the highest average yet attained in any big battle.

The increased operation per-centage is in direct proportion to the number of Medical Officers at work. In 1914, the number never exceeded six, and the Casualty Clearing Stations were few, while in the Third Battle of Ypres, the Medical Officers in Casualty Clearing Stations were 24 or more, and other personnel and equipment were in proportion.

The paramount reason for early operation is the prevalence of Gas Gangrene, and this has diminished as a direct result of early and intelligent operating. Losses of limbs and lives have diminished in proportion as gas gangrene has decreased, and, except in the case of those patients who have not been brought in till after the lapse of many hours, gas gangrene itself is of comparatively rare occurrence. It is, however, quite certain that it will again become prevalent unless we can maintain at the highest possible level the surgical staffs at the front.

In this connection it should be specially noted by the War Office that the need for early operation in France is much greater than in the other seats of war. I have been informed by experienced Surgeons in all those Areas that gas gangrene is either very rare or else entirely absent in those regions, and that consequently there is nothing like the same necessity to operate early on as many patients as possible. It is this need for operations that calls for a corresponding increase of Surgeons and it appears certain that a larger proportion of Surgeons is needed in France than elsewhere. This should be kept in mind in distributing Medical Officers to the different seats of war.

The Appointment of Anaesthetists

at Casualty Clearing Stations.

The present position of anaesthetists is not satisfactory. The working staff of a Casualty Clearing Station consists of six - a surgical specialist, a second surgeon, an officer in charge of the medical cases, and three other medical officers. One of these is called the "Anaesthetist" but he often has no more claim to that position than any of his fellows. But not only is he not usually a specially skilled person, he also has no security of tenure and may be sent without notice to a Field Ambulance or a Regiment after holding office a short time. During the past year, anaesthetists have acquired an increasing importance; first, because of the efforts to counteract and avoid "shock", second, because of the introduction of Gas and Oxygen anaesthesia on a large scale, and of various forms of apparatus for its administration and third, because of the training of nurses to give anaesthetics.

It is therefore necessary to appoint suitable anaesthetists and also most necessary to ensure that they shall not be removed except for special reasons. This would ensure the presence in each Casualty Clearing Station of some one who would take an interest in anaesthesia if he knew his appointment had some permanency and would also ensure that the various apparatus was in the charge of some responsible officer. It would further provide a skilled person to train and to supervise the work of the new women anaesthetists.

I would therefore suggest

(1) That the D.M.S. of each Army authorise his Consulting Surgeon to satisfy himself as to whether there is in each of his Casualty Clearing Stations a competent anaesthetist.

(2) That he reports the result of such enquiry to the D.G.M.S.

(3) That all those who are reported competent should then be definitely appointed "Anaesthetists" to their respective Clearing Stations.

(4) That in the event of no competent medical officer being reported by the Consulting Surgeon, a special appointment be made by the D.G.M.S.

(5) That no anaesthetist should be removed from his post without the permission of the D.G.M.S.

The duty of the Anaesthetist would primarily be to administer anaesthetics and to make arrangements for their administration by others. He would also be responsible for the various anaesthetic apparatus and for taking care that suitable supplies of anaesthetics and apparatus were provided. In addition to these special duties he would assist in the general medical and surgical work of his unit.

J—17/9/18

THE TREATMENT OF FRACTURED FEMURS AT THE GENERAL HOSPITALS.

A report by Captain Max Page on the results of Fracture of the Femur as seen in England has recently been circulated by order of the Director General, and it is evident that further steps should be taken to improve the treatment of such cases.

With this object in view, I have recently called two meetings of the Consulting Surgeons. One, of the Consultants of the First and Second Armies and the Consultants of the Boulogne, Wimereux, Camiers and Etaples bases. The second, of the Consulting Surgeons of the Fourth and Fifth Armies with the Consultants of Rouen, and Le Treport. (Colonels Bruce and Maynard Smith could not attend).

It is agreed that the fractures of the Femur now arrive from the front in very good condition, and that the present methods adopted there are satisfactory.

All the L. of C. Consultants, however, are of the opinion that more might be done at the General Hospitals than can be done at present, and all agreed that great improvement would be produced by collecting patients with fractures of the femur into a sufficient number of special hospitals with special staffs of surgeons and Nursing Sisters.

I am quite convinced that this specialisation is necessary if the best results are to be obtained, for, at the present time, it is evident that the results obtained in hospitals which have specialised are much above the average results obtained elsewhere.

The Consulting Surgeons of the L. of C. have expressed their opinions in the conclusions which I enclose herewith. I agree with all they say, and would only add that the greatest benefit is to be expected from the supply of adequate X-Ray apparatus to the proposed special hospitals. It is most necessary for the treatment of these cases of fractured thigh that X-Ray examinations of the patient <u>in his bed</u> shall be made possible, and for this purpose special arrangements and apparatus are needed. It is not reasonable to supply these in every General Hospital, but they might very properly be supplied to a limited number of special hospitals such as it is proposed to create.

If it is decided to collect cases of fracture of the Femur into special hospitals there need be no delay in carrying the proposal into practice. Cases now in various hospitals need not be moved, but all incoming new cases might at once be sent to such hospitals as may be selected in the different areas. The special staff could be subse--quently supplied gradually as the numbers of the cases increase and as beds are freed by the discharge of other cases. I would suggest that a beginning might be made on January 1st, 1918.

I would suggest that the various Consulting Surgeons on the L. of C. should be asked which hospitals in their area they would propose to set apart.

19th Dec., 1917.

Surgeon General.

We have considered the question of the treatment of fractures of the femur and are of opinion that it would be an advantage

(1) To collect these cases in special hospitals.
(2) To place them under the care of selected medical officers.
(3) To provide such hospitals with portable X-Ray apparatus.
(4) To arrange for Officers as well as other ranks to be received in these hospitals.
(5) As these cases are especially helpless and require an adequate staff of nurses and orderlies for their care, that steps be taken to provide such additional personnel as may be required.
(6) That such cases should not be placed in buildings of more than one storey because of (a) danger of fire (b) portability of apparatus.

Sd/ William Thorburn, Col.,
Con. Surg., Abbeville
and Treport.

Sd/ E.M. Pilcher, Col.,
Consulting Surgeon
Rouen Base.

[redacted],

[redacted].

It is obvious from enquiries we have made in England, from our observations in this country, and from reports received from time to time that the end results of cases of compound fracture of the femur still leave room for improvement. It is therefore of the greatest importance that immediate and serious consideration should be given to the possibility of still further improving the arrangements for the treatment of these cases. It has been amply proved that the retention of cases of this character in France has been of great benefit to the patients, and therefore, assuming that this practice will be continued the number of cases which will accumulate at the bases will be so large as to justify more special arrangements being made for their reception and treatment.

The present arrangements have the following defects:-

(1) The cases are distributed too widely and it is extremely difficult for a Consulting Surgeon to keep in touch with them.
(2) The accommodation in some hospitals is more suitable than in others.
(3) The treatment of cases of this character requires surgeons of natural aptitude, individual interest, and experience in this class of work, and these qualities cannot possibly be possessed by all who are called upon to look after them.
(4) The attention and interest of the Surgical Staff are constantly being diverted by the necessity of attending to large numbers of other wounded who may be admitted.
(5) The Medical Officers are constantly changing.

To overcome these defects we beg to recommend:-

(1) That all the cases of fractured femur be sent to one hospital in the Boulogne-Wimereux area, one in the Etaples-Camiers area, and one in the St. Omer area.
(2) That the surgical division of each of these hospitals be primarily devoted to the treatment of cases of fracture and that other casualties be not admitted as a rule to those hospitals which may be selected at the Boulogne and Etaples bases.
(3) That each officer in charge of the Surgical division of such a hospital be chosen for his special experience and skill in this class of work and that suitable medical officers who will not be available for reinforcements for other units shall be added to the staff.

We are of opinion that these arrangements will lead to apprec--iable improvement in the end results obtained in cases of fracture of the femur in particular, and also of the leg bones.

Intld/ A.F.
Intld/ A.E.W.J.
Consulting Surgeons,
B. E. F.

Dec. 8th, 1917.

Sd/ Andrew Fullerton.
Sd/ H. A. Ballance.
Sd/ A.E. Webb-Johnson.
Sd/ Owen Richards.
Sd/ Geo. E. Gask.

D. D. M. S.

Boulogne Base.

It is Obvious from inquiries we have made in England, from our observations in this Country, and from reports received from time to time that the end results of cases of compound fracture of the femur still leave room for improvement. It is therefore of the greatest importance that immediate and serious consideration should be given to the possibility of still further improving the arrangements for the treatment of these cases. It has been amply proved that the retention of cases of this character in France has been of great benefit to the patients, and therefore, assuming that this practice will be continued, the number of cases which will accumulate at the base will be so large as to justify more special arrangements being made for their reception and treatment.

The present arrangements have the following defects:-

(1) The cases are distributed too widely and it is extremely difficult for a Consulting Surgeon to keep in touch with them.
(2) The accomodation in some Hospitals is more suitable than in others.
(3) The treatment of cases of this character requires surgeons of natural aptitude, individual interest, and experience in this class of work, and these qualities cannot possibly be possessed by all who are called upon to look after them.
(4) The attention and interest of the Surgical staff are constantly being diverted by the necessity of attending to large numbers of other wounded who may be admitted.
(5) The Medical Officers are constantly changing.

To overcome these defects we beg to recommend:-

(1) That all the cases of fractured femur be sent to one Hospital in the Boulogne-Wimereux area, or in the Etaples-Camiers area, or in the St Omer area.
(2) That the Surgical division of the Hospitals be entirely devoted to the treatment of Orthopedic cases and that no other casualties be admitted.
(3) That each Officer in charge be chosen for his special experience and skill in this class of work and that he be supplied with suitable Medical Officers who will not be available for reinforcements for other units. Shall be added to the Staff.

We are of opinion that these arrangements will lead to appreciable improvement in the end results obtained in these cases. in cases of fracture of the femur in particular and also of the leg bones.

as a rule, to those Hospitals which supply stretcher cases to the Boulogne Etaples area

December 8th 1917.

A. F.

R. H. W. J.

Consulting Surgeons.
B. E. F.

Andrew Fullerton
H. A. Ballance
R. H. Well-Johnson.
Owen Richards
Geo. E. Gask.

This is Alfred Webb-Johnson working

My Lord

We have the honour to say that we have received a copy of your Lordship's letter to Sir A Stoddart, in which you express your wish that we should withdraw the letter which we both signed

We have seen Sir J. Rees & we desire to leave ourselves entirely in your Lordships hands although we do not pretend that you entirely realise the very natural ~~feeling~~ which we all have after personally ~~dictions~~ charges made by Sir A Wright that we are responsible for the "lives of thousands" of our soldiers

We know, we believe completely refuted the various accusations made against ourselves who are responsible for giving advice as to treatment and we earnestly hope that you will believe that our reply has satisfied you would express your opinion that these accusations

are unfounded

We have

W.P.H.

July 29. 1917

To The Right Hon the Earl of Derby

SUB-COMMITTEE OF THE DIRECTOR GENERAL'S ADVISORY COUNCIL,

"FOR CONSIDERATION OF STREPTOCOCCUS INFECTIONS OF WOUNDS".

Second Meeting.

Abbeville., December 13th 1918.

Present.

Members. Major-General Sir Anthony Bowlby., KCMG, KCVO, &c. (In the Chair)
Colonel G.E. Gask., D.S.O.
Colonel T.P. Dunhill., C.M.G.
Colonel S.L. Cummins., C.M.G. (Secretary)

Colonel G.W. Crile., U.S.Army.

Major W.H. Tytler., CAMC., Captain E.F. Bashford., RAMC., Captain A. Fleming., RAMC., and Captain L. Colbrook., RAMC., attended.

At the request of the Chairman, Colonel Cummins presented to the Meeting summaries of reports received from some of the above Officers; from Majors Fitzgerald., Houston., Richardson., Patterson and Cookson and Captains J.A. Wilson., A.B. Porteous and D.C.Barron., R.A.M.C.; as well as letters and reprints from Colonel J.G. Adami., CAMC., Lieut.Colonel M.H. Gordon., RAMC., Lieut.Colonel W.J. Elser., U.S.Army., Major Kenneth Taylor., U.S.Army and Captain S.R. Douglas., I.M.S.

The thanks of the Committee are due to Major Kenneth Taylor, U.S.Army., who has kindly supplied a collection of Streptococcus cultures isolated by him from wounds. This collection is still under investigation as to type.

The questions in the "Agenda" were then considered by the Committee as follows:-

Question I.

(a) What are the type or types of Streptococci that require to be seriously considered in wound infections?

(b) Is the "haemolytic" character a matter of fundamental importance? e.g., Can non-haemolytic Streptococci be ignored, for practical purposes, in wounds?

Discussion.

Captain Bashford described his technique for the determination of whether an organism is or is not haemolytic. He considered that much confusion had arisen through failure to make use of a standard and reliable technique for this purpose.

In the investigation of wounds at the Surgical Research Hut at Etaples, S.Pyogenes was the Streptococcus most frequently isolated.

Captain Fleming reported that, in work carried out by him with Captain Porteous, at No:8.Stationary Hospital, and previously in conjunction with Captains Douglas and Colbrook, the S.Pyogenes was found to be by far the most important Streptococcus of wounds. The biological unity of this type, and it's differentiation from the Salivarius and Faecalis types, had been established by serological methods, including agglutination and absorption tests.

Though non-haemolytic Streptococci are to be found in wounds, especially early and where gangrenous muscle exists, their importance is secondary. In support of this, Captain Fleming reported that all strains isolated by him, by blood

culture/

culture, had proved to be S.Pyogenes.

Colonel Cummins read a note by Major Richardson referring to eight strains isolated by him in blood-culture, all of which were haemolytic and gave the cultural characters of S.Pyogenes.

Major Tytler and Captain Colbrook agreed that S.Pyogenes was the most important Streptococcus of wounds.

As to whether non-haemolytic Streptococci could, for practical purposes, be ignored;

Captain Bashford reported that, in his opinion, non-haemolytic Streptococci were undoubtedly virulent in some instances. He had isolated a considerable number of non-haemolytic Streptococci from the blood in cases of Septicaemia following wounds.

Colonel Cummins read extracts from reports by Major Cookson who had found a certain number of non-haemolytic Streptococci "of undoubted virulence" in wounds. The grounds for considering them virulent were not stated. Major Houston had reported the finding of S.Pyogenes in blood culture in cases of Septicaemia following wounds.

Resolution on Question I.

In the opinion of this Committee, Streptococcus Pyogenes is the most important Streptococcus of wounds in the present War.

Non-haemolytic Streptococci play a secondary role but the evidence does not justify the opinion that they can be ignored.

Question II.

(a) At what stage do wounds become infected with Streptococci?

(b) What is the source of the Streptococci of wounds?

Discussion.

Colonel Gask reported that, although the Military Situation since the last meeting, had prevented any systematic investigation on this subject in the Fourth Army, he had formed the impression that haemolytic Streptococci got into wounds from the Attendant's throats and hands.

Major Tytler quoted work carried out with Captain A. Stokes.,DSO.,RAMC., at No:10.Casualty Clearing Station. In this investigation it was found that haemolytic Streptococci were present in about 15% of all the wounds examined, the average time since wounding being 12 hours and the extremes not being much on either side of the average.

Colonel Orile had records of 10% of haemolytic Streptococci in 300 wounds arriving at a Casualty Clearing Station.

Colonel Dunhill quoted work by Major Patterson at No:5. General Hospital. Fifteen per cent of haemolytic Streptococci were found by this observer. Total numbers not stated. Captain Newton, working at head wounds, had no exact figures to report but had found Streptococci present in fragments of bone and metal driven deep into the brain. These Streptococci had not been typed. Colonel Dunhill was not in a position to say whether they were haemolytic or not; but their presence seemed to point to direct infection by projectiles and fragments.

Swabs from the skin of the chest and abdomen of 60 men of R.E. and Base Details had been "cultured" by Major Patterson but no Streptococci were isolated from them.

Captain Fleming stated that, in a large series of cases investigated by him, examination of open wounds that had been in a Base Hospital more than a week revealed the presence of S.Pyogenes in 90% of the cases. This summer, many "Gauze Packs" removed from excised wounds on arrival at the Base were examined

by/

by Captain Fleming.

Where the patient had been sent straight on to the Base after excision of the wound, S.Pyogenes was found in the pack in only 15 out of 75 cases but this organism was present in almost every case where the patient had been kept at a Casualty Clearing Station for more than three or four days.

Although haemolytic Streptococci were relatively rare, other bacteria, such as aerobic and anaerobic bacilli and Staphylococci, could usually be recovered from the depths of the pack, often in large numbers.

It can easily be demonstrated that haemolytic Streptococci grow much better than these organisms in the body fluids so it may be assumed that, had haemolytic Streptococci been present as a primary infection, they would have been demonstrable on arrival at the Base.

Captain Bashford, from observations at the Surgical Research Hut, Etaples, was able to confirm the findings of Captain Fleming and, though not in possession of exact figures, agreed that the infection of open wounds with S.Pyogenes stood at about 90% within seven days of arrival at a Base Hospital. He considered that the three sources of Streptococci were (1) Foreign bodies, (2) Orderlies and Sisters and (3) Improperly sterilized instruments, gloves,etc.

Captain Colbrook agreed that the percentage of wounds infected with S.Pyogenes after a week in a Base Hospital was high; probably about 90%.

Colonel Dunhill pointed out that a large proportion of severe wounds of the Compound Fracture of Femur type could be successfully closed on arrival at a Base Hospital seven days after wounding.

Major-General Sir A.A.Bowlby quoted figures indicating a steady rise in the percentage of Compound Fracture of Femur successfully closed throughout the months of August, September and October. This was the result, not of better technique, but of bolder measures and it was probable that many more could have been closed if the Surgeons had ventured to try; but the requisite knowledge only came with the experience gained during the Summer and Autumn.

He considered that, in view of the great increase in the percentage of positive findings of S.Pyogenes during the course of treatment, the question as to the source of infection of wounds was as follows:-

Did the Streptococci develop from a small number already there? Or, were they put there ?

Colonel Cummins, referring to the success attending closure of Compound Fracture cases on arrival at Bases, said that this was a tribute, not only to surgery, but to the value of a method that did away with repeated dressings and their attendant risks. It was much easier to control the conditions of an operation than those of a dressing.

He pointed out that, though S.Faecalis might be expected to be present in clothing-fragments and on the skin, it was most unlikely that S.Pyogenes could be commonly introduced from these sources at the time of wounding. On the other hand, there was undoubted evidence that, though not a normal inhabitant of the fauces, S.Pyogenes might very easily establish itself in the human throat. In a series of 762 strains examined by Holman, 46 were derived from the nose and throat. M.H. Gordon had recorded the finding of 60% of S.Pyogenes in 155 Streptococci from the throats of Scarlet Fever patients. That War conditions might lead to the "passing round" of S.Pyogenes from throat to throat was shown in an investigation by H. Fox and W. Hamburger at Camp Taylor., Ky; where 83% of the personnel of a Company were found to have their throats infected with this organism six months after arrival in Camp, although only 15% were infected on

arrival/

arrival. These observations proved that Human Carriers of S.pyogenes must necessarily be fairly common under War conditions.

Once infection had taken place, each wound became a potential source of infection for others. Colonel Cummins read extracts from a report by Captain D.C. Barron.,RAMC., showing that, even after what had been accepted as a good technique for sterilization, Streptococci and other organisms were recovered from Forceps, Gloves and other surgical appliances, as actually laid out for use in operation. Attention to these findings and a more thorough technique, had completely put an end to this source of infection in the Unit concerned.

Captain Bashford said that similar tests by him had had an exactly similar result. The same measures that had been found successful in stamping out Puerperal Fever were those that should be applied in preventing the infection of wounds by Streptococci.

Colonel Crile agreed as to the dangers attending faulty technique in sterilization of appliances. In an investigation made in the A.E.F., 19% of Attendants had been found to be throat carriers of haemolytic Streptococci. (Details communicated later by Colonel Crile; Of 8060 Orderlies, Nurses and Medical Officers examined, 1549, or 19%, were found to be carriers of haemolytic Streptococci. The extremes varied, in different Units, from zero to 88%.)

Resolution on Question II.

The Committee notes that only 15% of early wounds were found infected with S.Pyogenes at a Casualty Clearing Station; and that the percentage rose to 90% after cases had been for upwards of a week in a Base Hospital.

In view of these facts, and of the type of Streptococcus involved, the Committee cannot avoid the conclusion that the contamination of wounds with haemolytic Streptococci is largely attributable to infection while in Hospital. Preventive measures should take into account the danger of transmission of infection from case to case by hands, instruments and surgical appliances. To this end, the closest bacteriological control of the technique of sterilization of instruments and appliances is absolutely necessary.

The possible danger to patients from human carriers of haemolytic Streptococci should never be lost sight of.

Question III.

(a). Have any points bearing on the methods of recovery from Streptococcic infections come to light ?

(b). If so, can these factors be exploited in treatment ?

Discussion.

Captain Colbrook stated that, working with Sir Almroth Wright, it had been possible to show that, in cases actually suffering fromStreptococcic Septicaemias, the leucocytes had lost none of their efficiency against Streptococci; in fact, their efficiency was increased above the normal.

Experiments in the use of non-specific immunization in treatment were in progress but there was not yet anything important to report.

Colonel Crile had seen good results follow large non-immune transfusion of blood but the observations were not sufficiently controlled to justify conclusions.

Colonel Dunhill had noted good results in a few cases from the use of blood from immunized Donors.

Cont/

Captain Fleming advised the routine use of S.Pyogenes Vaccine in all infected wounds with a view to lessening the risk of Septicaemia. Streptococcic Septicaemia, in his opinion, was due rather to the Streptococci being continually thrown into the blood from septic foci than to a multiplication of these organisms in the blood. The transfusion of blood immunised"in vitro" by Wright's method had been tried, but the results were, so far, inconclusive.

Captain Bashford stated that Streptococcic Septicaemia was much less frequent where thorough Carrel-Dakin treatment had been carried out. The fact that Septicaemic Streptococcal cases did recover showed that nature had a secret way of dealing with these infections.

Colonel Crile. "The better the surgery, the less the incidence of Septicaemia."

Resolution on Question III.

The Committee is of opinion that more can be done by preventive than by curative measures in the limitation of the Streptococcal infections of wounds.

In view of the large number of wounded men still under treatment in England, it is suggested, subject to the approval of the Director General, Medical Services, that the Proceedings of this Committee be forwarded to the War Office for any action, in the application of the information now available, that may be considered advisable.

The Committee is of opinion that, in view of the importance of Streptococcic infections, both in Military and Civil Medicine and Surgery, research on this subject should not cease with the War. The attention of those concerned with Public Health, both in the Army and in Civil life, should be called to the need for the fullest investigation of all questions connected with the prevention and cure of Streptococcal infections.

(Sd) S.L. Cummins.

A.P.O., S.I.,
14th December 1918.

Colonel., A.M.S.,
Adviser in Pathology.
Secretary.

Memorandum - Operations at the Front.

1. Surgeons lately, or 'just' returned from the Front seem anxious to impress on persons likely, in their view, to help them, the exceedingly high mortality among the abdominally wounded. They attribute this to insufficient opportunity for operation until the patients reach the Base Hospital, "which may mean very considerable delay". (The quotation is from the letter of a duly qualified and trustworthy correspondent. Delay in reaching the Base Hospitals is, by no means, impressed on the mind of some who have worked lately in and about the Base Hospitals of Boulogne and district. But the term, as see Dr. Sir Starr Jameson's testimony below, is relative).

2. If there were some provision made for moveable theatres (aseptic and antiseptic) which, with adequate nursing staffs, could be brought up to within easy distance of the firing line, it is urged that the mortality in abdominal cases, as in other cases such as compound fracture, would "probably be enormously reduced".

3. It may be, or has been urged against this contention that there are admirable surgeons with sufficient appliances close to the firing-line, and that operations, as a rule, are effectively performed with tolerable success, where immediate operation seems called for. On the other hand, cases of abdominal wounds, and the graver cases for operation seem to be pretty generally, if not habitually, sent in practice to the Base Hospitals, or, even treating the Base Hospitals as 'clearing-houses', almost immediately straight to England. The same witnesses who can testify to the general swiftness with which the wounded are transferred from the firing-line to these hospitals, can testify also to this.

Dr Starr Jameson instances the case of one officer

commanding a battalion of the Seaforth Highlanders now in London. The officer was "got to London from the Front as quickly as could be". Sir W. Watson-Cheyne was in readiness to treat him, and it was supposed that the patient would at once be sent from a private house where he had arrived to Hospital. On seeing the patient's condition Sir William refused to hear of any hospital, had the patient taken from bed at once and put on a table and promptly operated on him. It is admitted now that this operation - against the patient's wish and his own doctor's remonstrances - saved the Colonel's life.

Sir Starr Jameson, who can supply further details, pleads with the anonymous surgeons from the Front for the establishment of moveable theatres, and the best surgical and nursing skill, at the Front. It seems to him "vitally necessary because poisoned wounds are now so prevalent."

This has been sent here by Charles Boyd, 2 Down Street, Piccadilly.

11.6.15. (Ind). A.K.

This communication seems to have been written in ignorance of what is done at the clearing stations both with regard to (1) The equipment and supply of Operating Theatres: and (2) The treatment of patients with abdominal wounds.

With regard to (1).

Operating theatres already exist in all the clearing stations and are never more than a very few miles from the "First aid Posts", they are reached in from half an hour to one hour by motor ambulance.

It is perfectly well known that all these clearing stations are as near to the front as it is possible to put any operating theatre, and no operating van or motor could be usefully taken nearer, and would therefore be no more accessible than are the existing theatres. On many occasions the clearing stations have been shelled, and they are all only just beyond shell fire. All these theatres are completely equipped for any operations, and are therefore of course fitted with all "sterilisers" etc. required for "aseptic or antiseptic" methods of treatment. They are all far longer and more suitable in every respect for the performance of operations than any van could possibly be.

With regard to (2)

It is stated in the communication, Page 2 that "cases of abdominal wounds and the graver cases for operation seem to be pretty generally and if not habitually, sent to the Base Hospitals".

This statement is so entirely incorrect that it is difficult to understand how it could have been made at all; although it is true that the majority of all operations are necessarily done at the Base, where patients can be retained for weeks if required.

Patients with abdominal wounds have always been kept at the clearing stations, and reference to "Circular Memorandum No. 6" issued by the Director General will show that the patient should be taken "to the clearing station as quickly as possible, and in all cases kept there for about a week at least".

Many operations have actually been performed within a very few hours of injury, but it is the deliberate opinion of both French and English Surgeons that only a small minority of abdominal injuries should be treated by operation, for the great majority of them do better without it.

The practice in all our Hospitals has been to discriminate, and many successes have followed operations done for wounds of the intestines, the liver, the bladder, etc.

It is to be noted that special mention is made in the communication of "compound fractures", but it is already the custom to operate on these when advisable, and, in para. 7 of "Memo No. 6" it will be found that this treatment is advised, and methods are briefly detailed. Many hundred operations of this kind have been done, and are of daily occurrence. The same is also true of injuries to the head.

The general idea of the writer seems to be that all operations are better done at once, whereas, as a matter of fact, the majority of men with bad smashes of the limbs are so collapsed that they often cannot be touched for many hours, and if they were operated on at once they would be killed thereby.

Where operations for serious emergencies are required it is also most important that the patient should be kept absolutely quiet afterwards, and, without careful nursing and medical attention, such operations cannot be safely

safely be performed at all. It is evident that such conditions cannot be found inside a travelling operating theatre, and if the patient had to be taken in a motor ambulance for some miles to a clearing stations, after an operation, it is quite certain that his chances of recovery would have been much better if he had been taken there first of all. It is absolutely necessary that wherever the operation is done it is there that the patient should be treated and nursed for some time subsequently, and the clearing stations are admirably nursed.

14th June, 1915. Sd/ Anthony Bowlby.

P.S. At a single Clearing Station, about 5 miles from the nearest Trenches nearly 600 Operations, of all kinds, have been performed during the past six months. At one Hospital 288 cases of perforating wounds of the abdomen have been treated. Of these ~~were admitted~~ 71 died within a few hours of admission, from shock & hemorrhage. 217 of the remaining 246 patients 167 recovered, i.e. nearly 80 per cent.

With regard to Professor Rossi's criticisms on surgical operations at the front, the first thing to notice is that they are based on a complete misconception of the actual conditions. He states that our Casualty Clearing Stations are "never" nearer to the front than "Twelve miles" and are generally "eighteen to twenty-four miles" distant, and he very naturally considers these distances are too great for urgent cases requiring operation. He would probably express different opinions if he knew the facts.

No Casualty Clearing Station which receives seriously wounded men is ever eighteen miles in the rear, and the average distance of the advanced Casualty Clearing Stations from the front trenches on the whole British Front is about eight miles, while many are less than this.

Professor Rossi is an advocate of the French and Italian method of performing certain operations of urgency in small ambulances in dugouts or shell proof shelters, but he evidently does not appreciate the great differences which exist between our "Casualty Clearing Stations" and the French "Hopital d'Evacuation". In the first place these French Hospitals are placed on the average, several miles ~~fxmm~~ further back than are ~~our~~ our Clearing Stations, and in the second place, while they are much larger, they are not nearly as numerous.

The effect of these conditions is that in the British arrangement there is no ~~front~~ part of our whole line in which the Casualty Clearing Stations are not easy of access by short journeys on roads which are available for motors, while at some points of the French front the distance to the more centralised Hopital d'Evacuation is very considerably greater. Consequently there is a need for advanced operating centres in the French Army which does not exist in our own. It is a fact that in the British Army the patients may have to travel about four miles further to reach a Casualty Clearing Station than they do at some parts of the French front to reach a Field

Ambulance equipped for operations, although this is by no means always the case. But, even if they do, the time occupied is only some 20 or 30 minutes longer, and when the Casualty Clearing Station is reached the patient is in very much better surgical surroundings than he is in a dug out or shelled building. And it must also be remembered that, whereas the wounded man can be kept in comfort for an indefinite time in a Casualty Clearing Station, he is often obliged to be evacuated from a Field Ambulance very hurriedly.

But it does not follow that because the operating Field Ambulance is nearer the front it is therefore the more quickly reached, and it is open to question whether the average French wounded soldier reaches his operating area as quickly as does the British soldier. Each has to be brought back to a First Aid Post or Dressing Station through communication trenches, and as the line of road communication is naturally to the rear, and not parallel to the front trench, the British soldier has the more natural line of evacuation to the Casualty Clearing Station area, into which he is at once taken by a special motor ambulance if his injuries make it advisable to lose no time. The fact is that when a man is wounded in the front trench most of the time spent in getting him to a Casualty Clearing Station is spent in getting him out of the trenches and to the Dressing Station. The further transit to the Casualty Clearing Station afterwards does not occupy one tenth part of the whole period and is certainly the most easy part of the journey. The result is that, if there is no difficulty in getting a patient clear of the Trench area, he may well be in a Casualty Clearing Station within two or three hours of being wounded.

Apart from the mere question of the time occupied in evacuating a patient to a Casualty Clearing Station there are other important considerations.

(1) Operation alone without good conditions ofmlight,warmth, and fresh air and good nursing is of but little avail to a dangerously wounded man.

(2) No advanced field ambulance for operations can do with less than four medical officers, of whom at least two must be surgeons of more than the usual experience and skill.

(3) These surgical staffs would be to a great extent wasted when no heavy fighting was in progress, yet they could not be released from duty, as emergencies may arise at any moment. The result would be that many of our best surgeons would be locked up, while plenty of the ordinary work was being done at the Casualty Clearing Stations by less skilled men. It is difficult enough as it is to find enough skilled surgeons for all the Casualty Clearing Stations and it would be still more difficult if some 50 additional operating centres were at work.

(4) We are told by the most experienced French Surgeon, Professor Tuffier, that when heavy fighting is in actual progress their small emergency operating field ambulances "have not given very good results, and very oftem have been unable to deal with the numbers of wounded they have received". This is exactly what might be expected, and it does not encourage us to depart from our present methods which have been proved to be efficient even in the heaviest fighting.

(5) The reports of some thousands of abdominal operations performed in the British Casualty Clearing Stations have been already published by many surgeons and show that many hundreds of lives have been saved. No similar records are yet published by other nationalities and there is no reason to believe that the results obtained by them are better than our own, whereas it is certain that in some places they are not as good.

(6) We already arrange for the reinforcement of active areas by the addition of Surgical specialists who are experienced in the surgery of the front

Our own system of Casualty Clearing Stations provides for a continuous line of well equipped, well staffed and well nursed operating centres which are placed on good roads and railway lines, and are so near to the front and to each other that all parts of the firing line have ready access to one or other of.them. If it happens that for some military or other reason there is a gap in this line of advanced Casualty Clearing Stations then "an advanced operating centre" is established with a suitable staff so as to be sure that the more serious cases do not have too far toxtravel. We thus combine the use of our Casualty Clearing Stations with the use of such special operation centres as are indicated from time to time, and according to the requirements of the military situation. Our system is to keep the Casualty Clearing Stations far enough forward and in sufficient numbers to deal with the wounded with the least delay and to supplement them by smaller operating centres as the latter are required.

I found that the Surgeons whom I saw at the Base Hospitals were all of one opinion, namely, that the wounded had arrived in much better condition during the fighting of the Spring than formerly: That complications had been much fewer: that there own operating work had been lightened: and that patients had done so well because of the early operations at the front.

They said that almost the only wounds that had not done well were those which had not been operated on at the front, or had not been satisfactorily dealt with, and I think it may be concluded that the policy of doing more operations in the Casualty Clearing Stations during heavy fighting has been very fully justified.

A few other facts of practical interest may be noted:

(1) No less than 6 of the 22 cases of gas gangrene originated during one long train journey of 17 hours:
(2) The patients treated by the "Carrel" method arrived in very good condition:
(3) The treatment by "B.I.P" was approved by all the Surgeons at the Base, but, with a caution that the wounds should not be completely closed by suture, unless they are quite small and uncomplicated by fracture.
(4) Not only should all fractures and also all wounds of joints be carefully splinted, but splints should also be used to immobilize ~~with~~ extensive wounds of the soft parts alone.

The increased staffs of the Casualty Clearing Stations were able both at Arras and Vimy and also at Messines to deal with the great majority of the patients requiring operation, but there is no doubt that a still further increase of staffs and of opportunities for operating would permit of more operations being done at the Front and would also enable them to be done with less delay and to the advantage of the wounded.

I have already submitted proposals as to the requirements for thus increasing the operations at the Casualty Clearing Stations and I would now only add that in proportion as these operations are done at the Front, it becomes necessary to supply additional medical officers to take charge of the X-Ray Apparatus. It has certainly become desirable that each of the latter should be in the charge of special operators, for unless this is done there are many patients with serious injuries who would still not be dealt with by the Casualty Clearing Stations even although a sufficient operating staff were available.

(Sgd.) ANTHONY A BOWLBY,

22/9/17. Surg -Genl.

June 11th, 1915.

My dear Sloggett,

There is a good deal of talk of this - There is a Hector Munro I believe alarming London drawing-rooms.

Will you give me the reply from Bowlby and Wallace. My own opinion is that Berkeley Moyniham should be with you and well up to the front (verb sap), but of course, you are the judge.

Yours ever,

(Sd). Alfred Keogh.

RAMC 365/1

ROYAL NAVAL HOSPITAL,
CHATHAM.

April 12th 1915

Dear Bowlby,

I understand Mary & Baker are sending you & post today 600 tubes of Cresol paste 20% as you have the Borax powder you ought to be able to give the thing a thorough trial. Edmunds who has been working with me is being sent off to the Dardanelles this week so that he will be able to work the matter out very thoroughly with full knowledge of the laboratory work we have been doing. I also enclose some copies of the instructions for which I sent you a proof & also the Hunterian oration which you may like to refer to again.

Perhaps you won't mind if I give you some of my ideas on the matter.

1. In the first place the idea is quite a new one. It is not the indiscriminate use of antiseptics but the introduction of antiseptics into a wound in such a manner that they may remain there, diffuse in the blood & tissues & carry on their work for a considerable time, at least 24 hours & probably much longer. They are

introduced in media which to a certain extent hold them up & only slowly part with them so that they have no irritating effect but guiltily do very efficient work. This work is in the first instance to arrest the growth of the bacteria in their vicinity & after a time the bacteria so arrested in their action die. The inhibition of the bacteria occurs pretty quickly with creol paste, 20% would inhibit the growth of bacteria on an area something like 2 to 3 inches in diameter in about 2 hours & kill all the bacteria in that area in 10 to 12 hours. Boracic powder diffuses a good deal further & kills on a large area & in a shorter time. Naturally they must be able to remain there, if they are swept out by blood they must be reintroduced hence active & severe bleeding must be stopped first.

2. The method succeeds in civilian practice, E.g. Last week we had 2 cases of bad compound fracture of both bones of the leg. A. Compound fracture of both bones of the leg low down by fall from a height in the dock yard. Bones protruding through the wound & dirty & straggling wound bruised. Admitted about 2 hours later. I rubbed all the protruding parts very thoroughly with boracic powder, enlarged the opening in the skin & got rid all the lacerated parts beneath thoroughly washed everything with 1 - 20

ROYAL NAVAL HOSPITAL,
CHATHAM.

carbolic lotion & rubbed ~~in~~ boracic powder everywhere.
As the bones would not keep in position drilled them
& this was done as usual in Co. fractures & then
introduced cresol paste in small quantities
everywhere, stitched up most of the wound except
one part where skin had been torn away, no
drainage tube, a final bandaging of the surface
with boracic, antiseptic dressing & splint. Case
came in on April 7th. Dressed 8th & 9th & a little
paste & boracic ~~powder~~ applied & the surface each
day. On 10th cultivations taken from the surface sterile.
Not dressed yesterday, dressed today & will not be left for
several days. — No reaction, no temperature, no pain
swelling & inflammation, absolutely aseptic result.
B. On April 6th a man was knocked down & motor cycle
at air station at Grain. Double compound fracture
both bones of the leg, much soiled with earth & pro-
fusion of bones. Taken over to Sheerness, washed out
with 1-20 carbolic lotion & cresol paste put in wound &
no boracic. Dressing not changed, admitted here on
evening of 9th. As patient was quite well, no temperature
& quite comfortable I left it till next morning when

it was dressed for the first time, nearly 4 days after the injury. No smell, inflammation or suppuration. There was a big mass of blood clot all over the wound in that the ends of the bone could be felt. as I think it is a mistake to interfere with the clot under these conditions I simply applied the paste + powder on the surface, no washing + applied an antiseptic dressing + fixed on Hackenbruch's metal splints with which I am gradually reducing the facture. I dressed it today for the 2nd time, still perfectly quiet + facture being gradually got into position. Cultivation 2 days ago gave a few colonies of micrococcus + pi- -dermidis. Such is the times on which I would treat these cases. Had I had the last case in my hands at first I would have reduced the factures + fixed them as in the first case but not having got the case for 3½ days I believe it is far best to leave them alone + not break up the clot but concentrate on asepsis in the first instance. Later on, if the Hackenbruch ap- -paratus does not work, which it generally does, the position of the bones can be rectified by operation.

3. You may quite rightly say that your wounds are much worse than these + of course that is so as we have also had ample evidence but after all it is only a question of

degree. Naturally the 3 wounds are much more complex, bruised & soiled but I feel sure that a considerable proportion of these for pain early (within 5 to 12 hours) will follow the above course & that

ROYAL NAVAL HOSPITAL,
CHATHAM.

so much faith in the combination of Bismal & the paste that I believe even after a longer time you will get a certain proportion of success. Of course the difficulty will be to get the stuff far enough in, the paste ought not to be so difficult to manage. We have only provided 2 kinds tubes so that the soldiers should not probe them in too much but a catheter a tube can be pressed the end & the stuff squeezed much further in. I daresay for that purpose you would need to have larger paint tubes but that you can always order. As to the powder it is not so easy but a good deal can be carried in with the finger & rubbed over the sides of the wound. Apparently you need not fear putting in too much. Besides the earth injection does not I believe extend above an inch or two in in the first instance. Unless clothing is carried in & in any case the paste will delay growth for a good long time till you can clean out the wound. The line I should take would be that if I failed it was because I had not got the stuff far enough in & would try to devise means of getting it better in next time:

Mayo Robson has been using the paste alone in some

French Hospital it is quite sufficiently about the way the clot remains unaltered in large shell wounds.

4. Don't let the men be disturbing the clot by probing wounds, putting in drainage tubes &c. in cases where are no doubt firm clot is present in the wounds & where there are no inflammatory symptoms. Just put some more paste & pour the antiseptic & leave just very seldom.

5. above all things avoid you bacteriologists. They have caused endless mischief already with their pseudoscientific talk about anaerobic bacteria, autolysis &c & their wild hypotheses which they commit into facts in a few days. This is simply a matter for surgeons & sane bacteriologists. We don't want any fancy ideas.

Excuse my sending you such a long letter but I am intensely interested in the matter & wanted to give you some of my ideas. Only wish I could come out for a week or two but I am afraid it is too much to hope that the army authorities would allow such a thing.

Kind regards

Yours sincerely

W. Watson Cheyne

TELEPHONE, 983 PADDINGTON.
TELEGRAMS, WATSCHELN, WESDO, LONDON.

75, HARLEY STREET,
CAVENDISH SQUARE, W.

May 18th 1915

Dear Bowlby.

As you will see from the instructions I enclose the treatment at the base depends on the condition of the wound. I should say means & pest anything like all the wounds to remain aseptic but even if they don't much time is gained & very possibly the tetanus & gangrene bacilli may be actually sorted. If it fails the clot will be ligued or absent & there is no trouble when the case gets to the base in putting in drainage tubes &c. as required. If on the other hand the wound is full of solid clot it does not fail & it ought

not to be disturbed unless there is pain
swelling &c indicating acute sepsis.
I have a strong suspicion from what
you say that in some cases anyway
it may not have been necessary to disturb
the clot. If there is no temperature or
local pain & swelling, haemmines &c
leave it alone & it will gradually
organise. In my first case the mixture
of grease & blood clot looked very queer
& some of the men who saw the case
thought it was septic & wanted to clear
out the clot. I said no & the case did
quite well. If every thing is quiet first
smear some paste on the gauge, dress
the wound & leave it alone for several
days. My wish is to get the wound full
of aseptic blood clot & leave it to
organise. From what Addinsell tells
me the worst of the cases leave him

TELEPHONE, 993 PADDINGTON.
TELEGRAMS, WATSCHELN, WESDO, LONDON.

75, HARLEY STREET,
CAVENDISH SQUARE, W.

aseptic & can hardly have gone wrong
in the short transit. I know at
Chatham how difficult it is to
persuade the men & leave the cases
alone & not to change the dressings
every day but they are now quite
convinced & there no trouble. The
other point: is some curious mischance
the chemists who made up additionally
last supply B paste put far too little
boracic in it, in fact thought they could
improve on our prescription, with the
result that it is sure to irritate the skin
in some cases: however that is a minor
matter this supply will soon run out & I

have seen that it shan't occur again. This is however a minor matter & will be all right if the case is only dressed once or twice a week.

I wish you would ask for me to be sent out say for a fortnight. I know exactly what I want & could see if it was going to work in a few days. Medicinally would give me 2 or 3 weeks leave. This would rest the matter at rest otherwise I am so convinced that the thing is feasible that I can't leave it at peace. I don't want to ask to go out but if you would ask to get me out to look into the matter with you I would come as soon as I could get a uniform made.

Yours &c

W. Watson Cheyne

ROYAL NAVAL HOSPITAL,
CHATHAM.

May 24th 1915

Dear Bowlby.

Thanks for your letter & report. I have also heard from Wright & Addinsell. As I expected the cases which Addinsell, who is the only man whom I have seen on the subject & who therefore knows my ideas, has treated seem to be good & the cases you complain of seem to have been treated by others who have evidently misunderstood my plans. I do not blame them for that because our reports, which I read along with this only appeared in the Naval Medical Journal & can't therefore have reached them yet. We recommend at present a trial of two substances (though there are others which ought also to be tried) viz. cresol paste & boracic powder. The cresol is of no use as a disinfectant for spore bearing Organisms such as tetanus & gangrene but it does delay their growth & that of the pyogenic ones. Its function is only to delay the spread of infection till the patient's

besides the dressing station when in the case of large wounds & soiled ones I would open up the wound remove the paste, clean the wound out with H_2O_2 & carbolic & put in & fill up the wound with boracic powder, in bad wounds also leaving in a drainage tube. Those men who have put in this paste have not followed this course but have thought that they were responding for the disinfection of the wounds. Of course if at first they had got the boracic also into every part of the wound the case was different & they might have delayed interference. The real antiseptic however is the boracic & this seems to be a remarkable one. I don't care a straw whether you leave out the cresol or not, in fact I have always been rather against it myself but I have so far not got a good substitute for it for this temporary purpose. When I spoke of cresol paste in my Hunterian oration I did not assign it any other place than this & it was quite clear that it was only an experiment & I specially suggested that a small section at the front should be set apart for experimentation in these matters & a small committee of whom I particularly wanted to be one. I have certainly tried to make it all as clear as I could & I thought no one could misunderstand it but I suppose they have no time to read & ponder over things.

Now I do hope you will allow Admiral & Mrs Thorpe

I quite agree to stopping the others till something definite can be laid down. Worrall's cases clearly show that there is something of real value here & I will let him have any stuff & any fresh ideas which occur to me. I particularly want him later on to try a preparation of the 2 & 2 which ought to meet your views with regard to anaerobes but let him go thoroughly into the bowel at present. He has to devise means of getting it into the depths of perforating wounds which are the real difficulty as in the case mentioned by Ritchie: open shell wounds ought to be quite easy. I am sure you will miss a great opportunity if you stop the investigation just now. I assume you that I am still in possession of all my faculties & am not urging this from any prejudice & without due sense of my responsibilities. Of course it is very saddening to be so near the scene of action & yet so far.

ROYAL NAVAL HOSPITAL,
CHATHAM.

Yours sincerely
W. Watson Cheyne

Tuesday

Was in Admiralty this morning & they had just received following telegram from the Dardanelles "Paste & powder most satisfactory, 36 severely wounded treated, 23 quite clean, slightly and 4 definitely septic but none spreading!!" So you see Worrall's cases shows that it is the organ &

Will the Ship Volunteer is at fault. - Will be away for 3 weeks. (Malta & back)

ROYAL NAVAL HOSPITAL,
CHATHAM.

April 19th 1915

My dear Bowlby.

I am glad the stuff has arrived all right & I hope you will find it useful.

As to your remarks about H_2O_2 & phenol, in the first instance I only looked for & hoped to find some means of delaying the infection till the wounds could be thoroughly disinfected but as the work went on I came to think that the material if it got thoroughly into the wound would do the disinfection in a good many cases. ~~Of~~ At the same time it seemed to me that if the wounds had to be opened up to remove clothing &c. they might as well be washed out with H_2O_2 & carbolic so as to give less for the Bovril & paste to do. Of course you won't get a really aseptic result & washing out though it may diminish a delay the sepsis. H_2O_2 bubbles out the loose dirt but its action

is so rapid that it has not time to disinfect ~~it~~ in a dirty wound & besides also the 1-20 cannot be expected to produce an aseptic result. Nevertheless I expect they would help & make the task of the boracic & paste easier. At the same time it is quite a good Experiment to see the effect of the boracic & paste alone, indeed I am in hopes that in a good many cases you won't need to do much in the way of opening up the wound if the stuff has been well put in previously.

I am working just now with a preparation of H_2O_2 which I may ask you to try presently if I can find some means of combining it so that the H_2O_2 is only given off slowly instead of violently. I am trying a powder on animals this week & may write to you about it later on. In the meantime I hope what you have got may turn out trumps.

I shall send you a reprint of our report I hope in a few days.

Kind regards

Yours sincerely

W. Watson Cheyne

If you want more stuff & don't want to order it direct let me know & I shall gladly send you another supply.

To the Editor of THE LANCET.

SIR,—With your permission I should like to join in the discussion opened by Sir Watson Cheyne at the recent meeting of the Medical Society on "The Treatment of Wounds in War," and I do so because for the last six weeks I have seen these wounds under different conditions from those in which they have been seen by the surgeons who took part in the debate. I spent my first three weeks in France at the base hospital at Rouen, but ever since the beginning of the "Battle of Ypres" I have been in daily attendance in one or other of the "clearing hospitals," or "clearing stations," as they are now to be called, to which the wounded are brought from the field ambulances. They often arrive within a few hours of injury, but more frequently after a longer interval of 12 to 18 hours, and more rarely only after the lapse of one or two days. It must be remembered that in this war there is never an armistice for the burial of the dead or for the relief of the wounded, and it is usually only at night that our "stretcher-bearers" can remove men who cannot walk to the field ambulance. On the other hand, the motor ambulances cannot usually take the wounded on to the clearing hospitals by night because they would draw fire if they showed lights, and because the roads are almost impassable even by the light of day. The conditions of a field ambulance receiving wounded at night quite preclude anything except the simplest dressings, and consequently nothing much is attempted before the day dawns. Soon after this the patients begin to be removed to the clearing hospitals. Many men who are shot in our own attacks lie outside our lines unaided even for days, for our own stretcher-bearers would be shot at once if they went out towards the German lines to help either British or German.

It must next be remembered that it has been the very worst cases—namely, the fractures of the femur and the leg bones, as well as the head and spine cases, and big shell wounds—which have been most delayed in getting to the field ambulances. For those men who were hit in the arms, or had slight flesh wounds, could get away with or without help in many instances, while these could not be moved without stretchers and bearers. And, in addition, again because they were so disabled, they have unavoidably been left lying in the wet mud of manured fields till their torn trousers and their wounds were soaked in a mixture of blood and dirt that it was impossible to even get the torn muscles mechanically clean, let alone aseptic. In many cases also men have lost so much blood that they could not stand an operation on the chance of further loss by opening up wounds, and there is no doubt that their powers of resistance to microbic infection are in many cases greatly lowered by the combined effects of shock from the injury and from bleeding, and from exposure to cold and wet, with prolonged starvation.

Such are the conditions in which many men are hit, and I will now turn to the nature of the wounds. First, rifle bullet wounds. The wounds inflicted in this war differ most materially from those of the South African war in two essentials. In the first place, the bullet is a different one, and even at long range it hardly ever makes the very small punctures which the old Mauser bullet made. These small punctures were the indication of a correspondingly slight injury to the parts beneath, and so also the much larger wounds of exit and entrance of the new bullet indicate a correspondingly slight injury too. Both Mr. Makins and I are quite convinced that these bullet wounds are not comparable to the wounds of the Boer war, and I can further testify that the effects of our own bullet on the wounded Germans I have seen is also much more severe than were those of the Lee-Metford in 1900, though not so severe as the German missile. In the next place, it is well known that the Boers habitually fought at very long range, whereas here the exact contrary is the case. Most of the attacks on the British have been made at night, so that large masses of men could get close to the trenches before being seen, and instead of rifles being fired at from 800 to 1500 yards most of the rifle fire has been within 150 or 200 yards, while the great majority has been when the men were almost in contact or but few yards apart. The effect of this has been to cause the most typical "explosive effects," so that I have seen the greater part of the muscles of the forearm torn and extruded through a huge rent in the skin and fascia, and that without the bones being injured, in a case where a man was accidentally shot at a distance of three or four yards, and where there could be no possible doubt of the nature of the injury. Of course, in such cases where the bones are struck as well the effects are infinitely worse, and large portions of the muscles are rent and torn away with vessels and nerves, while parts of long bones are shot out and fractures extend over the whole length of the shaft. One might well believe that these injuries were due to shells, but I have had abundant evidence that these immense wounds have been caused in very large numbers when the men were so closely engaged in combat that all shell fire had ceased, and when there was consequently no doubt of their origin. Almost all the experiences of bullet wounds in the Boer war have been set at naught, and one never sees a clean hole bored through the patella as I saw six times in South Africa, or a bullet wound through the head whose entrance or exit were difficult to find.

The bullet of the machine gun is the same as the rifle bullet. Second, shell wounds. These of course are to be further divided into wounds by shrapnel bullets and wounds by fragments of the shell case. The effect of the bullet varies in proportion to the height of the shell from the ground when it explodes and the velocity of the shell at the same moment. If a shell bursts when it has lost its velocity and is high in the air, the bullets also are quite spent and may fail to penetrate even the clothing. But if the shell bursts close to a man and when its velocity is very great, the bullets are projected with great force, and often many of them strike a single man. In this way whole limbs may be shattered or even torn off, and the viscera may be so injured that death is practically instantaneous. In intermediate cases the bullet penetrates with more or less velocity, and may in the latter case be deviated or stopped by a bone. These bullets are much more likely to carry into the wound portions of clothing than is the rifle bullet, and as their velocity and penetration is less they much more often lodge, otherwise they present no special points of interest. Portions of the shell case itself, or even the whole case, may strike a man, and the effect is the same as that caused by the howitzer shells.

A howitzer shell differs from shrapnel in that it contains no bullets, but only a bursting charge, and this charge usually is made to detonate when the shell strikes the ground. The wounds are therefore caused by the portions into which shell is shattered by the explosion, and while some of these may weigh several pounds, others may be smaller than a bullet. The wounds caused by these shells are the most horrible of all, and are much more often fatal than shrapnel wounds. The limb is often so violently contused by the mass of jagged metal tearing its way through all obstruction, that far beyond the actual wound the tissues are so injured that they slough in large masses. Immense

rents are torn in the fascia and skin, and through these a mass of mangled muscles, fascia, and bone is thrust, much of which has its vessels so extensively destroyed that it is all dead from the moment of the injury. Such a wound presents a mass of slate-coloured or blackened tissue, from which blood-stained serum exudes, but which bleeds little. The whole limb in many cases is swollen by the extravasation of blood, which spreads far and wide along the intramuscular planes, and which by the tension it causes may yet further seriously interfere with the circulation of the limb as a whole. Large portions of clothing covered with mud are frequently thrust deep amongst the torn muscles, and gravel or soil may also be carried in by the shell.

Such, then, is a short description of the conditions in which the wounds are inflicted and the nature of the wounds themselves as seen soon after their infliction. I will now turn briefly to the question of the principles of treatment.

In the first place, it must be realised that the exigencies of war do not ordinarily permit of any equipment at clearing stations except that which can be easily removed at the shortest notice, and, as no tents or huts are supplied, use has to be made of any available space or building. The accommodation will vary from a barn or a railway waiting-room to a town hall, or a church, or a school, or a college. There may be no time whatever to prepare or clean such a building before the wounded begin to arrive, and there is seldom much time afterwards, while every wounded man and orderly adds to the mud on the floors. There are ordinarily no beds, and the patients lie on the stretchers on which they were carried in, but we have always obtained 50 the lowest some beds for each of the "stations." The clearing station is equipped to provide for 200 cases, but it will be some indication of the pressure if it is realised that a single station has on several occasions dressed in 24 hours more than 1000 wounded.

It is seldom possible to remove all their blood and mud stained clothing from the soldiers because there is but little to take its place, except some shirts and socks and a pair of blankets for each man, and in fractures of the lower extremity most of the dressings and splints have to be applied and the wounds dressed as the patient lies on his stretcher raised on trestles or benches for the purpose. One room is set apart for operations and an operating table and accessories are set up here, and a well-trained orderly, or two if they can be spared, acts as the necessary sterilisation of bowls and instruments, &c.

There seems to be an idea that "aseptic" surgery has been practised at the front, but, as far as the clearing stations are concerned, this is entirely a misapprehension. I have myself never given up "antiseptic" principles and treatment, and I was glad to find that in every clearing hospital antiseptics were always used.

The usual routine for all flesh wounds which are of the punctured variety, and for all abdominal or thoracic wounds, is to paint the skin far around with 2 per cent. iodine in spirit, and to wash the wound itself with either carbolic acid 1 in 20 to 1 in 40; iodine from 1 to 2 drachms to the pint; or strong peroxide of hydrogen. The dressings have always been "antiseptic," and have always consisted of biniodide of mercury gauze and absorbent wool, for no "plain" gauze is provided. If there has been a fracture without extensive laceration or comminution the same procedure is adopted. But if there has been an extensive fracture, especially of the leg, with laceration, then, whenever it has been possible, the patient has been anæsthetised and the wounds have been enlarged and washed out with antiseptics, and broken bone has been removed and drainage provided.

But the number of cases in which such prolonged treatment can be carried out is necessarily limited by the space for work at disposal of the surgeons and the number of patients waiting treatment. For so much time may be spent on a very few patients that the net result would be harm to the majority. The remedy for all this is not merely a question of increasing the number of the surgeons. That has already been done. When one has to deal with such great numbers of wounded as were dealt with here it is largely a question of space and accommodation, and the difficulties encountered were far more due to the want of large enough suitable buildings near the battle than to anything else. It is easy to say that additional buildings might be obtained as they were required, or that the "buildings we did occupy might have been improved." Both these things were done, but no sooner were we getting comfortable in the little town of "B" than the enemy's shells drove us out in a great hurry, and we had to seek other and safer buildings some miles away to our great disadvantage. The same thing happened at "Y," and here unfortunately with loss of life to both officers and orderlies of the Royal Army Medical Corps. In yet a third town we have had to move because of re-arrangement of the fighting line with the French. All these events of course show how impossible it is to try to pitch anything like a "general hospital" close to the front, and if our "clearing stations" had not been very portable we should have undoubtedly been obliged to leave them behind in the hands of the enemy. War is war, and the surgery of war is not the surgery of peace, and never will be. The total number of wounded in this prolonged battle has been over 40,000. The actual figures I am now able to give will show at a glance what the work has been like. From Oct. 24th to Nov. 8th the total number of wounded treated at the clearing stations was 28,742, or at the rate of 1795 a day, the heaviest day being well over 3000. If these had been equally distributed amongst all the clearing stations on our 40 miles of front and had all come in no room was made for them these difficulties would have been less, but, as a fact, the pressure came especially on three or four stations, and the bulk of the wounded usually came in at the rate of many hundreds within two or three hours. The result was that often every square yard of floor space was taken up by hundreds of stretchers holding wounded men, and many who had injured hands and forearms were at first unable to get sitting space. Yet all these men were always fed and cared for and dressed during the day in which they were admitted. When one thinks that in a London hospital with ample space and permanent equipment the resident staff are really very busy if they have 20 broken legs to treat in a day, and that an operating surgeon who gets through six or eight operations in an afternoon, with plenty of assistants, has done a hard day's work, it is possible to get a faint idea of what it is to treat a hundred or more compound fractures besides caring for five or six hundred other shot through the chest, the abdomen, the head, &c., and many of whom required immediate attention. And besides the difficulties due to the mere numbers and want of space it must always be kept in mind that the whole object of a clearing hospital is temporarily to treat the patients and send them as soon as possible to the base hospital, so as to make room and be ready for more hundreds of patients from the next day's fighting. To-day's wounded must all be treated to-day, and the work of filling ambulances and trains must follow as soon as possible on the treatment of the wounds, so that what with unloading ambulances as they arrive and reloading them and the hospital trains, many hours hard work have to be done by the orderlies and surgeons, in addition to treating the wounds. Yet one clearing hospital by working day and night treated more than 3000 cases on each of three consecutive days.

Letter—Bowlby 3

The fact that so many wounds suppurate has caused criticism of the methods adopted, but if methods are judged solely by results without accurate knowledge of the conditions, then mistakes are liable to occur. My own opinion is that, even granted there were abundant time and opportunity in all the clearing stations, the most skilful treatment would not prevent nearly all the worst wounds from suppurating. As I have already pointed out, these are the very patients whose arrival is liable to be unavoidably delayed because they are so severely injured and their wounds are contaminated before arrival, not by the "clean dirt" of the sun-dried veld, but by a highly septic and manured soil. In these severe wounds also there is often so much necrosing soft tissue that even a slight infection would be difficult to overcome, let alone a massive infection of a large area. Yet I fully agree that many of these severe wounds should be opened up under an anæsthetic if conditions are sufficiently favourable, and Dr. Bowland and I have already advocated this in a "Report on Dry Gangrene" issued some weeks ago.

But it may fairly be pointed out that even if wounds have suppurated there has been an almost complete absence in the base hospitals, as well as those in the front, of real pyæmia, and there have, of course, been no cases of true "hospital gangrene" anywhere. My own opinion is that the wounded as a whole have done very well indeed considering that the buildings were necessarily quite unprepared for surgical work when the battle began, that the men and their clothes were very dirty, that it was often impossible to bring in the wounded for many hours, that the wounds were commonly grossly contaminated before they could be treated, and, above all, that the injured parts were often quite devitalised by the violence to which they had been submitted.

I confess that I have nothing but admiration for the way in which difficulties have been overcome, and I am also convinced that the percentage of mortality amongst the wounded has been very low. But all the same I hope and think that all who have worked here have learned, and are learning, to improve their methods, so that if in the near future there are yet more wounded men, the army benefit by past experience as well as by the criticisms and advice of our colleagues.

I am, Sir, yours faithfully,

ANTHONY BOWLBY.

General Headquarters, Expeditionary Force,
Oct. 20th, 1914.

RAMC 365/11

My dear Bowlby,

I presume you agree with me that the operating theatres at our clearing stations are as good as they could possibly be, and that there is no necessity for "moveable theatres" - ask Wallace what he thinks.

Yours,

(Sd). A.T.Sloggett.

12.6.15.

Please return correspondence.

THE WORK OF THE "CLEARING HOSPITALS" DURING THE PAST SIX WEEKS.

BY

COLONEL SIR ANTHONY BOWLBY, C.M.G.,

SURGEON-IN-ORDINARY TO THE KING; SENIOR SURGEON TO ST. BARTHOLOMEW'S HOSPITAL; CONSULTING SURGEON TO THE EXPEDITIONARY FORCE.

IT is nearly three months since I joined our army in France. I spent most of the first fortnight in Rouen, where were two excellent general hospitals, and where I had a very interesting experience.

Two months ago the British army moved from the Aisne to the North of France, and I was then invited to go up with the general head quarters and found myself acting as consulting surgeon to the "clearing" hospitals behind the firing line.

It is already well known that we occupy the line from near Ypres to La Bassée, a distance of some thirty to forty miles, and the northern part of this is hilly and undulating, while south of Bailleul the country is very flat and marshy along the river and canal of the Lys.

This town is some miles from each end of our line, and we have had "clearing" hospitals at the towns at each end, and in three other centres between.

THE FUNCTIONS OF A CLEARING HOSPITAL.

For the sake of those who are not yet familiar with army nomenclature, I will premise that a "clearing" hospital is placed conveniently near to the field ambulances of the different corps, and that the wounded are sent into it as soon as possible after being injured, and after their first field dressing. In actual practice this generally means that the men wounded during the night-fighting are brought in in the morning, and those wounded in the day may either be got in during the afternoon, or else it may be necessary to wait till darkness permits of their being brought in safely.

A "clearing" hospital is essentially a "mobile unit," and must be able to move with the army at the shortest notice. Consequently, it is not equipped like a "general" hospital, for it has no tents or huts, and it has stretchers instead of beds, and no such luxuries as *x* rays and a pathological outfit. It consists really only of a staff with a sufficient amount of surgical and medical equipment for emergencies, and is in future to be called a "casualty clearing station." But, although these are the normal conditions, we were very fortunate in that we found some excellent buildings in this town and in the neighbouring ones, and we occupied school houses, hospitals, lycées, and colleges, many of which had a few excellent beds and bedding, and two of which had sisters of charity as nurses, and operating theatres. What is very striking is that these small towns have far more commodious buildings than would be found in any similar places in Great Britain.

We arrived at this town one afternoon and were informed that fighting had taken place that day 14 miles away, and that there were 450 casualties to be sent for. There were 50 motor ambulances ready; suitable buildings were found for a clearing hospital staff to occupy, and preparations were at once made to house, feed, and attend surgically on the wounded.

It must be realized that a clearing hospital is supposed to be staffed and equipped for 200 patients, but warfare and necessity know no laws, and sufficient accommodation was at once found in a derelict college and in a jute factory, and all night the staff laboured hard and got through their work splendidly. But this was only the beginning of a month of unprecedented difficulties, all of which have been surmounted in the same spirit of prompt decision and energetic action which characterized this first incident.

As the divisions came up and moved into line other hospitals were started, and very soon the fight known as the "battle of the Lys" or the "battle of Ypres" developed along the whole front. But the pressure of the fighting would be at one part of the line one day, and at another point another time, and it was therefore my duty to go to the place which was the most busy, and either to stay there or else to go on to some other hospital as might be required.

It is quite impossible really to describe the scene at a clearing hospital when the fighting was at its height, but I will try to give some idea of it. Picture a large open space surrounded by buildings. Into this there drives a motor ambulance. The tail curtains are opened and reveal four "lying-down cases" on stretchers. These latter are swiftly and carefully slid out, and carried into a large receiving room 30 or 40 ft. long. Another ambulance draws up with six or eight men who are "sitting-up" cases, and these are helped out and walk into the receiving room. The clothes of the patients are all thick with mud. Ambulance follows ambulance, for the field ambulances at the front have been filled up during the night, and there has been heavy fighting again at daybreak—a common hour for attacks—and thus it has happened that on many days from 500 to 1,000 or more wounded have arrived at a single clearing hospital in a single twenty-four hours.

And now look inside the receiving room. Here are half a dozen or more surgeons, often some dressers who are medical students, and a score or two of well-trained and very efficient orderlies. Men with simple flesh wounds are sitting on the benches round the room while the surgeons look at their wounds, and perhaps decide that a simple dressing is all that is required; the skin is painted with iodine, the wound is washed with an antiseptic, a dressing is put on by the orderly, and the patient goes off to another room for rest and food.

In another patient the arm bones are fractured, and splints have to be applied before the wound is dressed. In another case there is a bad smash of the thigh or the leg bones, and an anaesthetic is required and given, while the clothes are cut off, the wound washed out with an antiseptic, and splints and dressings applied.

Here is a man in whom it is only too evident that the limb is hopelessly smashed, so the patient is put into the ambulance and sent round to a neighbouring building where a surgeon is in waiting ready to amputate, so the work of dressing the wounded is not interrupted by an amputation. But, in addition to the dressing of wounds, you will see that one surgeon is detailed to inject every man with antitetanic serum, and you will notice that all the men are given hot soup or milk, or perhaps stimulants, while they wait their turns to see the surgeon.

And so on some days for hour after hour, and for most of both day and night, the same scene is enacted with constant variations of detail. But consider for a moment what forethought has been necessary for such a condition to be successfully dealt with. Picture what stores of dressings and bandages are required to dress many hundred wounded men day after day at each of several hospitals, and remember that it has all to come from England and has all to be got to railhead in quantities greater than have ever been required in any previous war. Think of all the stretchers and blankets and a score of other requisites without which the whole thing would be a failure; then realize that we have never once run out of chloroform, dressings, or any single thing, with the sole exception that for some days, after using 30,000 doses, we had not quite enough tetanus antitoxin.

But you must next appreciate that the hospital is only a "clearing hospital" or "station," and in its turn it must be promptly cleared of all cases that can be moved, so as to be ready for next day's wounded. Therefore, ambulance trains must be ready daily to remove their hundreds to Boulogne or Rouen, or to hospital ships waiting to go to England. You might, at first thought, consider that there should be no difficulty about these trains, but there is a great one. The first duty of every general is to defeat the enemy, and trains for troops, and guns, and horses, and stores are the very first consideration, and Red Cross trains must wait their turn.

Remember that we are in the country of our ally, and the trains on the railways are all French, and under French management. We must take what they can afford to give us, and it is not in our power to provide facilities or engines, or engine-drivers, etc. So it comes about that the train question is a most difficult one; yet it is another of those difficulties that has been completely overcome by the energy and foresight of those in charge.

The Wounds.

And now a few words about the wounds themselves. In the first place, a certain number of the men are obviously dying, and this is specially true of wounds of the brain. In such cases there is little to do, and most of the patients are happily unconscious. But all patients with cranial wounds who are not too ill are operated upon subsequently. Wounds of the face are sometimes horrible. Many of these patients die, partly from shock and haemorrhage and partly from loss of blood and difficulty of swallowing.

Thoracic and Abdominal.

Chest wounds are tolerably common, for, now that the range is shorter and often very short indeed, many more men are wounded by rifle bullets.

There is always in lung injuries some dyspnoea at first, and the difficulty of breathing may be very great. Most men are relieved if given morphine and allowed to rest in a half-sitting position, and in twenty-four hours or less they get more comfortable. As a whole they do well, in spite of haemothorax, and wounds near the apex do better than those in the middle of the chest. Many of the latter are fatal from injury to a large vessel or to the heart. In all of these chest wounds operations are to be avoided.

The abdomen is to a great extent protected in the trenches, and abdominal wounds are not as relatively common as they were in South Africa. They have, however, been more common in the recent fighting, and I have seen, I suppose, between fifty and sixty. The conclusions of recent wars are confirmed—namely, that they should not as a rule be operated upon. The minority of those I have seen have recovered, although some of them have had such rigidity and vomiting as to make one feel sure of some peritonitis. Wounds through the upper part of the abdomen do better than those below the umbilicus, and bullets through the liver do not generally do much harm, although I have seen severe vomiting follow haemorrhage into the peritoneum, and have seen fatalities from bleeding.

We have established a general custom of keeping all patients with thoracic and abdominal wounds in the clearing hospitals for several days before allowing them to go to Boulogne, and I feel sure the quieter they are kept the better they do. I like to see them kept in the clearing hospital for at least five or six days if possible.

Extremities.

Wounds of the extremities vary immensely, of course, and while in some cases there are only small flesh wounds, in others, where the limb is not absolutely smashed by a shell fragment, the bones are powdered and the muscles extruded through huge rents in the skin. Many of the worst of them are due to shells, but by no means all.

The fighting has been practically hand to hand in and around the trenches, and huge lacerated wounds of exit, with or without fractures, are quite common and very numerous when bullets have been fired at such close quarters. Many such wounds are thought to be due to "explosive bullets" or to shells, but the explosive effect of bullets fired at very short ranges are unfortunately only too common in reality and are well known to all who have any experience of gunshot wounds.

Blood Vessels.

Injuries of blood vessels have in many cases caused gangrene without causing serious bleeding, and have often necessitated amputations. My very strong impression is that this is a much more common event with the present German pointed bullet than with the old blunt Mauser bullet of the South African war, and I am sure that the new bullet inflicts much more injury on the soft tissues than the older one. On the other hand, aneurysms and arterio-venous aneurysms, which were of frequent occurrence in South Africa, are relatively rare. I can only recall having seen six of all kinds amongst many thousand wounded. They may, perhaps, develop later.

Wound Infections.

Tetanus is probably not so common as on the Aisne, partly, perhaps, because we are on different ground and also because of the preventive inoculation. It is quite a mistake to suppose that it does not occur in bullet wounds but only complicates shell injuries. I have seen it in both, and I have seen it in slight bullet wounds as well as in serious ones. It has been treated by carbolic acid injections, by magnesium sulphate, by antitoxin, and by chloral and potassium bromide; but early acute cases almost always die whatever treatment is adopted, and a good many more chronic cases recover.

True "hospital gangrene," or "sloughing phagedaena," I have neither seen nor heard of in any hospital in France. On the other hand, the "spreading gas gangrene" or "malignant oedema" has attacked, as a rough guess, perhaps a half per cent. of the recent wounds of all the armies. Mr. Sidney Rowland has proved that it is due to one or other of a group of anaërobic spore-bearing organisms, and, as he and I have already written a report on it, I will not further describe it. It is, however, very noticeable that, in all the cases we have seen, it complicated wounds of the extremities only. The wounds of the head and neck, of the thorax and the abdomen, were all free from it. I take this to mean that it occurs especially in those injuries of limbs which are followed by much interference with the circulation due to swelling and stasis, and by oedema and blood extravasation, all of which also tend to produce sepsis, and which are all rare in wounds of the trunk and head, where the circulation is not materially affected. Consequently I believe that gangrene is to be prevented to some extent, at least, by avoiding all constricting bandages, which lead to congestion and oedema, and by opening up and washing with antiseptics wounds which seem to require it, so as to relieve tension and permit the removal of dirt, bone débris, and clothing, and all such wounds require the most free draining, and of course no such wounds are to be sutured.

There is also no doubt that if dressings are allowed to stay on too long, so that they dry and cork up the discharge, gangrene is specially likely to occur. Frequent dressings are therefore most necessary, and this is specially the case in shell wounds, where the contusions and lacerations of the tissues are far more extensive than can be seen, and are in no way limited to the obviously wounded area. The muscles and fasciae far away from the wound may subsequently slough from the mere traumatism, and in such dead tissues the spreading gangrene is specially likely to start.

True-pyaemia I have never seen, and I have not heard of its occurrence in the base hospitals either, and wounds as a whole, though they have usually suppurated, have done well, when one considers the very wide-reaching and destructive effects of modern bullets and shells, the mud-covered clothes of the soldiers, and the difficulty or impossibility of helping the wounded at once when under heavy fire. The soil of a richly manured agricultural country, which is also very thickly populated, is a very different matter from the sun-dried South African veldt. The one is full of septic organisms, the other is practically sterile. When many hours, or even days, have elapsed, it is evident that in such cases as these antiseptic treatment comes all too late to prevent suppuration.

As regards wounds by bayonets, I can only say I have seen but three, and I have seen none caused by sword or lance. I am also not aware that I have seen a wound caused by a revolver bullet.

The Wounded.

I cannot close these notes of the clearing stations without a word as to the demeanour of the patients. Nothing could be more admirable than the *sang-froid* and cheeriness of men and officers alike. Many of them were cold, wet, and hungry. All of them had more or less pain. Some of them had suffered exceedingly during their transit from the front, some of them were faint from loss of blood. A few were obviously dying. Yet no one really grumbled or made querulous complaints. At the most they asked for something to drink or for some one to move them to a more comfortable position. Many of them were so tired that, in spite of pain, they went to sleep on their stretchers, but, unless they were too tired, they were cheerful and grateful to those who helped them. Their spirit was not broken by their misfortune, and they were still as steady and self-reliant as when they endured the shell fire in the trench or advanced to a counter attack. "The men are splendid," said Sir Redvers Buller fifteen years ago, and this is still true to-day.

46, Queen Anne Street,
Cavendish Square,
London, W.

December 20, 1914.

My dear Haden Guest,

You were good enough to ask me to let you know some details about the Abdominal cases you saw at Furnes. I have just seen Dr. Beavis and he tells me that when he left Furnes this morning five of the seven cases were doing perfectly. As the operations were performed on the 15th and 16th I think one may hope that these will recover. The seven cases form an interesting group all having been received within a period of 36 hours, all being the result of rifle wounds, all reaching the hospital about 6 hours after the injury, whilst in all but one case the condition found at operation was obviously incompatible with life. In every case the bullet had passed through the body more or less directly from behind forwards. The cases were briefly as follows:-

1. Wound of left loin. Laceration of Jejunum. Resection of 3 feet near upper end. End to end anastomosis. Doing well.

2. Wound right buttock and right Iliac Fossa. Lower Ileum lacerated and at one point completely divided. Resection of 3 feet. End to end anastomosis. Doing well.

3. Wound of right buttock passing to centre of abdomen in front. Small intestine completely divided in three places. Mesentery extensively destroyed. Resection of 20 feet of small intestine. End to end anastomosis. Was practically moribund on admission. Improved enormously at first but died after 14 hours. Died.

4. Wound right loin. Lower Ileum lacerated and completely divided at one point. Resection of about 3 feet. End to end anast. Doing well.

5. Wound right loin Laceration of caecum. Opening sutured. Doing well.

6. Wound right loin. Extensive laceration of caecum and ascending colon which was almost divided. Resection of right half of colon. End to end anastomosis. Ileum to Transverse Colon. After 36 hours developed gas infection of abdominal wall. Died 12 hours later. Died.

7. Wound right loin. Exploratory laparotomy. Large retroperitoneal haematoma with bruising of caecum. No intestinal laceration. Abdomen closed. Doing well.

A point of some interest is that in the last four cases the position of the wound was almost the same in each. In every case except the last the abdominal cavity contained some pints of blood and intestinal contents. It was of course cleaned as thoroughly as possible but it is remarkable that in no case was

there any evidence of a marked peritonitis.

In view of such cases as these (and my whole experience has been the same) the old view that abdominal wounds should be left alone is no longer tenable. Obviously the modern bullet is a very different weapon from that used in South Africa. These cases if left alone must inevitably be fatal in a very few hours. I can imagine nothing more important in the present war than a series of hospitals within easy reach of the firing line where they could be dealt with. I feel pretty confident that if they could be tackled by an expert abdominal surgeon within 6 hours, fully 50% could be saved, and I suspect that my estimate is far too low. In no case whilst I have been at Furnes have I ever found a puncture of the intestine such as is always described or a wound of the intestine from which there was the remotest possibility of the patients automatic recovery. The fact is that our unique position at Furnes gave us a unique opportunity of investigating and treating these cases. It is deplorable to think how many lives are being lost through the lack of such hospitals.

With kind regards,

Sincerely yours,

(Signed) H. S. Souttar.

Soukkar's Letter of Dec. 20. 1914 is of historical interest: it refers to 7 abdomen operated on at Furnes in Belgium between Dec. 15th and 16th 1914

Soukkar between Sept. 17th and beginning of Dec. 1914 had also saved 4 out of 6 G.S.W. abdomen on which he had operated in "a Belgian field hospital in Belgium." Her cases were not published till January 1915.

Louis Bazy. the famous French surgeon had saved two or three G.S.W. abdomen before Xmas 1914

The British effort against operating on abdomen had been started by young Canfield of Liverpool. Owen Richards had his first abdom. case Jan 27. 1915 at No. 6. CCS.

A REPORT ON GAS GANGRENE.

By Colonel Sir Anthony A. Bowlby, C.M.G.,
and Lieutenant S. Rowland, R.A.M.C.

Reprinted from the Journal of the Royal Army Medical Corps,
November, 1914.

LONDON: JOHN BALE,
SONS & DANIELSSON,
Ltd., OXFORD HOUSE,
83-91, GT. TITCHFIELD
STREET, W.

A REPORT ON GAS GANGRENE.

By Colonel Sir ANTHONY A. BOWLBY, C.M.G.,
and
Lieutenant S. ROWLAND.
Royal Army Medical Corps.

It seems advisable to record briefly the conclusions at which we have so far arrived on the spreading gangrene which has occurred amongst the wounded of all the armies now in France.

One of us (S. R.) has examined the condition bacteriologically, and this examination was carried out in the "Mobile Field Laboratory." In a typical case affecting the hand, a bacillus was found which was isolated for examination. A culture of this, when inoculated into a guinea-pig, caused its death in eighteen hours. Post-mortem there was found a gangrenous cellulitis from which the inoculated organism was recovered. A second guinea-pig inoculated from this culture was sent to the Lister Institute. It arrived safely and died within a few hours of its arrival, thus affording abundance of fresh material for a more detailed examination than was possible under field conditions. An examination of the culture was meanwhile made in the field laboratory, and the conclusion arrived at was that it was probably the specific organism of malignant œdema. Further examination made at the Lister Institute by Dr. C. J. Martin, F.R.S., and Dr. Arkwright inclined these observers to the view that the organism in question was identical with one that for some time was confused with that of malignant œdema, known as the bacillus of Ghon and Sach. This organism was originally obtained from a case of gangrene in the human subject. There are some ten different organisms that have been isolated from cases of gas gangrene in man, all of which are closely allied and have the common characteristic of being anaerobic spore bearers. From other cases in the clearing hospitals at the front several more organisms of this group have been isolated and have been sent to the Lister Institute for confirmatory diagnosis.

A sample of earth from a trench was also examined. The inoculation of a few drops of water, in which this earth had been shaken up, into a guinea-pig, killed the animal in eighteen hours. Post-mortem, a similar gangrenous cellulitis was found. The animal was also found, like the guinea-pig inoculated from the gangrenous hand culture, to be infected throughout with a spore-

bearing anaerobic organism belonging to the same group. It is reasonable to conclude, therefore, that the gangrene found amongst our wounded soldiers is directly due to infection introduced at the time of the wound, and this is especially likely to occur if muddy clothing has been carried in by the projectile or if earth has been carried in by the explosion. We are, therefore, of the opinion that the gangrene that occurs amongst the wounded is a "traumatic infection," and dates from the moment of the injury. It is solely due to infection from the soil, and is in no way related to sloughing phagedena, or so-called "hospital gangrene."

Clinical Picture of Gas Gangrene.—In the cases we have seen the gangrene has always occurred in connexion with wounds of the extremities. We have not seen it on the head, neck, thorax, or abdomen.

Nature of Projectile.—We have seen it in wounds from rifles, shrapnel, and fragments of shell.

Nature of Wound.—We have seen it in both slight and very serious wounds; but a larger proportion of the serious wounds are affected by it, especially when large bones have been shattered and muscles extensively torn and extruded. We have seen it with and without fractures, and in a relatively large number of fractures of the femur.

Period of Onset.—It is most noticeable that it always shows itself within the first few days or even hours following the infliction of the injury. In two cases we have seen it well marked within thirty-six hours, and in several others already extensive on the third and fourth day. Several patients have died of it on the third day following that of the injury, and in other patients it has progressed so far that amputation has been performed on the third day.

Onset.—This is characterized by swelling of the injured part, and the gangrene seems especially liable to occur in connexion with that swelling of a limb which is due to extravasation of blood in the subcutaneous tissues and intermuscular planes. It seems to us that interference with the circulation either by extravasation of blood or by tight bandages has a marked influence.

In the early stages the patient complains of severe pain which is perhaps due to tension, the result of the swelling, but in the later stages the affected area becomes completely numbed and insensitive. The edges of the wound are generally ragged and sloughy, and a considerable quantity of blood-stained serum constantly exudes and soaks the dressings. This discharge emits a characteristic and most offensive odour which is so marked as to

be almost diagnostic. The skin, if not previously discoloured by extravasated blood, assumes a dark purple or slate-coloured hue. In the vicinity of the wound it changes subsequently to a more green colour. The swelling extends coincidently with the change of colour, and a few hours later the skin becomes nearly black, and finally forms a black, leathery slough. Beyond the area of discoloration the limb is swollen with gas and fluid exudation, and an emphysematous crackling can be elicited on pressure with the hand. This may spread to a distance of as much as a foot above and below the actually gangrenous area, and so rapid is the extension of the gangrene that we have seen the whole of the lower extremity completely mortified before the end of the third day after the infliction of the wound.

Condition of Patient.—Temperature is not materially affected in many cases, and high fever is rare. A temperature of 93° to 100° F. is usual. Respiration is not materially quickened; headache is not complained of. The mind is perfectly clear till near the end. The pulse is not greatly quickened, but rapidly loses power, so that several of the patients we have seen have had no perceptible radial pulse. The heart's action is greatly weakened so that its beat is quite difficult to feel.

Vomiting is common and in many cases is frequent. Diarrhœa is rare. Sweating is not generally present, and before death the skin is cold. The tongue is usually covered with a dirty fur, but the mouth is not exceptionally dry. Death appears to be due to cardiac failure, and we have been struck by the extraordinary clearness of the mind of a patient, almost pulseless, and within an hour or two of his death. In the worst cases the gangrene may spread with such rapidity that the whole limb may be cold, of a purple or black colour, immensely swollen and quite devoid of all sense of touch and power of motion within thirty-six hours of the onset of the gangrene. The smell of such a limb is overpowering, and almost precludes a careful post-mortem examination. If incisions are made before or after death, gas and sanious fluid bubble up. Pus is confined to the edges of the wound and is very little in proportion to the sanious discharge.

The practical conclusions we would draw from these observations are as follows:—

(1) All tight bandages, and especially those applied at the first field dressing, should be avoided. Shell wounds are so often followed by so much interstitial hæmorrhage that the part swells and the bandage rapidly becomes tighter and interferes with the

circulation. Consequently, many bandages require to be cut within a few hours of their application.

(2) In many cases the tension requires to be relieved by incisions and drainage, and the opportunity should be taken to wash the wounds thoroughly with an antiseptic. Peroxide of hydrogen is one of the best. Great care should be taken to remove portions of clothing, as these contain the infective agent. Shattered fragments of bone and pieces of shell or gravel should be taken out.

(3) Amputation may often be successfully performed through tissues made emphysematous by gas but not yet gangrenous.

(4) The group of anaerobes causing gangrene are spore bearers, and spores (especially of this group of anaerobes) are especially difficult to kill by any antiseptic solution or even by boiling. Consequently, in order to sterilize instruments and other things that have been infected other measures are required:—

(*a*) Destruction of blankets and clothing soaked by the discharge.

(*b*) Heating in an autoclave at a temperature of 120° C.

(*c*) Boiling for an hour in a solution of 1 in 20 carbolic acid or lysol (1 in 10).

It should be remembered that the mud on the clothes of wounded soldiers is almost certainly infected, and care should be exercised to see that the area in which operations or dressings of wounds are performed should be kept free from possible contamination from such a source.

(5) Where possible it is advisable to isolate patients under treatment in hospitals, and this is all the more necessary on account of the bad smell which is inseparable from the condition.

The above is a copy of a report sent to the Director of Medical Services on November 9, and is mainly the result of work done at the clearing hospitals at the front to which patients are taken within a few hours of being wounded. Many of the conclusions and practical recommendations, however, have been conveyed to the hospitals verbally or by official communication, and attempts are being made at the Lister Institute to provide an antitoxin.

addition to his armament.

I cannot doubt that in the future the surgeon will also work more with the bacteriologist than he did before the war for it has been by collaboration and experiment that many of our advances have been maintained without risk to our patients. And, whatever we may have learnt there is inevitably much more to learn in the near future. Let us all keep this in mind and let us also remember that, as far as details are concerned, a too rigid standardisation may be harmful. The only safe attitude is that we should be always inclined to believe that however good a method may be it is always possible to evolve another which may be better still.

I have endeavoured to point out to you in what I have said that the surgery of the immediate future may well be expected to benefit from our recent experiences; that we should improve our transport service and our first aid for the wounded in civil life; that shock can be better treated and can often be prevented; that anæsthesia can be rendered safer; that no antiseptic can sterilise infected wounds; that in delayed suture we have an important advance in surgical technique and that suppurating wounds can be treated by improved methods. You are all well aware that were I able to consider in detail the surgery of the various regions, such as the head, the chest, the abdomen, etc. I should be able to record very many examples of advances in surgery, but this is not the occasion for such a discussion and I am content to deal only with more general principles.

I cannot conclude this Address without expressing to you my deep sense of the honour you have conferred upon me in appointing me to deliver it. I had had but few opportunities of making the acquaintance of the surgeons of America before the war, but I have now the satisfaction of knowing that very many of them I can now call, not acquaintances but friends.

When you came to France you came to our aid. When I was in the greatest difficulty in advising our Director-General how to arrange for the increasing demands of the surgery of the Front in the summer of 1917 my difficulties disappeared when I was able to secure your co-operation in our casualty clearing stations at the Third Battle of Ypres. I shall never forget the spirit in which you joined us there. Your one wish was to help us and our soldiers, and in so doing to learn to help your own troops later on. You were willing to sit at the feet of young "surgical specialists" of an age to be your pupils, you took your turns like the youngsters on night duty or in the reception rooms, in the resuscitation wards and the operating theatres. You were full of enthusiasm and most stimulating in discussing with us the problems of war. But more than all of this - you sympathised with our soldiers in the trenches, our outlook was your outlook, and you worked hand in hand with us so that we became like Nelson's captains, a real "band of brothers". Wherever I went during that prolonged and trying struggle towards Passchendaele I found that American, British and Dominion surgeons had established a genuine appreciation of each other and of each other's work which will long outlast the war.

I shall never forget what you did.