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STATISTICAL REPORTS

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No. 4.—600 CASES OF GUNSHOT WOUND  
OF THE CHEST



February 27, 1919

IN close relation to the work the Medical Research Committee have undertaken for the Army Council in the compilation of the formal Medical Statistics of the War, the Committee have provided accessory help in various directions for the collection and preservation of medical records and of the after-histories of military patients, with a view both to the present guidance of medical officers and to the future purposes of the Medical History of the War. This accessory statistical work has been effected by the arrangements made for the interchange of information between separate medical units overseas and between those overseas and at home, by the schedule system of collecting information in chosen series of cases, by clerical help supplied for tracing personal histories after discharge, and in other ways. Many communications giving statistical summaries of the results of treatment in various classes of medical and surgical patients have already been published by permission in medical journals, and others have been given in several of the reports issued or published by the Committee. With the sanction of the Director-General, A.M.S., the Committee have made arrangements to issue from time to time for official distribution statistical summaries which, whether from their provisional nature or for other reasons, are not proposed for publication elsewhere.

### STATISTICAL REPORTS

- No. 1. 656 Cases of Gunshot Wound of the Head. (*June 13, 1918.*)
- No. 2. Gunshot Wound ; Compound Fracture of Femur, and Penetration of Hip and Knee Joints. (*August 8, 1918.*)
- No. 3. An Analysis of 8,670 Ophthalmic Cases treated at a Home Hospital. (*January 22, 1919.*)
- No. 4. 600 Cases of Gunshot Wound of the Chest. (*February 27, 1919.*)

# STATISTICAL AND CLINICAL REPORT ON 600 CASES OF GUNSHOT WOUND OF THE CHEST

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### I. INTRODUCTION.

THIS report deals with 600 cases which have been admitted to the Centre for gunshot wounds of the chest at Southmead, Bristol, since its inception in February 1917, and discharged before the end of November 1917. The large majority of cases came direct from France, a few were transferred to the Centre from other



hospitals in England, and a few came from the Eastern theatres of war. The following table shows the numbers in the various classes of case admitted:

TABLE I.

Empyema . . . . .	70 = 11 per cent.
Haemo- and pneumothorax . . . . .	375 = 62 "
Penetrating wounds without effusion . . . . .	97 = 16 "
Non-penetrating wounds . . . . .	58 = 9 "
	600

For purposes of record the cases were divided into three main classes as follows:

Class 1. Primary empyema.

- (i) Open.
- (ii) Healed.

Class 2. Early operation.

- (i) In which the pleura has been opened, with or without incision of the lung.
  - (a) Without further surgical treatment.
  - (b) In which a secondary operation for empyema has been performed.
- (ii) In which the external wound only has been excised.
  - (a) } Same as in 2 (i).
  - (b) }

Class 3. Cases in which no operation has been performed.

- (i) Requiring operation.
  - (a) For empyema.
  - (b) For removal of foreign body.
  - (c) For clotted haemothorax.
- (ii) Not requiring operation.
  - (a) Aspirated in France.
  - (b) Aspirated after admission.
  - (c) Not aspirated.

## II. DURATION OF STAY IN HOSPITAL.

The actual stay in hospital from the date of the wound in France or elsewhere has been ascertained in 324 cases. This period includes the time spent in Convalescent Auxiliary Hospitals, but not time spent at Command Depots. It was found advisable in all cases to retain patients in hospital until they were thoroughly fit, both in general condition and as to

their local lesions; the greater number spent some weeks at a Convalescent Hospital, but a fair proportion were discharged from the Centre direct to Command Depot or duty.

TABLE II.

*All Classes.* 324 cases; average number of days in hospital 92; of which an average of 20 were spent in France.

*Empyemas.* 31 cases. In hospital 195 days (France 61).

All other cases 293 cases. In hospital 81 days (France 16).

*Intrathoracic operation cases;* excluding empyemas. 21 cases. In hospital 129 days (France 31).

*Excision of external wound,* excluding empyemas.

Penetrating wounds 23 cases. In hospital 98 days (France 17).

Non-penetrating wounds 6 cases. In hospital 80 days (France 12).

*Haemothorax and pneumothorax cases* not operated on in France or England. 167 cases. In hospital 82 days.

Aspirated 73 cases. In hospital 88 days (France 16).

Not aspirated 94 cases. In hospital 80 days (France 15).

*Penetrating wounds* without haemothorax not operated on in France or England. 58 cases. In hospital 62 days (France 14).

*Non-penetrating wounds.* 18 cases. In hospital 58 days (France 16).

These figures probably represent the averages for a much larger number of cases, but it will be noted that the proportion of empyema cases is low, namely 9.6 per cent. of the total as compared with 11 per cent. in the whole series. This of course is due to the fact that these cases remain much longer in hospital, and consequently fewer have as yet been discharged. Thus the average of 92 days for all classes of case is probably too low.

These figures may be compared with those collected by Col. T. R. Elliott, A.M.S., and published in September 1917. 49 septic cases (empyema) in his series remained in hospital 7.3 months on an average. In the present series 31 cases remained 6.5 months.

75 haemothorax cases in Col. Elliott's series remained in hospital 3.8 months, 167 haemothorax cases in the present series remained in hospital 2.7 months.

In 1917 Col. R. D. Rudolf published a series of 35 cases, with an average of 20 weeks in hospital (= 140 days), and in 1916 the Statistical Department of the Medical Research Committee traced 19 cases observed by me in France who were returned to duty or furlough in an average of 12 weeks. Putting these three series together,

Elliott's cases	(124)	average	21 weeks	
Rudolf's cases	(35)	"	20 "	
Brickdale's cases	(19)	"	12 "	
	(178)	"	18 "	or 126 days,

as against 92 days in the present series. This means a reduction of about 1 month in the time spent in hospital, whether the comparison is made between the total cases, or in the septic and haemothorax cases separately.

### III. DISPOSAL OF CASES.

#### 1. *Empyemas.*

*In 31 cases*

18 cases were discharged to duty, employment, or Command Depot.

10 were discharged unfit (one owing to fractured humerus),

2 died.

1 returned to hospital for fractured arm.

#### 2. *Intrathoracic operations (excluding empyemas).*

*In 21 cases*

17 cases discharged to duty or Command Depot.

4 cases discharged unfit (3 for causes not connected with chest wound).

#### 3. *Excision of wounds.*

##### (a) *Penetrating.*

*In 23 cases*

22 discharged to duty, employment, or Command Depot.

1 discharged unfit.

##### (b) *Non-penetrating.*

6 cases, all discharged to duty or Command Depot.

#### 4. *Haemothorax and pneumothorax.*

##### (a) *Aspirated.*

*In 73 cases*

70 discharged to duty, employments, or Command Depot.

3 discharged unfit (1 foreign body in heart, 1 adherent pericardium, 1 recurrent effusion into pleura).

##### (b) *Not aspirated.*

*In 94 cases*

91 discharged to duty, employments, or Command Depot.

3 discharged unfit (1 foreign body in pericardium, 1 probably for rheumatism, 1 for fractured humerus).

#### 5. *Penetrating wounds without haemothorax.*

58 cases, all discharged to duty, employments, or Command Depot.

#### 6. *Non-penetrating wounds.*

18 cases, all discharged to duty, employments, or Command Depot.



Thus in 324 cases of all classes, 300 (nearly 90 per cent.) were discharged to duty, employments, or Command Depot, 21 (6 per cent.) were discharged unfit, of which 6 had other serious disabilities, 2 died, and 1 was returned to hospital for further treatment of fractured arm.

#### IV. ULTIMATE RESULTS.

It was possible to trace the ultimate results in the case of 106 patients in most cases from information kindly supplied by Dr. Matthew Young of the Statistical Department of the Medical Research Committee. 72, or 68 per cent., were returned to duty 12, or 11 per cent., to employments, 20, or 18 per cent., were discharged unfit (including 10 empyemas), and 2 died.

These figures do not, of course, represent the ultimate fate of the whole series, because in the first place the proportion of empyemas is too high, and in the second place severely wounded men are discharged directly from hospital whereas those likely to be fit for foreign service go to Command Depots, the returns from which are not immediately available. There is reason to believe that only very few of those sent to Command Depots from the Centre or from Convalescent Hospitals have failed to qualify for service either abroad or in the United Kingdom.

Further analysis of these results shows :

##### *Class I (empyemas).*

- 1 serving in United Kingdom.
- 1 discharged to duty with R.E. Railway Section, but found unfit after 2½ months. He had a fractured arm.
- 2 were discharged to employments.
- 7 discharged unfit.
- 1 died.

##### *Class II (cases operated on in France).*

###### Division (i) intrathoracic operations.

- 1 serving with B.E.F.
- 1 classified A 3.
- "    C 1.
- 2 discharged to duty, classification not known.
- 1 discharged to employment.
- 2 discharged unfit (1 empyema).

###### Division (ii) excision of wound only.

- 1 classified A 1.
- 1 serving in United Kingdom.
- 1 classified B.
- 1 discharged to duty, classification unknown.
- 1 discharged to employment.
- 1 discharged unfit (empyema).
- 1 died.

*In Class III.*

- 27 serving with B.E.F. or classified A 1.
- 30 serving in United Kingdom.
- 2 sent to Australia, classified B 2.
- 2 discharged to duty, classification unknown.
- 3 discharged to employment.
- 6 discharged unfit.

## V. EFFECTS OF BULLETS AND SHELL FRAGMENTS.

The following tables show the effect of various projectiles in 542 cases. The empyemas have all been grouped together, and the other classes include only non-septic cases. Non-penetrating wounds have not been included in these tables. It will be seen that there were 319 bullet wounds compared to 209 shell fragment wounds, but that the number of empyema cases in each was equal. This means that shell fragments produced an empyema in 16.2 per cent., and bullets in 10.3 per cent. of the cases.

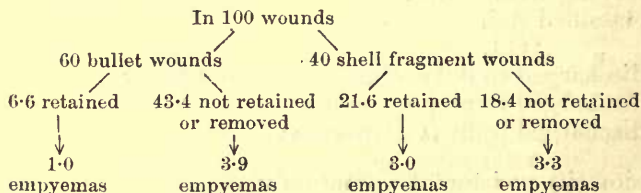
54 per cent. of shell fragments were retained in the chest, and of these 14 per cent. produced an empyema; 26 per cent. were not retained, and of these 18 per cent. produced an empyema. 11 per cent. of bullets were retained, and of these 16 per cent. produced an empyema; 70 per cent. of bullets were not retained, and of these 9 per cent. produced an empyema.

The order therefore of frequency in which the four classes stand is:

Shell fragments, not retained . . . . .	18 %	empyemas.
Bullets, retained . . . . .	16 %	"
Shell fragments, retained . . . . .	14 %	"
Bullets, not retained . . . . .	9 %	"

If to the projectiles not retained be added those removed, the percentages of empyema cases work out at identical figures, probably because in the great majority of cases the projectiles are removed from the chest wall after traversing the thorax, and these wounds are therefore pathologically perforating in most cases.

The comparison may be made clearer by the following scheme:



Thus, though in this series the actual numbers in the four classes with one exception are closely approximated, shell fragments are seen to be much more likely to cause empyema than bullets, but bullets when retained both relatively and absolutely give rise to fewer empyemas than any other class, though the retention of the projectile does not make much difference in the case of shell fragments.



TABLE III.

	Shell fragments.			Bullets.			Bombs.			Undetermined.		
	Retained.	Not retained.	Removed.	Retained.	Not retained.	Removed.	Retained.	Not retained.	Removed.	Retained.	Not retained.	Removed.
Empyemas . . . . .	16	10	8	6	22	6	1	—	—	—	—	—
Intrathoracic operations . . . . .	5	12	11	3	9	5	1	1	2	—	—	—
Excision of wound only . . . . .	7	11	10	—	5	1	1	—	—	—	1	—
Haemothorax . . . . .	63	16	12	21	43	31	4	1	1	—	—	—
Penetrating wounds with- out haemothorax	20	6	—	7	42	8	1	—	—	—	—	—

TABLE IV.

	Shell fragments.			Bullets.		
	Retained.	Not retained.	Removed.	Retained.	Not retained.	Removed.
Empyemas . . . . .	16	10	8	6	21	6
	23.8 %	11.4 %	14.9 %	8.9 %	31.3 %	8.9 %
All penetrating and per- forating wounds	96	45	34	31	205	49
	20.8 %	9.7 %	7.3 %	6.7 %	44.5 %	10.6 %

## VI. EMPYEMAS.

The results in treatment of empyemas are presented here under three headings.

- (1) Primary empyemas opened in France, without previous operation on the lung (Class I in the series).
- (2) Empyemas occurring secondarily after thoracic operations in France (Class II in the series).
- (3) Empyemas opened after admission to the Centre, primary or secondary to thoracotomy (included in Class III in the series).

(1) *Primary Empyemas.*

Of these there were 40 cases; 22 were still in auxiliary convalescent hospital or had been transferred to Australian or Canadian hospitals at the time this report was written, 17 were finally disposed of to duty or Command Depot, or had been discharged unfit, and one died.

The results as regards the function of the lung are classed as:

- (a) *Good*, where the physical signs have cleared up completely and there is good expansion of the chest and little or no deformity.

- (b) *Fair*, where there are still physical signs in the chest, but fair expansion and not much deformity.
- (c) *Poor*, where the physical signs are still well marked, and expansion poor, with or without much deformity of the chest.

The bacteriological findings are noted in the synopsis of cases whenever they had been determined. There is a general prevalence of streptococci, either alone or with other organisms. In those in which the empyema was opened at a later date staphylococci and other organisms were more commonly found. The larger number of cases were apparently simply opened and drained. Any further methods of treatment are noted in the synopsis whenever they were recorded on the field medical cards.

In the case of secondary empyemas, the primary operation was performed within 24 hours, unless otherwise stated.

The following figures refer to the whole number of cases, as far as the results could be ascertained.

In 27 cases a good functional result was observed, on an average in 4.3 months; in 19 cases a fair functional result in an average of 4.4 months; and in 10 cases a poor functional result in an average of 7.8 months. Of the remaining 24 cases, 2 died, and in 22 the functional result could not be observed.

In the first group (good), 65 per cent. were opened and drained within the first fortnight, and 22 per cent. within the second fortnight.

In the second group (fair), 52 per cent. were opened and drained within the first fortnight, and 31 per cent. within the second fortnight.

In the third group (poor), 23 per cent. were opened and drained within the first fortnight, and 7 per cent. within the second fortnight.

Stated in another way:

In cases drained during the first fortnight 56 per cent. gave good functional results, 3 per cent. fair, and 10 per cent. poor.

In cases drained during the second fortnight 45 per cent. gave good functional results, 45 per cent. fair, and 10 per cent. poor.

In cases drained later than the second fortnight, 25 per cent. gave good functional results, 45 per cent. fair, and 50 per cent. poor.

### *Synopsis of Cases.*

*2-3 months after date of wound (5 cases).*

I (2). Drained 18th day, sinus healed in 2½ months, fair functional result. (An officer, transferred to another hospital owing to fractured leg, was still in hospital 1 year after wound.) (Streptococci.)

I (23). Drained 6th day, much blood clot evacuated; sinus healed, and good functional result in 2 months.

I (28). Drained 14th day. Sinus still present in 2½ months, with persistent physical signs, but fair functional result. (Staphylococci, *B. Welchii*, *B. sporogenes*.)



I (34). Drained 14th day, and subsequently irrigated. Tube removed in 10 days. A small sinus still present, but very fair functional result in 6 weeks. (Anaerobes.)

I (36). Thoracotomy 16th day, after four aspirations. Fluid blood evacuated, and wound closed. Re-opened and drained 19th day. Further operation for improved drainage, 52nd day. Poor result in 2 months.

3-4 months after date of wound (9 cases).

I (14). Drained 19th day, after one aspiration fluid blood. Carrel tubes removed in 7 weeks, sinus nearly healed and fair functional result 3 months. Subsequently discharged to C. D. (Sterile.)

I (3). Drained 9th day after one aspiration. Very long sinus 2 months later; good functional result but sinus not quite closed in 4 months. C. D. Now serving in United Kingdom. (Streptococci, anaerobes.)

I (8). Drained 4th day. Further operation 14th day, tube removed in 2½ months. Healed in 4 months with good functional result. Discharged to C. D. (Streptococci, staphylococci, *B. Welchii*.)

I (33). Drained 4th day, and F. B. removed from surface of lung. Operation for improved drainage in 3 months. Final result not known. (Streptococci, *B. sporogenes*, *B. Welchii*.)

I (35). Drained 4th day, 3 Carrel tubes. Syringed daily with chloramine T. Fair functional result in 3 months. Still in hospital with unclosed sinus where F. B. was removed from beneath sternum.

I (39). Drained 11th day. Carrel tubes. Daily wash out. Sinus healed and good functional result in 4 months.

I (40). Drained 23rd day after 3 aspirations. Jaundice and bile-stained discharge through empyema. Sinus still present, moderately fair functional result in 4 months.

I (43). Leaking wound stitched. Double haemothorax and haemo-pericardium. Latter resected, F. B. removed, wound closed, good result. Empyema on L. side subsequently drained 27th day. Very fair functional result in 3½ months, pleural sinus healed. Still a small sinus over pericardial wound. (Streptococci, staphylococci.)

I (44). Drained 7th day after 2 aspirations. Wound healed and very fair functional result in 3 months. (Streptococci.)

5-6 months after date of wound (11 cases.)

I (13). Drained 11th day, good functional result in 5½ months. C. D.

I (21). Drained 8th day, severe secondary haemorrhage, good functional result in 5 months. C. D.

I (16). Drained 3rd day. Tube removed in 2 months, good functional result in 5 months. C. D. (Anaerobes.)

I (24). Drained 22nd day through wound. Resection and improved drainage 42nd day. Tube removed 5th month. Sinus healed and good functional result in 6 months. C. D. (Streptococci, pneumococci.)

I (25). Drained 9th day. Small sinus but good functional result in 5 months. C. D. (Streptococci.)

I (4). Drained 2nd day, severely ill, bedsores and anaemia on admission in England. Tube removed in 2½ months, healed in 6 months, with some flattening of chest but fair functional result. (Officer, discharged to C. D.)

I (5). Drained 11th day after one aspiration. Further resection for secondary haemorrhage. Good functional result and sinus healed in 6 months. One month later discharged to employment (clerk), owing to scar tissue which impeded arm movement.

I (27). Drained 12th day, sinus healed and good functional result in 5 months. (Streptococci.)

I (29). Leaking wound sutured. Drainage 29th day after one aspiration. Good functional result but sinus still present in 5 months.

I (30). Drained 18th day. Only clotted blood removed. Operation for improved drainage 101st day. Sinus healed and good functional result in 6 months.

I (31). Drained 28th day; layer of lymph sponged off surface of lung. Only



fair functional result and sinus still discharging in 5 months. (Streptococci, staphylococci.)

I (32). Drained 38th day. Operation for improved drainage 102nd day. Poor functional result in 5 months.

*6-10 months after date of wound (11 cases).*

I (9). Drained 6th day, portions of necrosed ribs caused sinus to re-open. Sinus finally healed with good functional result in 7 months. (Anaerobes.)

I (17). Drained 20th day after 4 explorations. Good functional result in 4 months, but sinus not healed in 8 months. (Streptococci, staphylococci.)

I (19). Drained 13th day after 1 aspiration. Sinus practically healed, but poor functional result in 4 months. Scoliosis and large axillary scar limiting movements of arm in 8 months. (Staphylococci.)

I (20). Twice aspirated, but not drained for 2 months (Palestine), severely ill. Sinus healed in 4 months. Poor functional result and much shoulder-drop in 8 months. (Pneumococci.)

I (22). Localized empyema communicating with lung abscess drained 55th day after one aspiration and two explorations of pleura. Poor functional result and long sinus still present in 9 months.

I (15). Drained 8th day. Fair functional result but sinus not quite closed in 10 months. (Streptococci.)

I (6). Drained 31st day. F. B. removed from abscess in liver, severe secondary haemorrhage from liver; subsequent discharge of bile through empyema. Fair functional result in 6½ months, but some persistent physical signs, and very deeply adherent scar over lower ribs in 10 months.

I (10). Drained through intercostal space (date not recorded); still a small sinus, pyrexia and poor functional result in 5 months. Signs of peritoneal effusion during 5th and 6th months. Resection and drainage R. pleura (localized empyema), in 5½ months. Pyuria. Very poor functional result and unhealed sinus in 10 months. (Staphylococci.)

I (11). Drained 17th day, after 2 aspirations. Portions of necrosed rib caused re-opening of sinus, which finally healed with poor functional result in 11 months. (Streptococci, staphylococci.)

*Discharged in 11 months (2 cases).*

I (1). Drained 12th day. Sinus healed and good functional result in 3½ months. Discharged to duty (R. E. railway troops), but after 2½ months discharged unfit possibly owing to weakness of arm from fractured humerus (11 months). (Streptococci.)

I (12). Mediastinal abscess drained 28th day (Mesopotamia). Rib resected and F. B. removed from lung 42nd day. Poor functional result, much chest deformity and shoulder-drop in 7 months. Scar adherent to ribs and poor expansion in 11 months.

*Discharged in 12 months (1 case).*

I (7). Drained 31st day after 4 aspirations. Re-opened and drained in 4½ months; wound healed but broke down again in 9 months. Fair functional result but flattening of R. chest in 12 months.

*Died (1 case).*

I (18). Drained 28th day, washed out with saline. Bronchitis and pleurisy of opposite side. Temperature never quite fell to normal, and on 57th day rose to 103°, falling just before death on 68th day. P. M. large F. B. (shell casing) at bottom of empyema. Double empyema, septic bronchitis, and early pericarditis. (Streptococci.)

*Result unknown.*

I (38). Drained 3rd day, after one aspiration. Transferred to Dartford in 6 weeks.

I (41). Drained 36th day, with removal of clots, one previous aspiration. Tube still in after 2 months, but functional result not known. (*B. Welchii*, pneumococci.)

(2) *Secondary Empyemas.**Synopsis of Cases.*(i) *After intrathoracic operations (14 cases).  
3 months after date of wound.*

II (23). Pleura sutured, but haemothorax not cleared out. F.B. removed from shoulder. Empyema drained 14th day. Many small shell fragments retained. Good result in 3 months. Subsequently re-admitted for further treatment of partial fracture of humerus. (Streptococci).

II (219). Wound excised, F. B. removed from pleural cavity. Subsequently twice aspirated, but clear fluid only drawn off. Wound discharged pus on 10th day. Drained. Good result in 3 months, but scar deep and adherent.

II (34). Open pneumothorax, wound excised, fractured rib removed, pleura closed. Empyema drained 8th day. No F. B. Good functional result, but some flattening of chest in 3 months. Discharged later to Command Depot.

II (76). Wound excised, fractured rib removed, F. B. removed border of lung. Haemothorax cleared out, wound closed. Subsequently aspirated 3 times. Empyema drained 11th day. Fair result with some flattening of chest in 3 months. Discharged later to Command Depot.

II (89). Operation 4th day. Wound excised, small haemothorax cleared out. No F.B. Subsequent attack of broncho-pneumonia. Empyema drained 36th day. Still discharging in 3 months, with much falling of chest and shoulder-drop. Staphylococci. Result will probably be only fair.

*More than 3 months after date of wound.*

II (16). Operation 2nd day, wound excised, fragments of rib removed, haemothorax cleared out, wound closed. Empyema drained in 3 months. Sinus healed in 5 months, but again broke down in 6 months. Poor result in 7 months. Subsequently discharged unfit.

II (21). Operation 14th day. Thoracotomy. Pleura washed out with Eusol. Wound closed. Subsequently aspirated twice. Persistent sinus. Empyema drained in 2½ months. Poor result with much shoulder-drop and deformity of chest in 6 months. Discharged unfit.

*Cases still discharging pus 3 months after date of wound.*

II (80). Wound excised, fragments of rib removed, lung sutured, haemothorax cleared out, wound closed. 12th day wound broke down and empyema was drained.

II (102). Wound (sucking), excised, fragments of rib removed, haemothorax cleared out, wound closed. Twice aspirated. 12th day empyema drained. No F. B. (Streptococci.)

II (110). Wound excised, lung sutured, haemothorax cleared, wound closed. 14th day empyema drained. No F. B. (Streptococci, pneumococci.)

II (111). Wound excised, F. B. removed from chest wall, haemothorax cleared out. Wound closed. Aspirated once, 17th day empyema drained.

II (118). Operation 4th day: wound excised, fragments of ribs removed, wounds in diaphragm and liver closed, wound closed. 13th day empyema drained and irrigated, F. B. retained in chest wall. (Staphylococci.)

*5 months after date of wound.*

II (83). Wound excised, fragments of rib removed. F. B. removed, haemothorax cleared out. 8th day wound leaking. Empyema drained with Carrel tubes. General pyaemic infection. Pneumonia and multiple abscesses. Amputation through thigh. No F. B.

In one other case observations were only possible for 1½ months.

II (27). Operation: wound excised, fragments of rib removed, haemothorax cleared out, wound closed. 7th day empyema drained. F. B. retained. Transferred to Dartford.



(ii) *After excision of superficial wound only (9 cases).**2 months after date of wound.*

II (26). Wound excised and portions of rib removed on 1st day. Drained on 24th day. Wound healed with fair functional result in 2 months (transferred to Wokingham).

II (95). Wound excised 1st day. Drained 29th day, pyogenic membrane removed, and pleura washed out with saline. Later, irrigation with Dakin solution and Flavine pack. Empyema still discharging, but fair functional result in 2 months.

II (34). Wound excised and sutured 1st day. Drained 4th day. Tube removed 20th day. Healed and good functional result in 2 months, when discharged to C. D.

*3 to 4½ months after date of wound.*

II (6). Wound excised 1st day. Drained 14th day after one aspiration. Fair result 4½ months, subsequently discharged to Labour Corps. (Streptococci).

II (22). Wound excised 1st day. Drained 9th day. No note as to final condition, but fit for C. D. in 4½ months. (Strepto-bacillus.)

II (125). Wound excised and sutured 1st day. Drained 6th day. Tube removed 12th day, closed in 3 weeks. Good functional result in 3 months.

*5½ to 6 months after date of wound.*

II (35). Wound excised 25th day; drained 45th day, healed in 3½ months, some flattening and shoulder-drop but good functional result in 5½ months, C. D.

II (11). Wound excised and ribs found to be fractured first day. Drained 31st day. Partial Estländer with excision of 3 ribs in 2½ months, Carrel tubes. Small sinus, but fair functional result with flattening of chest in 6 months. (Transferred to Wokingham.)

*Died.*

II (13). Wound excised and F. B. removed from under skin on 4th day. Septic pleurisy with continuous pyrexia. Drained 33rd day after one aspiration; no pus but only clear fluid evacuated. Died 52nd day. P. M. double streptococcal pleurisy, and abscesses in lungs.

(iii) *Cases operated on after admission (7 cases.)*

III (416). Thoracotomy and closure 29th day. Blood and clot removed. (streptococci and *B. pyocyaneus* present). Good functional result in 3 months. Subsequently sent to Command Depot.

III (107). Admitted 18th day after wound in back. Temperature normal till 21st day. Signs of fluid at left base. 25th day empyema discharged through wound. Resection and drainage. Fair functional result in 3 months. F. B. retained in lung. Subsequently discharged to Command Depot.

III (378). Pleuritic effusion becoming purulent (streptococcal). Drained 2½ months after wound. Had been aspirated twice. Good functional result in 4½ months. Subsequently sent to Command Depot.

III (118). Drainage 29th day. Very severe infection but empyema localized by adhesions. Good functional result in 5 months. Subsequently sent to Command Depot.

III (106). Thoracotomy 35th day, clot and blood cleared out, wound closed. Drained 44th day. Flattening of chest but good functional result in 6 months. (Streptococci, staphylococci). Subsequently sent to Command Depot.

III (275). Septic contralateral pleurisy. Aspirated once. Drainage 135th day. Severe infection with abdominal symptoms. Further operation for drainage in 7th month, when upper abdomen also explored without result. Empyema localized by adhesions. Poor functional result in 11 months. (Staphylococci).

III (252). Thoracotomy 32nd day. Patient (Canadian) was transferred to Dartford too soon for complete observation.



## VII. EARLY OPERATIVE TREATMENT.

Sixty-two cases occurred in the series in which an intrathoracic operation with excision of wounds was done during the first day or two in France, of which 14, or 22.5 per cent., subsequently developed an empyema. This percentage is of course higher than that of the whole series (11 per cent.), but must be considered satisfactory when it is remembered that these were selected cases which the surgeons who first saw them considered so likely to become septic that an operation was undertaken.

Primary union of the superficial wound occurred in 29 cases, or 60 per cent. of those in which an empyema did not develop. In 9 the wound broke down, leaving usually a large granulating surface, and in 5 the superficial wound was drained.

In 2 an abscess formed in the chest wall, and 2 were left open by the surgeon. In one partial primary union occurred.

In 76 cases the external wound or wounds were excised, but no intrathoracic operation performed at the early stage. Fifty-six were penetrating wounds, and 9 of these (16 per cent.) developed subsequently an empyema, 10 did not develop a haemothorax; 20 were non-penetrating wounds. The empyemas have already been considered in a previous section of this report, including one of the 10 cases without haemothorax which subsequently developed a general pyaemia and died.

Of the 29 in which the pleura was not directly involved, in 8 the wounds healed by primary union, and in 2 there was partial primary union. Twelve were left open, packed or drained, and 7 after complete closure broke down, leaving a granulating surface.

Of the 37 in which there was also a haemothorax (not including the empyemas), in 15 the wounds healed by primary union, and in 2 there was partial primary union. Six were left open, packed or drained, and 13 after complete closure broke down, leaving a large granulating surface.

TABLE V.

	Number of cases.	Number closed.	Percentage closed.	Number of primary unions.	Percentage of primary unions.
Intrathoracic operations . . . . .	48	40	83	29	72
Excision of external wound only					
With haemothorax . . . . .	37	30	81	15	50
Without haemothorax . . . . .	29	17	60	8	46
Total . . . . .	114	87	76	52	60

It will be seen from the Table that complete closure was rather more often practised when the pleura had been explored and emptied at the operation, and that it was successful in a higher percentage of cases, as far as primary union is concerned. The retention of the haemothorax in the pleura seems, therefore, to have lessened the chances of primary union.

Unfortunately, the number of bacteriological investigations in this class is small. Thirty haemothorax cases in the two groups were examined, of which 21 were sterile and 9 lightly infected (30 per cent.). In the haemothorax cases in this class of both groups in which primary union occurred, 16 only were examined, 11 sterile and 5 lightly infected (31 per cent.). The actual infection of the haemothorax, therefore, as far as these meagre figures can be supposed to show, does not seem to affect the occurrence of primary union.

Again, in non-penetrating wounds complete closure was still less frequently attempted, and primary union occurred in a smaller proportion of such cases. In many of these cases, however, the wound was very large and severe or involved the shoulder, so that drainage or packing the wound was necessary, and closure after excision was less likely to succeed.

The synopsis of cases shows that of 37 cases in which the haemothorax was cleared out at the primary operation, in 9 a good result was observed within 1 month, in 9 within 2 months, and in 6 within 3 months. In 2 cases a good result was observed in  $3\frac{1}{2}$  and 6 months respectively. In 65 per cent., therefore, the lung appeared to be completely restored within 3 months.

In 8 cases a fair result was observed, but only 2 of these were kept under observation for more than 3 months, so that improvement possibly occurred later. One case, in which the result was only fair in 5 months, was subsequently found fit for Command Depot, and one observed for  $5\frac{1}{2}$  months had pus cells in the pleural fluid aspirated.

In two cases a poor result was obtained after  $4\frac{1}{2}$  and 6 months respectively.

In 5 cases the haemothorax was not apparently evacuated at the primary operation; 2 showed a good result within a month, and one in 2 months, having subsequently been aspirated. One other case not aspirated did not clear up for 6 months. In the last case a fair result was obtained after aspiration in 2 months.

In 6 cases there was no evidence of a haemothorax; a good result was observed in less than a month in 4 cases, and in the remaining 2, in 2 and 3 months respectively.

In all, therefore, good functional restoration of the lung occurred in 36 out of 47<sup>1</sup> cases which were regarded in the early stage as potential empyemas, and in only 2 was the result, as regards the lung, poor.

### *Synopsis of Cases.*

#### *Haemothorax cleared out at time of operation.*

##### *1. Good result within 1 month.*

(24) Operation: haemothorax cleared out. Foreign body retained. Good result in 3 weeks.

(72) Operation: haemothorax cleared out, diaphragm and liver torn (suture), pleura subsequently aspirated, sterile fluid. Foreign body not retained. Good result in 1 month.

<sup>1</sup> In one other case with haemothorax a good result was obtained, but the date is not at present clearly ascertained.



(104) Operation: haemothorax cleared out; physical signs persisted. Foreign body not retained. Good result in 1 month.

(113) Operation: haemothorax cleared out; lung bruised; pleura subsequently aspirated. Foreign body not retained. Good result in 1 month.

(115) Operation: large haemothorax cleared out; wound of diaphragm closed. Foreign body removed from chest wall. Good result in 1 month.

(116) Operation: large haemothorax cleared out; lacerated lung sutured. Foreign body not retained. Good result in 1 month.

(78) Operation: haemothorax cleared out; wound in diaphragm closed; pleura subsequently aspirated. Foreign body not retained. Good result in 1 month.

(122) Operation: haemothorax cleared out; pleura subsequently aspirated (sterile). Foreign body removed from chest wall. Good result in 1 month.

(138) Operation: haemothorax cleared out. Foreign body not retained. Good result in 1 month (transferred to orthopaedic section for other injuries).

*Good result within 2 months.*

(42) Operation: haemothorax cleared out; physical signs persisted. Foreign body removed from chest wall. Good result in 2 months.

(46) Operation: small haemothorax cleared out; pleura subsequently aspirated several times. Foreign body removed from pleura. Good result in 1½ months.

(51) Operation: haemothorax cleared out; pleura subsequently aspirated (sterile). Foreign body removed from lung. Good result in 2 months (discharged unfit owing to ulnar paralysis).

(74) Operation: haemothorax cleared out; wound of diaphragm sutured; physical signs persisted. Foreign body not retained. Good result in 2 months.

(79) Operation: haemothorax cleared out; physical signs persisted. Foreign body retained below diaphragm. Good result in 2 months.

(105) Operation: haemothorax cleared out; physical signs persisted. Foreign body not retained. Good result in 2 months.

(47) Operation: haemothorax cleared out; pleura subsequently aspirated (sterile). Foreign body removed from chest wall. Good result in 2 months.

(24) Operation: small haemothorax cleared out; pleura subsequently aspirated (streptococci and staphylococci present). Foreign body not retained. Good result in 2 months.

(137) Operation: open pneumothorax, with small effusion, cleared out; subsequently aspirated. Foreign body not retained. Good result in 1½ months.

*3. Good result in 3 months.*

(51) Operation: very small haemothorax cleared out; physical signs persisted. Foreign body not retained. Good result in 2½ months.

(52) Operation: haemothorax cleared out; pleura subsequently aspirated (sterile). Foreign body removed from mediastinum. Good result in 2½ months.

(57) Operation: haemothorax cleared out; wound in lung sutured; pleura subsequently aspirated. Foreign body removed from chest wall. Good result in 3 months.

(60) Operation: haemothorax cleared out; pleura subsequently aspirated (sterile). Foreign body removed from pleura. Good result in 2½ months. Discharged unfit owing to old deformity of chest and bronchitis.

(168) Operation: large haemothorax cleared out; diaphragm wounded; spleen torn. Foreign body not retained. Good result in 3 months.

(33) Operation: pneumothorax. Foreign body not retained. Good result in 3 months. Discharged unfit owing to other injuries.

*4. Good result after 3 months.*

(75) Operation: haemothorax cleared out; very septic wound; pleura subsequently aspirated several times (streptococci present). Foreign body removed from chest wall. Good result in 3½ months.

(29) Operation: haemothorax cleared out. Foreign body not retained. Good result in 6 months.



5. *Fair result.*

(12) Operation: large haemothorax cleared out; pleura subsequently aspirated (sterile). Result doubtful, classified A.

(33) Operation: haemothorax cleared out; wound in diaphragm sutured; pleura aspirated (sterile). Foreign body removed. Fair result in 1 month.

(73) Operation: haemothorax cleared out. Foreign body not retained. Fair result in 2 months.

(93) Operation: small haemothorax cleared out; wound in diaphragm closed. Fair result in 2 months. Foreign body not retained.

(88) Operation: haemothorax cleared out; pleura subsequently aspirated several times. Foreign body retained. Fair result in  $2\frac{1}{2}$  months.

(90) Operation: haemothorax cleared out; pleura subsequently aspirated without result. Foreign body removed from pleura. Fair result in  $2\frac{1}{2}$  months.

(39) Operation: haemothorax cleared out; wound in diaphragm closed; physical signs persisted. Fair result in 5 months. Foreign body removed. Ultimate disposal, C. D.

(62) Operation: haemothorax cleared out; subsequently aspirated and pus cells found. Foreign bodies retained. Fair result in  $5\frac{1}{2}$  months.

6. *Poor result.*

(56) Operation: haemothorax cleared out; spleen lacerated (drainage); large pneumo-haemothorax subsequently aspirated (streptococci). No foreign body. Poor result in  $4\frac{1}{2}$  months.

(19) Operation: large haemothorax cleared out; pleura subsequently aspirated. Foreign body present close to heart. Poor result in 6 months.

*Cases in which there is no record of the treatment of the Haemothorax.*

(2) Small haemothorax subsequently aspirated. No F. B. Good result in 2 months.

(63) Operation: pleura closed, and subsequently aspirated. Foreign body retained. Good result in 1 month.

(77) Operation: pleura closed, and subsequently aspirated. Foreign body not retained. Prolonged sub-acute broncho-pneumonia. Good result in 1 month.

(59) Operation: pleura closed. Foreign body removed from pleura. Physical signs persisted. Good result in 6 months.

(64) Operation: pleura closed; subsequently aspirated (sterile). Foreign body retained. Fair result in 2 months.

*Cases in which there was no evidence of a haemothorax.*

(37) Operation: pleura closed. Foreign body removed from pleura. Much atrophy of shoulder girdle muscles, due to wound through shoulder. Good result in 2 weeks.

(120) Operation: pleura closed. Foreign body removed from chest wall. Good result in 3 weeks.

(109) Operation: pleura closed. Foreign body not retained. Good result in 3 weeks.

(58) Operation: pleura closed. Foreign body removed from diaphragm. Good result in 1 month.

(100) Operation: pericardium exposed. Foreign body removed; pleura and pericardium closed. Very septic wound. Good result in 2 months. Other severe wounds. Femoral thrombosis.

(15) Operation: liver explored; abscess drained; subsequent pleural effusion aspirated. Foreign body not retained. Good result in 3 months.

The synopsis of haemothorax cases in which the external wound was excised shows that out of 32, a good result occurred within 1 month in 10, within 2 months in 8, and within 3 months in 3. In 3 more it was noted in 4 months. Thus, as in the previous group, a good result within 3 months was obtained in 65 per cent. of the cases.

In 4 cases a fair result was noted within 2 months, and these may have improved later. In one case there was a fair result only in 3 months. In the 3 cases in which only a poor result could be recorded, the observation did not extend beyond 2 months.

*Synopsis of Cases. Haemothorax with excision of external wound.*

*Good result within 1 month.*

(8) Wound excised; fragments of scapula removed; haemothorax very small and not aspirated, wound granulating. Good result in 1 month.

(9) Wound excised and closed; no injury to ribs; haemothorax very small and not aspirated; primary union. Good result in 18 days.

(17) Wound excised; fractured ends of ribs removed; haemothorax small and not aspirated; primary union. Good result in 14 days.

(53) Wound excised and closed; haemothorax very small and not aspirated; wound granulating. Good result in 18 days.

(55) Wound excised and drained; haemothorax aspirated. Good result in 1 month.

(57) Leaking wound excised and closed; haemothorax not aspirated; primary union. Good result in 1 month.

(87) Wounds excised; loose pieces of bone removed; aspirated twice; partial primary union. Good result in 14 days.

(121) Wounds excised and closed; haemothorax not aspirated; wounds granulating. Good result in 1 month.

(123) Sucking wound excised; fragments of rib removed; wound closed; haemothorax aspirated; primary union. Good result in 1 month.

(133) Wound excised and F. B. removed; wound left open; haemothorax not aspirated. Good result in 1 month.

*Good result in 2 months.*

(14) Wounds excised and closed; haemothorax aspirated; primary union. Good result in  $1\frac{1}{2}$  months.

(30) Wound excised and left open; haemothorax not aspirated. Good result in  $1\frac{1}{2}$  month.

(32) Wound excised and packed; pleura found punctured; F. B. removed from chest wall; small haemothorax not aspirated. Good result in  $1\frac{1}{2}$  month.

(48) Wound excised and closed; haemothorax not aspirated; wound granulating. Good result in  $1\frac{1}{2}$  month.

(106) Wound excised; F. B. removed from rib; wound closed; haemothorax not aspirated; wound granulating. Good result in  $1\frac{1}{2}$  month.

(10) Wound excised and closed; haemothorax not aspirated. Good result in 2 months.

(25) Wound excised, exposing pericardium; no pericarditis; wound closed; haemothorax aspirated; wound granulating. Good result in 2 months.

(28) Wounds excised and closed; haemothorax aspirated; primary union. Good result in 2 months.

*Good result in 3 months.*

(41) Wound excised; fragments of rib and scapula removed; wound closed; haemothorax aspirated; primary union. Good result in  $2\frac{1}{2}$  months.

(103) Wound excised; fragments of ribs removed; pleura not open; haemothorax not aspirated; partial primary union. Good result in  $2\frac{1}{2}$  months.

(7) Wounds excised and closed; very small haemothorax not aspirated; primary union. Good result in 3 months.

*Good result in 4 months.*

(45) Wound excised and closed; haemothorax aspirated. Good result in  $3\frac{1}{2}$  months.

(136) Entrance wound excised and closed; primary union; exit wound excised and drained; haemothorax not aspirated. Good result in  $3\frac{1}{2}$  months.



(82) Wounds excised ; F. B. removed from region of scapula ; wound closed ; haemothorax aspirated ; wound granulating. Good result in 4 months.

*Fair result.*

(101) Wounds excised ; F. B. removed ; track drained ; haemothorax not aspirated. Fair result in  $1\frac{1}{2}$  months.

(112) Wound excised and left open ; haemothorax twice aspirated. Fair result in  $1\frac{1}{2}$  month.

(92) Wound excised and closed ; fragments of rib removed ; haemothorax aspirated ; abscess formed in chest wall. Fair result in 2 months.

(135) Entrance wound excised and closed ; exit wound drained ; haemothorax not aspirated. Fair result in 2 months.

(79) Wound excised and closed ; haemothorax not aspirated ; wound granulating. Fair result in 3 months.

*Poor result.*

(91) Wounds excised and closed ; haemothorax aspirated twice ; primary union. Poor result in 1 month.

(128) Wound excised and closed ; haemothorax aspirated ; primary union. Poor result in 2 months.

(130) Exit wound excised ; entrance wound drained ; F. B. removed and exit wound closed, with primary union ; haemothorax not aspirated. Poor result in 2 months.

In 5 cases the result was not ascertained.

*Penetrating wounds without haemothorax.*

(4) Wound excised but not closed, and F. B. removed. No physical signs in 10 days. Discharged to Command Depot in  $2\frac{1}{2}$  months.

(18) Wound excised and closed ; F. B. not retained ; primary union. Patient suffered from dilatation of the heart, but was discharged fit for General Service in  $2\frac{1}{2}$  months.

(20) Wound excised, but did not heal by primary union ; considerable dry pleurisy. The large scar resulting impeded arm movements, and he was discharged unfit in  $2\frac{1}{2}$  months.

(36) Wound excised, but broke down ; large granulating surface ; F. B. not retained ; signs of considerable haemorrhage into lung, and subsequent mucopurulent bronchitis. The case was complicated by an attack of jaundice (toxic) and considerable muscular atrophy. Discharged to employment in 6 months.

(49) Wound excised ; healed by granulation ; F. B. removed from chest wall ; dry pleurisy. Discharged to Command Depot in 2 months.

(71) Wound excised and drained ; damage to head on humerus ; F. B. retained in mediastinum ; no physical signs in lungs. Transferred to Wokingham.

(99) Wound excised and partially closed ; signs of haemorrhage in the base of R. lung. Transferred to Dartford in  $3\frac{1}{2}$  months, with a small sinus still present.

(119) Wound in back with fracture of dorsal lamina ; wound excised ; bone and F. B. removed ; wound drained. No return as yet as to final condition.

(13) This case which subsequently died is included among the empyemas.

TABLE VI.

	<i>Group 1.</i>	
	<i>Under 3 months.</i>	<i>Over 3 months.</i>
Good	24	2
Fair	5	—
Poor	—	2
	<i>Group 2.</i>	
	<i>Under 3 months</i>	<i>Over 3 months.</i>
Good	21	3
Fair	5	—
Poor	3	—

The table shows that, as far as the functional result to the lung is concerned, the results are about equal; the poor functional results are not comparable, but the good results in each amount to 65 per cent. The cases in the first group were presumably more severe and the pulmonary embarrassment more marked initially than was the case in the second group; this, and the fact that a larger proportion of primary unions was secured, is remarkable testimony to the success of the surgeons who performed the early operations.

### VIII. HAEMOTHORAX.

#### (1) *Results of aspiration.*

Of the 292 haemothorax and pneumo-haemothorax cases comprised in Class III of this series, 138 were aspirated either before or after their admission to the Centre. The time occupied by the lung in regaining its functional activity was ascertained in 167 cases. In others the final result, though known, was not accurately timed, as the patients were transferred to auxiliary hospitals or to hospitals for overseas troops. In others again a fair or poor result was recorded.

The haemothorax cases are in the following table divided into large and small. In the aspirated cases, all in which 30 ounces or more were evacuated at a single time are classified as large, and the rest as small. In the non-aspirated cases, all giving physical signs of fluid reaching into the axilla and up to the spine of the scapula, with more or less displacement of the heart, are classified large, and the rest small.

The table shows the number of cases in which a good result occurred in each class, and the number of months from the date of wound.

TABLE VII.

	<i>Months.</i>					<i>Total.</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	
Large haemothorax not aspirated . . . . .	1	9	7	1	1	19
Large haemothorax aspirated . . . . .	10	11	3	—	1	25
Small haemothorax not aspirated . . . . .	48	32	4	3	—	87
Small haemothorax aspirated . . . . .	14	18	5	—	—	37

This table shows that 42 per cent. of the large non-aspirated cases gave a good result in 2 months or less, and 84 per cent. of the large aspirated cases; 91 per cent. of the small non-aspirated cases gave a good result in 2 months or less and 86 per cent. of the small aspirated cases.

Aspiration therefore appears to have hastened functional recovery of the lung in the large haemothorax cases, especially as the non-aspirated cases on the whole were probably smaller than the aspirated ones.



In the case of small haemothorax, the non-aspirated cases seem to recover more quickly; this is probably because on the whole the aspirated cases were larger effusions.

In the following tables an attempt is made to show the value of early and complete evacuation of the large effusions. All cases are included, and not only those which could be followed up to a final result.

*Huemothorax aspirated 30 ounces or more.*

*I. Aspirated during the first week.*

III (288)	3rd day	50, 7th day $\bar{3}$ 70	Good result in 3 weeks
III (327)	3rd "	52 . . . . .	" " 3 "
III (388)	2nd "	36 . . . . .	" " 3 "
III (123)	1st week	30 . . . . .	" " 4 "
III (264)	4th day	5, 5th day $\bar{3}$ 35	Fair result in 4 "
III (126)	5th "	52 . . . . .	Good result in 5 "
III (306)	4th "	4, 6th day $\bar{3}$ 30	" " 8 "
III (115)	2nd "	30 . . . . .	" " 8 "
III (39)	3rd "	36 . . . . .	" " 12 "
III (266)	2nd "	38, 5th day $\bar{3}$ 24	" " 4½ months

*II. Aspirated during the first 14 days.*

III (393)	12th day	46 . . . . .	Good result in 3 weeks
III (224)	5th "	36, 8th day $\bar{3}$ 40	" " 4 "
III (77)	10th "	30 . . . . .	" " 8 "
III (124)	7th "	3, 9th day $\bar{3}$ 30	" " 12 "
III (294)	14th "	32 . . . . .	Fair result in 3 "

*III. Cases aspirated during the first 23 days.*

III (295)	3rd day	8, 16th day $\bar{3}$ 32	Poor result in 4 "
III (234)	12th "	4, 23rd day $\bar{3}$ 35	Good result in 4 "
III (218)	19th "	38 . . . . .	" " 6 "
III (278)	16th "	130 . . . . .	" " 6 "
III (399)	1st "	18, 15th day $\bar{3}$ 37	" " 6 "
III (415)	6th "	30, 11th " $\bar{3}$ 12, 22nd day $\bar{3}$ 20	" " 6 "
III (382)	8th "	46, 22nd " $\bar{3}$ 46	Poor result in 8 "
III (417)	18th "	42 . . . . .	Good result in 10 "
III (28)	12th "	49, 16th day $\bar{3}$ 14	Fair result in 10 "
III (132)	3rd "	35, 4th " $\bar{3}$ 14, 6th day $\bar{3}$ 7,	
	20th "	5 . . . . .	Poor result in 10 "
III (162)	4th "	30, 17th day $\bar{3}$ 17	Good result in 5 months

*IV. Cases not aspirated for the first time till the 21st day or later.*

III (245)	21st day	30 . . . . .	Good result in 4 weeks
III (199)	22nd "	57 . . . . .	" " 6 "
III (328)	34th "	41 . . . . .	" " 7 "
III (343)	34th "	39 . . . . .	" " 7 "
III (242)	24th "	31 . . . . .	Fair result in 10 "

Taking only those cases in which a good result was obtained, the following summary shows the advantage of early evacuation of a large haemothorax.

*I. Aspirated during the first week.*

10 cases, average amount withdrawn at one or more aspirations  $\bar{3}$  49. Eight cases (80 per cent.) showed a good result in an average of 5½ weeks.

II. Aspirated during the first fortnight.

5 cases, average amount withdrawn at one or more aspirations  $\bar{z}$  43. 4 cases (80 per cent.) showed a good result in an average of 7 weeks.

III. Aspirated during the first 23 days.

11 cases, average amount withdrawn at one or more aspirations  $\bar{z}$  60.

6 cases (54 per cent.) gave a good result in an average of  $7\frac{1}{2}$  weeks.

IV. Cases not aspirated till 21st day or after.

5 cases, average amount withdrawn  $\bar{z}$  39. 4 cases (80 per cent.) gave a good result in an average of 6 weeks.

It will be noted that the amount withdrawn in the last group was smaller than in the first three.

One other aspirated case was exceptional, as the effusion recurred; that is, a recurrent serous pleurisy was set up. The details are given below in the synopsis of cases (III. 102).

Haemothorax cases aspirated, from 15 to 30 ounces.

I. Cases aspirated during first week.

III (232)	2nd day	20	. . . . .	Good result in 2 weeks
III (309)	7th "	22	. . . . .	" " 4 "
III (317)	1st "	22	. . . . .	" " 4 "
III (394)	7th "	24	. . . . .	" " 4 "
III (406)	7th "	22	. . . . .	" " 4 "
III (202)	4th "	26	. . . . .	Fair result in 4 "
III (163)	4th "	15	. . . . .	" " 4 "
III (325)	3rd "	20	. . . . .	" " 4 "
III (356)	2nd "	16	. . . . .	" " 4 "
III (389)	3rd "	22	. . . . .	Poor result in 4 "
III (136)	2nd "	8, 6th day	15	Good result in 5 "
III (178)	3rd "	12, 6th "	9	" " 6 "
III (151)	3rd "	27	. . . . .	" " 6 "
III (153)	6th "	18	. . . . .	" " 6 "
III (418)	5th "	20	. . . . .	" " 6 "
III (358)	7th "	20	. . . . .	" " 8 "
III (42)	3rd "	21	. . . . .	" " 8 "
III (101)	7th "	26	. . . . .	" " 8 "
III (289)	1st "	22	. . . . .	Poor result in 8 "
III (315)	4th "	18	. . . . .	" " 8 "
III (396)	3rd "	28	. . . . .	" " 10 "

II. Cases aspirated during first fortnight.

III (281)	3rd day	17, 9th day	$\bar{z}$ 13	Fair result in 2 weeks
III (25)	10th "	24	. . . . .	Good result in 3 "
III (271)	7th "	26, 11th day	$\bar{z}$ 4	Fair result in 6 "
III (381)	15th "	22	. . . . .	" " 6 "
III (375)	15th "	18	. . . . .	Good result in 7 "
III (311)	8th "	15	. . . . .	Fair result in 7 "
III (80)	13th "	20	. . . . .	Good result in 8 "
III (395)	4th "	25, 9th day	$\bar{z}$ 17	Poor result in 8 "



III. Cases aspirated during first 28 days.

III (24)	2nd day	15, 18th day	$\bar{x}$ 6	Good result in 3 weeks
III (70)	3rd "	21, 15th day	$\bar{x}$ 18	" " 4 "
III (253)	17th "	21		Fair result in 4 "
III (252)	19th "	27		" " 4 "
III (144)	18th "	18		Good result in 5 "
III (361)	2nd "	21, 28th day	$\bar{x}$ 21	" " 5 "
III (139)	18th "	20, 25th "	$\bar{x}$ 12	" " 6 "
III (172)	16th "	20		" " 8 "
III (258)	10th "	20, 17th day	$\bar{x}$ 22, 22nd day $\bar{x}$ 5	" " 8 "

IV. Cases not aspirated till the 21st day or later.

III (366)	21st day	26	Good result in 6 weeks	
III (159)	21st "	27	Poor result in 12 "	
III (129)	22nd "	20	Good result in 8 "	
III (348)	23rd "	20, 27th day	$\bar{x}$ 22	Poor result in 8 "
III (212)	24th "	28	Good result in 10 "	
III (221)	25th "	28	" " 12 "	
III (308)	25th "	17	Fair result in 7 "	
III (307)	45th "	22	" " 8 "	

Summarized, these cases show that recovery of the lung was delayed in cases not aspirated before the 21st day, though the first 3 classes took on an average about the same number of weeks for recovery.

I. Aspirated during the first week.

23 cases, average amount withdrawn at one or more aspirations  $\bar{x}$  21.

13 cases (56 per cent.) showed a good result in an average of 5 weeks.

II. Aspirated during the first fortnight.

8 cases, average amount withdrawn at one or more aspirations  $\bar{x}$  25. 3 cases (37 per cent.) showed a good result in an average of 6 weeks.

III. Aspirated during the first 28 days.

9 cases, average amount withdrawn at one or more aspirations  $\bar{x}$  28. 7 cases (77 per cent.) showed a good result in an average of 5.5 weeks.

IV. Not aspirated till 21st day or later.

8 cases, average amount withdrawn at one or more aspirations  $\bar{x}$  26. 4 cases (50 per cent.) showed a good result in an average of 9 weeks.

14 cases were aspirated to amounts varying between  $\bar{x}$  5 and  $\bar{x}$  15 during the first 18 days, the average being  $\bar{x}$  9; none were aspirated more than once. 10 cases (71 per cent.) showed a good result in an average of 6 weeks.

The next Table (VIII) shows the number of weeks which elapsed before the physical signs in the lung cleared up in 168 cases, and brings out the advantage of aspirating the large

TABLE VIII.

	Weeks.														average							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16	17	18			
Large haemothorax not aspirated . . . . .	—	1	—	—	2	—	2	5	—	4	1	2	—	1	—	—	—	—	—	1	9	
Large haemothorax aspirated . . . . .	—	—	4	6	1	6	2	2	—	2	1	—	—	—	—	—	—	—	—	—	1	6
Small haemothorax not aspirated . . . . .	1	17	11	19	6	10	7	9	—	4	—	—	2	1	—	—	—	—	—	—	—	5
Small haemothorax aspirated . . . . .	—	3	6	6	4	5	1	7	1	2	—	2	—	—	—	—	—	—	—	—	—	6

Large haemothorax, whether aspirated or not, average of 43 cases in 7 weeks.  
 Small haemothorax, whether aspirated or not, average of 125 cases in 5 weeks.



haemothorax. The small haemothorax clears up well in any case, but the aspirated cases, as noted above, were probably larger than those not aspirated.

*Synopsis of 34 large haemothorax cases (aspirated).*

1. *Cleared up in 1 month or under.*

III (123). Shell fragment penetrating chest, F. B. apparently not retained. Aspirated 30 ounces within first week. Aspirated again 9th day air only. Pericardial effusion which cleared up in 14 days. Admitted 21st day, with slight physical signs. No F. B. by X-ray. Good result in 4 weeks.

III (224). Shell fragment, F. B. retained in R. chest. Aspirated 5th day  $\bar{3}$  36, 8th day  $\bar{3}$  40 (sterile). Admitted 14th day. Diaphragmatic adhesions shown by X-ray 19th day. Good result in 4 weeks.

III (245). M. G. bullet perforating L. chest. Admitted 14th day. Aspirated  $\bar{3}$  30 mixed with air on 21st day. Good result in 4 weeks.

III (264). M. G. bullet perforating R. chest. Aspirated 4th day  $\bar{3}$  5, 5th day  $\bar{3}$  35 (sterile). Admitted 14th day. Slight physical signs for 4 weeks. Probably residual clot.

III (288). Bullet perforating R. chest and retained in muscles of back. Aspirated 3rd day  $\bar{3}$  50. (Sterile) 7th day  $\bar{3}$  40. Admitted 12th day. Good result in 3 weeks.

III (306). Shell fragment, penetrating L. chest. Aspirated 5th day  $\bar{3}$  4, 6th day  $\bar{3}$  30. Admitted 19th day. Good result in 4 weeks, but still slight physical signs, which had cleared up completely when patient was discharged to Command Depot.

III (326). Rifle bullet perforating R. chest. Aspirated 3rd day  $\bar{3}$  52 (sterile). Admitted 8th day with slight physical signs and X-ray shadow. Good result in 3 weeks.

III (388). Rifle bullet perforating chest. Aspirated 2nd day  $\bar{3}$  36 (sterile), 4th day explored without result; admitted 23rd day with no physical signs or symptoms.

III (234). Shrapnel bullet, penetrating both chests and lodged near heart. L. haemothorax small and not aspirated. R. haemothorax aspirated 12th day  $\bar{3}$  4; admitted 15th day with signs of bronchitis L. side. Moderately large haemothorax R. side, with displacement of heart, confirmed by X-ray. Aspirated 23rd day  $\bar{3}$  31 (sterile). Good result in 4 weeks.

III (393). M. G. bullet perforating R. chest. Admitted 10th day, with signs of moderately large haemothorax, but without displacement of heart (confirmed by X-ray). Aspirated 12th day  $\bar{3}$  46 (infected). Good result in 3 weeks.

2. *Cleared up in 1 to 2 months.*

III (77). Multiple small shell fragments penetrating L. chest, some of which were retained in lung. Aspirated 10th day  $\bar{3}$  40 (sterile). Admitted 22nd day with slight physical signs confirmed by X-ray. Good result in 2 months.

III (115). Bullet perforating chest. Aspirated 2nd day  $\bar{3}$  30. 14 days' fever. Admitted with well-marked physical signs 21st day. Good result in 2 months.

III (126). Shell fragment perforating R. Chest. Aspirated 5th day  $\bar{3}$  52 (sterile). Admitted 36th day, no physical signs or X-ray shadow; but movement not good till 8th week.

III (199). M. G. bullet perforating R. chest. Admitted 19th day with signs of large haemothorax (confirmed by X-ray). Aspirated 22nd day  $\bar{3}$  57, with much air. Good result in 6 weeks. Field medical card stated that there were signs of a small haemothorax on 12th day, so that there must have been either considerably more haemorrhage after that date, or a serous effusion. The general condition of the patient on admission pointed to latter explanation.

III (218). M. G. bullet perforating L. chest. Admitted 13th day with signs of moderately large haemothorax without displacement of heart (confirmed by X-ray). Aspirated 19th day  $\bar{3}$  38 (infected). Good result in 6 weeks.

III (228). M. G. bullet perforating L. chest. Admitted 13th day with signs of good-sized haemothorax (confirmed by X-ray). Aspirated 20th day  $\bar{3}$  31 (infected). Good result in 6 weeks.

III (278). Shell fragment penetrating L. chest. No exit wound, but F. B. not seen by X-ray; admitted 10th day with signs of large pneumo-haemothorax and displacement of heart (confirmed by X-ray). 16th day aspirated  $\bar{z}$  130 (sterile). Good result in 6 weeks.

III (328). Shell fragment perforating L. chest. Admitted 19th day with signs of moderate-sized haemothorax without displacement of heart, (confirmed by X-ray), 34th day, aspirated  $\bar{z}$  41 (sterile). Good result in 7 weeks.

III (343). Rifle bullet perforating R. chest. Admitted 19th day with signs of good-sized haemothorax with cardiac displacement (confirmed by X-ray). Aspirated 34th day  $\bar{z}$  39 together with air. Good result in 7 weeks.

III (415). Rifle bullet perforating L. chest. Aspirated 6th day  $\bar{z}$  30 (sterile), 11th day  $\bar{z}$  12. Admitted 17th day with signs of moderate-sized haemothorax with displacement of heart, confirmed by X-ray, 22nd day aspirated  $\bar{z}$  20 (sterile) with air. Good result in 6 weeks.

III (399). Rifle bullet perforating L. chest. Aspirated 2nd day  $\bar{z}$  18. Admitted 12th day with signs of good-sized haemothorax with displacement of heart (confirmed by X-ray). Aspirated 15th day  $\bar{z}$  37 (sterile). Good result in 6 weeks.

### 3. Cleared up in 2 or 3 months.

III (39). M. G. bullet perforating R. chest. 3rd day aspirated  $\bar{z}$  36. Admitted 15th day with signs of small haemothorax in R. axillary region and some displacement of heart (confirmed by X-ray which also showed diaphragmatic adhesions). Friction-sound heard at R. base in 6th week. Good result in  $2\frac{1}{2}$  months.

III (124). Rifle bullet perforating R. chest. Aspirated 7th day  $\bar{z}$  3 (sterile), 9th day  $\bar{z}$  30 (sterile). Admitted 23rd day with signs of a fairly extensive haemothorax, but without complete collapse of lung. Heart not displaced (confirmed by X-ray). Good result in  $2\frac{3}{4}$  months.

III (417). Bullet perforating L. chest and removed from under skin of back. Admitted 11th day with signs of moderately large haemothorax without displacement of heart (confirmed by X-ray). Aspirated 18th day  $\bar{z}$  42 (sterile). Good result in  $2\frac{1}{2}$  months.

### 4. Cases which did not clear up for more than 3 months.

III (102). Rifle bullet retained in L. chest, a little to L. of sternum, opposite 2nd rib. Aspirated 4th day  $\bar{z}$  26. Admitted 15th day, very anaemic in appearance, with signs of a large haemothorax (confirmed by X-ray), and displacement of heart. Aspirated 10th day  $\bar{z}$  70, sterile. Irregular temperature for 40 days. Physical signs cleared up to some extent, but lung did not expand well, in spite of physical exercises, and he remained dyspnoeic on slight exertion. Transferred to convalescent hospital in 2 months, and then again aspirated on 109th day  $\bar{z}$  40, as the physical signs showed re-accumulation of fluid. (This was stated to be 'thick fluid', but it is not clear whether it was altered blood or turbid serum.)

In 6 months movement was very poor, the chest had fallen in, and the breath sounds at L. base were very faint. He was a man of poor physique, and was discharged permanently unfit.

III (162). Shrapnel bullet penetrating L. chest, and removed from beneath clavicle. Aspirated 4th day  $\bar{z}$  30, 17th day  $\bar{z}$  7 (sterile). Fluid clotted imperfectly. Admitted 31st day, with signs of moderate-sized haemothorax without displacement of heart (confirmed by X-ray). Physical signs slight after  $2\frac{1}{2}$  months, chest practically normal in 5 months.

III (266). Shell fragment penetrating lung. Aspirated 2nd day  $\bar{z}$  38, 5th day  $\bar{z}$  24. Admitted 19th day with signs of a small haemothorax (confirmed by X-ray), which did not clear up for  $4\frac{1}{2}$  months.

### 5. Cases in which the date of recovery of lung could not be determined.

III (294). Rifle bullet perforating R. chest. Admitted 7th day, with signs of large haemothorax and displacement of heart (confirmed by X-ray). Aspirated 14th day  $\bar{z}$  32 (sterile). Physical signs had not cleared up in 3 weeks. Transferred to Dartford.

III (295). Rifle bullet perforating L. chest. Aspirated 3rd day  $\bar{z}$  8. Admitted



6th day, with signs of good-sized haemothorax and displacement of heart (confirmed by X-ray). Aspirated 16th day  $\bar{3}$  32 (infected). Temperature irregular till after 2nd aspiration. Heart normal in position, but physical signs in lung still present in 4 weeks. Transferred to Dartford.

III (264). M. G. bullet perforating R. chest. Aspirated 4th day  $\bar{5}$  5, 7th day  $\bar{5}$  35 (sterile). Admitted 13th day, with signs of small haemothorax, without displacement of heart (confirmed by X-ray). Physical signs less marked in 4 weeks. (Later reports not yet received.)

III (382). Shell fragment penetrating R. chest. Signs of pericarditis and large haemothorax. Aspirated 8th day  $\bar{3}$  46 (sterile): 22nd day  $\bar{3}$  46 (sterile). Admitted 33rd day, with signs of large haemothorax and displacement of heart. Explored 25th day, but only a little thick, dark-red fluid obtained (sterile). Still fairly extensive physical signs in 2 months. (Later report not yet received.)

III (132). Shrapnel ball perforating L. chest, and removed from under skin in 2nd left space. Aspirated 3rd day  $\bar{5}$  35, 4th day  $\bar{3}$  14, 6th day  $\bar{3}$  7 (with much air). Admitted 19th day, with signs of a large pneumo-haemothorax, and displacement of heart (confirmed by X-ray). Aspirated 20th day  $\bar{5}$  5 with some air, 49th day explored without result. Physical signs well marked in 2½ months. Was subsequently discharged to Command Depot.

III (28). M. G. bullet penetrating L. chest, and retained in front of 1st dorsal vertebra. Aspirated 12th day  $\bar{3}$  49, 16th day  $\bar{3}$  14 (sterile). Admitted 33rd day, with signs of a small haemothorax (X-ray showed a much greater extent of shadow than was to be expected from physical signs). Aspirated 46th day  $\bar{5}$  2 only (sterile). Probably residual clot. Physical signs had not cleared up in 2½ months, but chest reported normal in 6 months.

III (242). Rifle bullet perforating R. chest. Admitted 11th day, with signs of good-sized haemothorax, but without displacement of heart (confirmed by X-ray). Aspirated 24th day  $\bar{5}$  31 with air (infected). Physical signs persisted for 2½ months, but there were faint breath-sounds and good movement over the small area at the R. base and axilla. (Later report not yet received.)

## (2) *Delayed absorption of haemothorax.*

The following tables show the 'fair' and 'poor' results in haemothorax cases; those in which the last observation was recorded during the first 4 weeks can hardly be considered, as they might well have cleared up completely in average time, but in the remainder some delay beyond the average is certain or probable.

In 26 cases, therefore, there was some delay, and in 7 the delay was considerable.

In the following synopsis the histories of 13 cases are given, in which, although there were signs of a fairly large haemothorax, attempts at aspiration were not successful.

It seems probable that in these cases the haemothorax was partially clotted; the functional recovery of the lung is as follows:

Good result in 2 months	1.
"    "    3	6.
"    "    over 3 months	2.
Fair result in 2 months	1.
Poor    "    2	2.
"    "    3	1.

Of these, therefore, only 1 showed a good result in the average time.

TABLE IX. FAIR RESULTS.

	Weeks.														Delayed	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Large haemothorax not aspirated . . . . .	—	1	1	—	—	—	—	—	—	—	—	2	—	1	—	3
Large haemothorax aspirated . . . . .	—	—	1	1	—	—	—	—	—	2	—	—	—	—	—	2
Small haemothorax not aspirated . . . . .	—	—	1	4	—	2	—	1	—	—	—	—	—	—	—	4
Small haemothorax aspirated . . . . .	—	1	—	6	—	2	2	1	—	—	—	—	—	—	—	—

TABLE X. POOR RESULTS.

	Weeks.														Delayed	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Large haemothorax not aspirated . . . . .	—	—	—	—	—	—	—	2	—	—	—	1	—	—	—	3
Large haemothorax aspirated . . . . .	—	—	—	1	—	—	—	1	—	1	—	—	—	1	—	3
Small haemothorax not aspirated . . . . .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Small haemothorax aspirated . . . . .	—	—	—	1	—	—	—	—	—	1	—	1	—	—	—	6



In addition to the cases in the synopsis, there were 14 cases of small haemothorax in which aspiration was unsuccessful.

These gave :

	Good result under 1 month	4.
	"  "	2 months 5.
	"  "	3 months 3.
Fair	"  "	2 months 2.

The dates of exploration are shown in the following table :

TABLE XI.

<i>Large haemothorax.</i>	<i>Small haemothorax.</i>
3rd day, later, and 21st day.	1st day. 31st day.
3rd day, 11th day, and 22nd day.	2nd day (2 cases).
6th day, 12th day, and 36th day.	3rd day.
7th day, 35th day.	4th day and 23rd day.
10th day, 21st day.	10th day (3 cases).
17th day.	11th day.
18th day.	12th day.
19th day.	13th day.
20th day.	14th day.
26th day (2 cases).	27th day and 34th day.
35th day.	29th day.
36th day.	

In the large haemothorax cases, 5 explored during the first fortnight cleared up in an average of 11 weeks, and 6 explored during the second fortnight cleared up in an average of 12 weeks. 11 of the small haemothorax cases explored in the first fortnight cleared up in an average of 6 weeks, and one of the 2 explored after the first fortnight cleared up in 10 weeks.

Those, therefore, which appeared to become inaspirable early did not take longer to clear up than those in which the evidence of clotting was not obtained till later.

The cell-counts in these cases varied considerably, but will be further considered in a subsequent section. The cells were too few to count differentially in 7 cases (10th, 14th, 18th, 19th, 21st, 36th, and 53rd days). In 9 cases cell-counts were possible, and were as follows :

TABLE XII.

	<i>Endothelial.</i>	<i>Mononuclear.</i>	<i>Polynuclear.</i>
<sup>1</sup> 13th day	50	30	20
16th "	40	40	20
18th "	40	50	10
<sup>2</sup> 21st "	20	30	50
<sup>1</sup> 22nd "	60	30	10
<sup>1</sup> 25th "	10	10	80
<sup>1</sup> 27th "	10	50	40
33rd "	55	40	5
34th "	10	85	5

In 22 cases the fluid was examined for organisms either in France or England, 9 were found infected, and 13 sterile. This is equivalent to 41 per cent., a much higher percentage than that of haemothorax cases as a whole.

<sup>1</sup> These cases also showed presence of organisms.

<sup>2</sup> There were very few cells, and the figures are only approximate.

In a dozen such cases, the majority of which were still in hospital when this Report was written, and thus could not be included in the present series, the pleura had been opened. All but 2 were definitely infected, though not generalized empyemata. The pleura was found full of sticky gelatinous clot and flakes of fibrin with a variable amount of liquid. In some cases small masses of purulent material were found, and in others the fluid and clot were found to contain organisms when examined bacteriologically. Only 3 healed rapidly; one died of general pyaemic infection. In some cases the temperature rose after the operation and only gradually fell as free drainage was established. In one the chest had to be opened a second time owing to re-accumulation of pus. It seems that clearing out an inaspirable lightly infected haemothorax tends to the formation of a definite empyema. Unless, therefore, the temperature shows that considerable septic absorption is already taking place, it may be wiser to leave these cases alone.

*Synopsis of cases of clotted haemothorax.*

III (75). Rifle bullet perforating R. chest. Explored, but not aspirated, in France. Admitted on 16th day, with physical signs of moderate R. haemothorax, with heart displaced. Aspirated on day after admission, only  $\frac{3}{8}$  obtained. Fluid sterile. Apex returned to normal position 25th day, but physical signs did not clear up for 2½ months.

III (76). Rifle bullet perforating R. chest. Admitted 15th day, with signs of large haemothorax; heart considerably displaced. X-ray confirmed findings. Aspirated 19th day, but only  $\frac{3}{8}$  withdrawn. Fluid sterile. Heart did not return to normal for 1 month. Physical signs did not clear up for 12 weeks.

III (79). M. G. bullet perforating right chest and removed from under skin of back. Admitted 17th day, with signs of a large haemothorax and displacement of heart (confirmed by X-ray). Aspirated 20th day, only  $\frac{3}{4}$ . Heart normal in position in 1½ months. Physical signs cleared up in 2 months, but movement still somewhat impaired. Discharged to Command Depot in 3 months.

III (84). M. G. bullet perforating R. chest. Admitted 9th day, with signs of good-sized haemothorax (confirmed by X-ray). Explored 18th day, but only  $\frac{3}{8}$  withdrawn. Fluid sterile, with practically no cells. Physical signs not completely cleared up in 2 months.

III (97). M. G. bullet perforating L. chest.  $\frac{3}{8}$  withdrawn on 7th day and found to be sterile. Admitted 20th day, with signs of large L. haemothorax, heart much displaced (confirmed by X-ray). Explored 26th day, only  $\frac{3}{8}$  withdrawn. Fluid contained staphylococci, a few *B. pyocyaneus*, and diphtheroid bacilli. Heart normal in position in 6 weeks, but physical signs had not cleared up in 3 months, and there was considerable falling in of chest. Was fit for Command Depot in 5 months.

III (121). Shell fragment perforating R. back tangentially and removed in France from exit wound. Broncho-pneumonia in France. Admitted 33rd day, with signs of a large haemothorax (confirmed by X-ray). Heart not much displaced. Explored 35th day, but only small amount of blood withdrawn which was sterile. In 2 months breath-sounds still faint at R. base; air entry not quite normal when discharged to Command Depot in 4½ months.

III (147). Said to be M. G. bullet wound penetrating R. chest, but X-ray showed several small intrathoracic F. B.'s. Admitted 37th day, with signs of moderate-sized haemothorax. Temperature fell to normal just before admission. Explored 26th day, but very little fluid obtained, containing a few polynuclears. Feeble growth of staphylococci. Physical signs had not quite cleared up in 3 months, but had disappeared a fortnight later.

III (167). Wounded by several small shrapnel fragments, which were not seen by X-ray, in R. chest. Contra-lateral broncho-pneumonia in France. Explored



10th day, but only small amount of thick fluid and clot containing *B. aerogenes capsulatus* withdrawn. Admitted 18th day with signs of large R. haemothorax and much displacement of heart. Explored 21st day, but only a little fluid, which did not coagulate and contained no cells or organisms, was obtained. Physical signs had not completely cleared up in 2 months, but were nearly gone in 3 months.

III (194). Shell fragment penetrating R. chest. Small amounts of blood aspirated on 3rd, 11th, and 22nd days in France. Sterile, with no excess of leucocytes. Admitted 30th day, with signs of large haemothorax and displaced heart. Heart not normal in position for 7 weeks. Physical signs still present, with a good deal of falling in of chest in 10 weeks.

III (289). Shell fragment penetrating R. chest 7.5 cm. deep to anterior surface. Aspirated 10 c.c. on 3rd day, later aspirations without result. Admitted 17th day, with signs of a large haemothorax (confirmed by X-ray). Moderate displacement of heart. Aspirated 21st day, but only  $\frac{3}{2}$  of partially coagulable blood obtained. Fluid sterile with few cells. Physical signs still well marked in 2 months.

III (303). Shell fragment penetrating L. chest. F. B. in abdominal wall, L. loin. 7th day explored, sterile. Admitted 24th day, with signs of a large L. haemothorax (confirmed by X-ray), and displacement of heart. Explored in 3 places 35th day without result. Heart normal in position in 5 weeks, but physical signs still present at extreme L. base in  $2\frac{1}{2}$  months, though expansion was good, and patient fit for Command Depot.

III (305). M. G. bullet perforating R. chest, sucking pneumo-haemothorax. 5th day aspirated  $\frac{3}{1}$  with much air: no excess of leucocytes, sterile. 12th day aspirated  $\frac{3}{1}$ . Admitted 24th day, with signs of a large haemothorax and displacement of heart (confirmed by X-ray). Explored 36th day in 3 places, without result. Heart normal in position in 5 weeks. Physical signs cleared up in 3 months.

III (344). M. G. bullet wound perforating R. chest, extensive friction-sounds at R. base during first week in France. Admitted 11th day, with signs of a good-sized haemothorax and displacement of heart (confirmed by X-ray). Aspirated 36th day owing to persistence of physical signs, only  $\frac{3}{2}$  withdrawn. Fluid contained *B. pyocyaneus* and streptococci, a few cells. Heart normal in position, but well-marked physical signs in 6 weeks.

## IX. BACTERIOLOGICAL FINDINGS.

### (1) *Variety of organisms.*

In 80 cases there are notes of the organisms found on culture from fluid withdrawn. 41 of these were resected and drained. 39 recovered without resection.

#### (a) *Resected cases.*

*Streptococci* alone were found in 12 cases, on the 4th, 5th, 6th, 8th, 9th, 11th, 12th, 13th, 14th, 19th, and 38th day; streptococci and staphylococci were found in 3 cases, on the 15th, 17th, and 19th day; streptococci and anaerobes in 1 case on the 6th day; streptococci and pneumococci in 1 case on the 44th day; streptococci and *B. pyocyaneus* in 1 case on the 24th day; streptococci, staphylococci, and *B. aerogenes capsulatus* in 1 case on the 4th day.

In 3 cases more than one examination was made. In the first streptococci and anaerobes on the 13th and 17th day, but P.M. on the 68th day, streptococci only were recovered. In the second case streptococci, *B. aerogenes capsulatus*, and *B. sporogenes* were found on the 4th day, but only the two former on the 26th day.

In the third, streptococci alone were found on the 19th day, and in conjunction with staphylococci on the 24th day.

Thus streptococci were found alone or with other organisms in 22 cases, in all but 6 during the first 3 weeks.

*Staphylococci* alone were found in 8 cases, on the 2nd, 3rd, 7th, 13th, and 31st day, and in 1 case during the 4th and 6th months. In the remaining case the date is not noted. *Staphylococci* and anaerobes were found in 1 case on the 14th day, *staphylococci* and pneumococci in 1 case on the 14th day.

*Pneumococci* were found in 1 case, of which the date is not recorded.

*Anaerobes* were found in 4 cases, on the 2nd, 2nd, 4th, and 13th day.

A large Gram-positive *streptobacillus* was found in 1 case on the 8th day.

In 1 case *B. aerogenes capsulatus* was found alone on the 2nd and 3rd day, and on the 4th in conjunction with pneumococci.

(b) *Non-resected cases.*

*Streptococci* alone were found in 4 cases, on the 15th, 21st, 26th, and 60th days; streptococci and staphylococci in 5 cases, on the 12th, 19th, 22nd, 22nd, and 26th day; streptococci and *B. pyocyaneus* in 5 cases on the 19th, 20th, 24th, 28th, and 36th day; with anaerobes in 1 case on the 13th day; and with *B. pyocyaneus* and *B. aerogenes capsulatus* in 1 case on the 10th day.

Streptococci thus occurred alone or with other organisms in 16 cases, in 9 of these after the first 3 weeks, the latest dates being the 36th and 60th days.

*Staphylococci* were found alone in 11 cases, on the 12th, 12th, 12th, 16th, 20th, 21st, 25th, 28th, 29th, 31st, and 53rd day, with anaerobes in 1 case on the 27th day, and with pneumococci in 1 case on the 22nd day. In 1 case they were found associated with *B. pyocyaneus* and diphtheroids on the 25th day, and in 1 case with *B. pyocyaneus* and *proteus* on the 21st day.

*Anaerobes* were found alone in 5 cases, on the 3rd, 10th, 13th, 16th, and 23rd day.

*B. pyocyaneus* was found alone in 2 cases, on the 13th and 17th day.

*Staphylococci* were thus found alone or in combination in 15 cases, as against 10 instances among the empyemas.

*B. pyocyaneus* occurred in 9 cases, as against one case of empyema, in which it was only found in the fourth week; anaerobes were about equally frequent in both classes. Streptococci were much less frequent in non-resected cases.

(2) *Lightly infected cases.*

In Class II of this series (cases in which an intrathoracic operation or excision of wound had been performed in France), a statement as to the bacteriological findings was recorded in 30, 9 of which were reported as infected (30 per cent.), of these 17 had an intrathoracic operation, with 4 infected cases, and 13



excision of wound only with 5 infected cases. The examinations were in all cases subsequent to the operation.

In Class III (simple haemothorax cases), bacteriological examinations in France or England were noted in 154 cases, 39 of which were found to be infected (25 per cent.).

In 28 cases of both classes, the duration of the fever could be determined, and in 7 others it could not have lasted more than a fortnight. The duration therefore was 14 days or under in 34 per cent., and over 14 days in 63 per cent., averaging in the latter group 29 days, the longest period being 67 days. In one case it was of a recurrent type.

### *Duration of Fever in 39 lightly infected cases.*

#### 1. *No fever after admission to Centre (9 cases).*

III (75). Admitted 15th day, anaerobes reported from France 6th day. Clotted haemothorax.

III (80). Admitted 18th day, anaerobes reported from France 13th day.

III (97). Admitted 19th day. Fluid reported sterile 7th day. Clotted haemothorax. Staphylococci, *B. pyocyaneus* and diphtheroids 25th day.

III (218). Admitted 12th day. Aspirated 29th day, very scanty growth of streptococci and *B. pyocyaneus*.

III (228). Admitted 13th day. Aspirated 20th day, staphylococci.

III (252). Admitted 7th day. Aspirated 19th day, staphylococci and streptococci.

III (304). Admitted 8th day. 13th day explored, *B. pyocyaneus*.

III (344). Admitted 11th day. Bronchitis and pleurisy, explored 36th day, streptococci and *B. pyocyaneus*. Clotted haemothorax.

II (91). Admitted 18th day. Diplococcus reported from France 12th day. Clotted haemothorax.

#### 2. *Not more than 14 days fever (5 cases).*

III (113). 14 days' fever. Two aspirations sterile; 13th day *Staphylococcus aureus*.

III (361). 5 days' fever. Aspirated 2nd day, sterile; 28th day staphylococci.

III (367). 5 days' fever. Small haemothorax, explored 10th day; *B. pyocyaneus*, a few streptococci, and *B. aerogenes capsulatus*.

III (418). 6 days' fever. Temperature practically normal after aspiration. Explored 16th day, staphylococci.

II (124). 4 days' fever. Aspirated 22nd day, streptococci and staphylococci.

#### 3. *Recurrent fever (1 case).*

III (366). 6 days' fever. Temperature then normal till 15th day when slight rise began, and subsequently attained 102.4°. Aspirated 21st day, scanty growth *Streptococcus faecalis*. Temperature normal 24th day.

#### 4. *More than 14 days' fever (22 cases).*

III (139). 31 days' slightly irregular temperature. Aspirated 18th day; a few staphylococci, a few *B. pyocyaneus*, a few *B. proteus*.

III (132). 34 days' slightly irregular temperature. Aspirated several times before admission on 20th day. Aspirated 21st day. *B. pyocyaneus* and a few streptococci (pneumo-haemothorax).

III (137). 18 days' fever. Explored 27th day, staphylococci and very slight growth of *B. aerogenes capsulatus* (small clotted haemothorax).

III (129). 30 days' slightly irregular temperature. Aspirated 22nd day, staphylococci and streptococci, (open pneumo-thorax, plugged at C.C.S.).

III (147). 25 days' irregular fever. Explored 53rd day, feeble growth of staphylococci (pneumo-haemothorax, clotted).

III (161). 25 days' irregular fever. Aspirated twice before admission on 28th day. 4th day streptococci and a few anaerobes, 18th day sterile.

III (167). 21 days' slightly irregular temperature. Explored 9th day. *B. aerogenes capsulatus*, also signs of contralateral broncho-pneumonia. Explored 51st day, sterile (small clotted haemothorax).

III (199). Admitted 19th day with slight fever. Aspirated 23rd day, staphylococci and pneumococci. Temperature normal 24th day (pneumo-haemothorax).

III (212). 37 days' slightly irregular temperature. Aspirated 24th day, streptococci and *B. pyocyaneus*.

III (217). 51 days' fever. Aspirated early in France, explored 31st day. *Staphylococcus aureus*. Bronchitis.

III (242). 27 days' fever, which subsided after aspiration. Staphylococci.

III (253). 16 days' fever. Aspirated 18th day, a few *B. pyocyaneus*.

III (295). 20 days' fever. Aspirated 16th day, staphylococci and *B. perfringens*. Lysis began after aspiration.

III (308). 25 days' slightly irregular temperature. Fell to normal after aspiration, staphylococci.

III (393). 17 days' fever. Aspirated 12th day, streptococci and staphylococci. Temperature rose abruptly after aspiration and fell by lysis.

III (420). 27 days' slightly irregular temperature. Aspirated 2nd day, sterile. Broncho-pneumonia (contralateral) during 1st week, explored 26th day, staphylococci and streptococci (clotted haemothorax).

II (41). 45 days' slightly irregular temperature. Aspirated 6th day, *B. aerogenes capsulatus*, 10th day sterile. History of Bronchitis before admission on 30th day.

II (45). 39 days' fever. Aspirated 2nd day, sterile; 25th day, staphylococci.

II (56). 67 days' fever. Aspirated 9th day in France. Temperature was gradually subsiding, but was not normal till after aspiration 67th day, feeble growth of streptococci. Large pneumo-haemothorax. Laceration of spleen.

II (75). 38 days' fever. Aspirated and found sterile several times during first 3 weeks in France. 28th day aspirated, streptococci and *B. pyocyaneus* (pneumo-haemothorax).

II (128). 47 days' fever. Aspirated 2nd day in France. Aspirated 15th day, streptococci (pneumo-haemothorax).

II (130). 36 days' fever, wound discharging, much pleurisy, explored 12th day, staphylococci (clotted haemothorax).

#### 5. Cellulitis ( 1 case).

II (82). Prolonged fever due to cellulitis of arm, aspirated 22nd day, streptococci.

### X. CELL COUNTS.

Seventy-six cytological examinations of the pleural fluid from 72 patients were reported from France or carried out after admission of the patient to the Centre.

In 50 a full differential count was made, in 26 the cells were either absent or too few for accurate counting, or only a partial report was received.

The earliest differential count was made on the 9th day, the latest on the 67th. The counts, however, showed extreme variation; even when the sterile and lightly infected cases were grouped separately the counts in two cases on the same day after the wound were often quite dissimilar. When the cell counts were grouped in weeks instead of days, and an average for each week taken, a certain broad tendency could be observed, as will be seen in the following Table:



TABLE XIII.

## WEEKLY AVERAGES OF CELL COUNTS.

Week.	Number of Cases.	Sterile.			Week.	Number of Cases.	Infected.		
		Endothelial.	Mononuclear.	Polynuclear.			Endothelial.	Mononuclear.	Polynuclear.
2	8	42	30	28	2	3	30	40	30
3	14	24	48	28	3	7	26	41	33
4	7	29	46	25	4	10	25	37	38
5	5	30	55	15	5	—	—	—	—
6	1	15	80	5	6	—	—	—	—
10	—	—	—	—	10	1	10	10	80

It appears from this Table that in the sterile cases, the polynuclear cells, and to a less extent the endothelial cells, tend to decrease, while the mononuclear cells tend to increase. In the infected cases the polynuclear cells tend to increase, while the endothelial and mononuclear cells tend to decrease.

The cell counts already tabled in the section on inaspirable haemothorax cases do not differ in type from the general average, if the one somewhat doubtful count is excluded.

In the sterile cases, those showing a high mononuclear count appeared to clear up in a shorter time after the date of the aspiration or exploration than those showing a high polynuclear or endothelial count and a low mononuclear count.

In 12 cases in which the mononuclear count was 50 per cent. or over, 11 showed a good or fair result in an average of 24 days, and 1 a poor result in 21 days, 6 had cleared up or nearly so within 15 days.

Four cases in which the mononuclear count was 20 per cent. or under, cleared up on an average in 56 days.

In 7 cases in which the polynuclear count was 50 per cent. or over, 5 cases cleared up or nearly so in an average of 61 days, and 2 showed a poor result in 14 and 75 days.

In 7 cases in which the polynuclear count was 50 per cent. or over, 6 gave a good result in an average of 33 days. One was only observed for 5 days more, and had then partly cleared up.

In the infected cases the results were discordant, the reaction to the presence of organisms being apparently the determining factor in the cell count. In 7 cases with a high polynuclear count only one cleared up within 3 weeks, and 4 which were aspirated or explored later in the course of the case still showed a poor result in 3 or 4 weeks or longer. In these cases the probability of residual clot or fibrinous pleurisy accounted for the persistence of physical signs.

In a few cases an excess of polynuclears was noted during the first week in France, but bacteriologically they were sterile. In the series of counts made at the Centre a polynuclear count of over 50 per cent. occurred in an equal number of sterile and infected cases (8 of each).

In 20 cases no cells or only occasional cells were reported; in

13 the fluid was sterile and in 7 infected. Seven (or one-third) were examples of inaspirable haemothorax. The earliest case was explored on the eighth day, and the latest on the fifty-third day. Only four were found within the first fortnight after the wound.

## XI. GROCCO'S PARAVERTEBRAL TRIANGLE.

In 95 cases of haemothorax the presence or absence of this sign was noted in the reports. In 52 per cent. it was present and in 48 per cent. it was absent. Many of the latter cases were small effusions. It was not noted in any case in which there was demonstrably no fluid. It was, however, no indication of the occurrence or otherwise of partial clotting.

## XII. COMPLICATIONS.

### I. *Pulmonary and Thoracic.*

Bronchitis . . . . .	18 cases
Pneumonia	
Same side . . . . .	2 "
Contralateral . . . . .	11 "
Broncho-pneumonia	
Same side . . . . .	1 case
Contralateral . . . . .	3 cases
Pneumonia and subphrenic abscess . . . . .	1 case
Pneumonia and jaundice . . . . .	1 "
Pleurisy—dry	
Same side . . . . .	27 cases
Contralateral . . . . .	5 "
Both sides . . . . .	2 "
With effusion	
Same side . . . . .	5 "
Contralateral . . . . .	2 "
Pericarditis—dry . . . . .	4 "
With effusion . . . . .	2 "
Haemopericardium and pleurisy . . . . .	1 case
Pericarditis and pleurisy . . . . .	1 "
Adherent pericardium . . . . .	1 "
Dilated heart . . . . .	6 cases
Tachycardia . . . . .	2 "
(Duration 3 months and 5 weeks.)	
Mediastinal abscess . . . . .	2 "
Abscess of lung . . . . .	1 case
Recurrent haemoptysis . . . . .	1 "

(6 months after wound.)

### II. *Abdominal.*

Biliary fistula . . . . .	3 cases
Serous peritonitis . . . . .	1 case
Wound of kidney . . . . .	3 cases
Bruising of kidney . . . . .	2 "



III. *Nerve lesions.*

Brachial plexus . . . . .	20	„
Axillary nerve trunks . . . . .	1	case
Nerve trunks upper extremity . . . . .	9	cases

IV. *Vascular lesions.*

Damage to subclavian artery . . . . .	3	„
Damage to arteries in upper extremity . . . . .	1	case
Femoral thrombosis . . . . .	1	„

V. *Fractures and injury of bones and joints.*

Humerus . . . . .	8	cases
„ partial . . . . .	2	„
Radius and ulna . . . . .	2	„
Radius . . . . .	5	„
Ulna . . . . .	2	„
Phalanges of fingers . . . . .	3	„
Tibia . . . . .	1	case
Fibula . . . . .	1	„
Jaw . . . . .	1	„
Skull . . . . .	1	„
Injury to head of humerus . . . . .	2	cases
Damaged shoulder joint . . . . .	3	„

VI. *Amputations.*

Arm . . . . .	1	case
Thigh . . . . .	1	„

VII. *Miscellaneous.*

Subcutaneous emphysema . . . . .	36	cases
Jaundice . . . . .	1	case
Retention of urine (first few days) . . . . .	2	cases
Multiple arthritis . . . . .	1	case
Multiple wounds . . . . .	4	cases

## XIII. LATE SYMPTOMS.

Nearly all cases of gunshot wound of the chest, except those which are non-perforating, suffer from more or less dyspnoea and pain for a variable period. The dyspnoea, which is noted during the earlier stages while there is still fluid or air in the pleura, is generally more marked in the latter condition; but when the physical signs have cleared up, there is often slight dyspnoea on exertion, which may persist for 2 or 3 months, and is gradually relieved by exercises and graduated route marches. In two cases admitted to the Centre who had been wounded in the chest early in the war and returned to duty, the men stated that severe strain or long and arduous marching caused pain and dyspnoea, but it did not seem to have produced serious disability, as they were only sent to hospital when wounded for a second time in the chest.



The pain is sometimes fairly severe and constant, and is usually felt along the costal margin, radiating downwards into the abdomen, or upwards into the thorax. It has never in our experience caused sufficient disability to prevent a return to duty, though it has sometimes persisted for 3 or 4 months. Diaphragmatic adhesions have been observed in the cases examined by X-rays.

Both pain and dyspnoea are usually attributed by the patients to the retention of a foreign body, but they certainly occur with equal frequency in cases where no foreign body can be demonstrated.

Rather severe dyspnoea has been noticed in a few cases, usually in officers, which persists even on slight exertion for 6 weeks to 2 months. No anatomical cause could be found for this, and it seems probable that it is a neurasthenic condition. It clears up eventually.

The presence of large and deeply adherent scars is a true disability, and is especially noted in empyema cases which have been drained through an incision high up in the chest, near the outer scapular border.

The cases with a foreign body near the heart, or actually in the pericardium, did not present any special symptoms while under observation, but it was considered more prudent to recommend them for discharge as unfit. In one case, however, the patient was sent to Command Depot from a convalescent hospital, but his ultimate fate is not yet known. He was probably still in the depot when the armistice was declared.

#### XIV. TRANSPORT TO ENGLAND.

The great majority of the cases bore the journey extremely well, even those evacuated under pressure during the first week or so. The chief complaint was dyspnoea, owing to the length of time they had to lie flat, and this was most marked in pneumothorax cases, and frequently only slight with even large fluid effusions. We had no direct evidence of increased haemorrhage due to the journey to England, though in a few cases in which there was a moderately large effusion the note made at the casualty clearing station was to the effect that the haemothorax was small. This may have been an error due to necessarily hurried examination, or possibly serous effusion had increased the bulk of the fluid during the week or ten days which elapsed before the patient arrived at the Centre.

The cases which bore the journey badly and arrived more or less collapsed were (1) those suffering from severe septic absorption, (2) emaciated cases with bed sores, who had been long in hospital in France, (3) those with other severe injuries.

Septic cases, such as empyemas which were draining well and in which the temperature had fallen, felt no ill effects from the journey to England.

In no case was the patient's ultimate recovery prejudiced, as far as could be seen, by the transfer to England.

In concluding this Report, I wish to express my acknowledge-



ments for the valuable help I have received from the following Dr. Matthew Young, of the Statistical Department of the Medical Research Committee, who has traced the histories of cases discharged from Command Depots; Professor Walker Hall, who has conducted the bacteriological and cytological examinations at the Laboratories of the University of Bristol; the Medical Officers in charge of auxiliary hospitals who have filled in and returned the forms sent them relative to the condition on discharge of their patients, and especially to Dr. Nesbitt Burns, of Hart House, Red Cross Hospital, Burnham; and W. Croom, Esq., of the Inquiry Bureau, 2nd Southern General Hospital, who has given valuable assistance in tracing discharged men.

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