V.—Analysis of Thoracic Cases Operated on (Recoveries only).—
(Continued.)

twentieth day; Case 21 on the nineteenth; Case 22 on the fifteenth; Case 23 on the thirtieth; and Case 24 on the twenty-first.

Case 25.—Traumatopnoea with hole in lung admitting two fingers. Complete operation. Aspirated. Got up on the thirty-fifth day.

Case 26.—Traumatopnoea with hole in lung admitting two fingers. Complete operation. Aspirated, but leaked pus (staphylococcus) from localized empyema. Was out of bed on the sixty-fourth day.

Case 27.—Traumatopnoea with missile lodged in mediastinum. Complete operation; missile removed from mediastinum. Aspirated. Got up on the fiftieth day.

Case 28.—Traumatopnoea (hole into chest admitting two fingers) and laceration of lung. Complete operation. Aspirated; leaked pus (staphylococcus) from localized empyema; closed completely and spontaneously. Patient was out of bed on the ninety-sixth day.

Case 29.—Traumatopnoea (admitting three fingers); laceration of lung, pericardium perforated. Complete operation; small missile not removed. Aspirated. Got up on the twentieth day.

Case 30.—Penetration of chest and mediastinum; laceration of lung. Complete operation; missile removed from mediastinum. Aspirated; leaked pus (staphylococcus) from mediastinum; closed completely and spontaneously. Got up on the twenty-eighth day.

Case 31.—Penetration of chest; laceration of lung; multiple wounds. Complete operation; multiple wounds excised. Aspirated. Got up on the forty-first day.

Case 32.—Penetration of chest; multiple wounds. Complete operation; multiple wounds excised; amputation of left arm. Aspirated. Evacuated on the thirty-fifth day.

Cases 33 to 36.—Penetration of chest; laceration of lung. Complete operation; missile removed, except in Case 36. Aspirated. Case 33 got up on the fortieth day; Case 34 on the forty-fifth; and Case 35 on the sixty-fifth. Case 36 was evacuated on the twenty-first day.

Case 37.—Penetration of chest (through-and-through); laceration of lung. Complete operation on the ninth day, because of *B. perfringens* infection. Infected haemothorax (*B. perfringens* and streptococcus); operation late. Developed empyema after operation; aspirated four times (cultures unchanged). Recovery without drainage. Was out of bed on the fortieth day.

Case 38.—Penetration of right and left chest; mediastinum traversed; missile lodged in heart; right haemothorax. Aspiration of right chest only at first. Later, complete operation on left side; missile not removed. Patient got up on the sixty-fifth day.

Case 39.—Penetration of right and left chest; one large parietal wound; double haemothorax. Complete operation on side of parietal wound. Aspirated. Got up on the forty-fifth day.

Case 40.—Crushed chest, no external wound; four ribs fractured on the left side, and two on the right; left haemothorax. Complete operation, left side. Aspirated; empyema developed. Patient was out of bed on the seventieth day.

Note.—In the Z group the proportion of bomb and shell wounds was unusually high; only two cases were wounded by rifle bullets and two by shrapnel ball. The severity of the group, considered as a whole, was exceptional.

As regards the operations performed, none were left open at operation, except one with extensive gas gangrene of the entire left lung and chest wall. The case was considered absolutely hopeless, but made a good recovery, and has been evacuated with a large opening (2½ in. in diameter) in the chest wall not yet healed.

No case was reopened, but five leaked pus from their incisions—as a rule, at the most dependent part. We believe this was due to localized collection of pus in the pleural cavity adjacent to the incisions, because the lungs as a whole were well expanded.

Spontaneous closure of the sinuses took place without interference with the wound or sinus, except in one case still discharging a little pus at the time of evacuation, and one case—with gas gangrene of chest wall and lung—which reopened completely and died twenty days after operation.

The improvement in results of the abdomino-thoracic operations we believe to be due to the more complete thoracic operation which is being done as part of the combined operation.

All cases in the Z group were anaesthetized with novocain and gas and oxygen (if required), except two (multiple wounds), who had not ether.

In every fatal case complete autopsy was performed, except five in which the lesions of the chest and the accompanying multiple wounds were so gross that there remained little more to expose.

VII.—Empyema occurring in Non-operated Cases.
(Five Cases.)

Case 1.—Penetration of chest, through-and-through (rifle bullet). Patient moribund on admission. Haemopneumothorax aspirated repeatedly; condition scarcely improved. Later empyema developed (streptococcus and staphylococcus). Treated by repeated aspirations. Condition remained very grave. Resection and drainage on the thirty-ninth day. Evacuated (not convalescent) on the forty-seventh day. He reached England and had got out of bed, January 9th, 1918.

Case 2.—Penetration of chest, right and left; fractured ribs both sides, comminuted on right; probable injury of liver (developed jaundice); right haemothorax. Moribund on admission. Developed double bronchopneumonia. The case appeared hopeless and operation impossible, but recovered with late development of empyema (right); cultures sterile! Resection and drainage on twentieth day. Evacuated on the twenty-seventh day, convalescent but still draining.

Case 3.—Small parietal wound of chest; multiple wounds; chest not penetrated. Developed pneumonia with empyema (pneumococcus) on side of parietal wound. Aspirated, and eventually drained without resection of rib. Closed rapidly after drainage. Evacuated, convalescent, on the forty-third day.

Case 4.—Penetration of chest; left haemothorax with active haemorrhage on aspiration. Aspiration repeated with oxygen replacement. Moribund on admission. Developed empyema (staphylococcus); repeated aspirations (280 oz. withdrawn in all). Developed acute parenchymatous nephritis. Empyema cleared without resection; nephritis improved greatly; trace of albumin remained. Evacuated, convalescent, on the eighty-third day.

Case 5.—Penetration of chest, through-and-through; small haemothorax, right. Haemothorax aspirated. Developed double bronchopneumonia and empyema on side of haemothorax. Aspirated; not resected. Died on the twenty-sixth day.

THE TREATMENT OF SEPTIC HAEMOTHORAX
AND EMPYEMA.

By CAPTAIN J. CAMPBELL, R.A.M.C.(S.R.).

Quite a number of cases of septic haemothorax in the early stage can be successfully treated by resection of a portion of rib and careful removal of all fluid and clot, followed by washing out and complete closure of the pleural cavity. On the other hand, a severely septic haemothorax does not yield to such treatment, and frequently leads to death of the patient (50 per cent. of cases) either from septicaemia or general toxic absorption. Short of this unfortunate result, drainage as usually carried out by the insertion of a large tube in the pleural cavity is followed by long severe pyrexia and exhausting suppuration.

The excellent results obtained elsewhere by the Carrel-Dakin method suggested that considerable advantage might be obtained from its use in some modified form in these cases also. Accordingly, I made several attempts to use it in different ways, but found that the most convenient and beneficial method is as follows:

The patient is x rayed, and any foreign body carefully localized. Under a general anaesthetic the wound is explored, the fractured portions of rib resected, and the wound sewn up if its condition allows.

The pleural cavity is then drained in the usual fashion, resecting about three and a half inches of rib as far forwards and as low as possible—that is, usually the eighth rib in the mid or anterior axillary line. Through this opening the cavity is explored, and an easily accessible foreign body and fragments of loose bone lying in the cavity or on the surface of the lung removed. Blood clot and fibrin are swabbed out as far as possible, and any septa forming loculi broken down. The cavity is next washed out with a warm mixture of hydrogen peroxide and ensol, or Dakin's solution. A rubber tube of a quarter of an inch internal diameter, with a large lateral opening a quarter of an inch from one extremity is then inserted, so that this end lies in the most dependent part of the pleural cavity when the patient is lying on the normal side—that is, in the costo-vertebral recess behind the pericardium. Finally, the wound is loosely sewn up, but no attempt is made to effect an airtight closure round the tube.

When the patient has recovered from the operation, the size of the cavity is estimated by filling it carefully (but usually incompletely) with warmed Dakin's solution, and then emptying it. After this the cavity is filled through the

tube every four hours to about one-third of its capacity or less with Dakin's solution. At the end of two hours another long tube is attached to the tube in the chest and the fluid siphoned out, the patient meanwhile lying on the sound side with the chest opening uppermost, or as nearly so as possible. The patient is told to pant or cough slightly at frequent intervals as long as the fluid remains in the chest, and by this means splash the fluid about inside the cavity, and so bathe with it the entire infected surface and any recesses that may exist.

In this way the pleural cavity contains for two hours a large quantity of sodium hypochlorite solution and is more or less empty for a like time. During the former period the patient lies rigidly on the sound side, without any raising of the shoulders, to prevent escape of the fluid and consequent flooding of the bed; during the latter he is free to lie as he chooses. Thus the patient gets a reasonable amount of rest and comfort and is saved the exhaustion associated with the maintenance of one constant position. In addition, once daily, the tube is removed, sterilized, and replaced, and the cavity washed out as in the usual treatment for empyema. To overcome the disadvantage of injecting cold fluid into the chest, I have found that it is better to make the Dakin's solution of double strength and, prior to filling, to dilute it with an equal quantity of warm sterile water.

If the original wound and site of fracture lie sufficiently far forwards, advantage is taken of this site for the insertion of the tube.

Sometimes difficulty is met with in siphoning out the fluid; this may be due either to the tube that is connected to the tube in the chest not being first filled with liquid or else to air being unable to enter the pleural cavity; in the latter case, it is well to slip an open-ended Carrel tube into the chest alongside the first. When this is done I use the smaller tube for filling up the pleura, as then the liquid cannot be injected too quickly.

When treatment is carried out in this way, it is found that pus formation and offensive odour largely disappear at the end of thirty-six hours and are absent at the end of three to four days; the patient's tongue becomes clean and moist almost at once; delirium and emaciation, so frequently seen in these cases, are absent, and the temperature and pulse rates fall much more rapidly than usual; indeed when looking at them, it is hard distinguish these cases from those that are not infected.

If pus continues to form under this method of treatment, it appears to be due to one or more of the following causes:

1. The Dakin's solution is not of proper strength or is used in insufficient quantity.
2. The cavity is not regularly filled and emptied.
3. A loculated cavity exists which the fluid does not reach.
4. A foreign body or loose bone fragments still remain in the pleural cavity.
5. Sloughing or abscess formation is taking place in the lung substance.

After using this method of treatment on a number of cases I have found that it is superior to other methods of treatment that I have tried. The benefit derived from it can easily be demonstrated by the rapid diminution of the number of organisms per field of the microscope in films made from the surface of the pleura. By this method, too, it is comparatively easy to raise the pleural cavity to "suture standard" and sew up the wound at an early date, with the result that lung expansion becomes more perfect and pleural thickening is largely avoided. I think another great advantage is that cross infection of the empyema cavity from without is avoided.

It is only recently that vitiligo, or leucoderma, has been associated with syphilis. E. M. Auer (*Amer. Journ. Med. Sci.*, Phila., 1917, vol. cliv, pp. 592-596) gives about a dozen references from literature to this subject, and quotes Zelenev's analysis of 52 cases of leucoderma with the conclusion that, etiologically, they fall into two groups—tuberculous and syphilitic. Auer also reports four cases of leucoderma in patients with late syphilitic lesions of the central nervous system, and draws attention to the early appearance of leucoderma as compared with the other symptoms; he points out also that the symmetrical and segmental distribution of the areas of leucoderma suggests a lesion of the central rather than of the peripheral nervous system.

THE ENDOTOXIN OF THE MENINGOCOCCUS

A METHOD OF EXTRACTING IT FOR THE PURPOSE OF STANDARDIZING ANTIMENINGOCOCCUS SERUM.

BY

M. H. GORDON, C.M.G., M.D.,

TEMPORARY HONORARY LIEUT.-COLONEL R.A.M.C.

(From the Central C.S.F. Laboratory, London.)

Few who have studied acute cases of cerebro-spinal fever during an outbreak can fail to be impressed by the potency of the toxin of the meningococcus, and if the observer is a bacteriologist he may be struck also by the relative infrequency with which this micro-organism is to be cultivated from the blood of the patients. Although the meninges are one of the chief sites of infection, a further feature of the disease that calls for notice is the relatively large number of pus cells that it may be necessary to search in film preparations of the cerebro-spinal fluid before one is found that contains meningococci. While there are occasional and striking instances in which the meningococcus is detected in large numbers in the cerebro-spinal system, or in the blood, in many cases of cerebro-spinal fever actual proliferation of the meningococcus in the tissues of the patient appears to be limited. Nor is this relatively restricted proliferation apparent only in cases that recover; even in fatal cases bacteriological investigation after death may reveal that the degree of meningeal suppuration is out of all proportion to the number of cocci present either in films or cultures of the meningeal exudate. There is little doubt that this limited proliferation of the meningococcus is often apparent rather than real, owing to the autolytic tendency of the coccus as well as to the lytic action of the secreted body fluids, both of which tend to liberate its endotoxin. In this relation it is of interest to recall that during the classical researches in course of which he reproduced the essential lesions and symptoms of cerebro-spinal fever in monkeys, and studied the fate of this micro-organism when introduced into the peritoneal cavity of guinea-pigs, or into the spinal canal of monkeys, Flexner observed this same point, and remarked that multiplication on the part of the cocci is not at all essential to the production of the peculiar symptoms and lesions: the meningococcus causing death by a poison liberated from the bacterial bodies.

For the purpose of comparing the pathogenic value of the meningococcus when alive, and when all chance of proliferation is eliminated, a series of experiments has been undertaken, and is still in progress, at the Central Cerebro-spinal Fever Laboratory. In the first place, three specimens of meningococcus were selected of definite pathogenicity to the mouse when introduced alive into the peritoneal cavity of that animal; and the effect on their individual pathogenicity was determined by killing the coccus by ether and then evaporating the warm broth suspension containing it to dryness *in vacuo* at 37° C. A series of falling doses of the suspension of living cocci was injected intraperitoneally into mice, and then duplicates of these doses were etherized, dried *in vacuo*, and next day (or later) redissolved by grinding up in distilled water, and, cultures having been taken to prove that the meningococcus was dead, injected intraperitoneally into mice. Proceeding in this way, it was found that, in the case of two of the meningococci, the coccus was fatal to the mouse in a smaller dose when alive than when killed in the manner described. In the case of the third meningococcus, however—which was a specimen of Type II recently isolated from a rapidly fatal case of cerebro-spinal fever—the coccus was fatal to mice in the same dose when killed, dried, and dissolved in the manner described, as when alive. While it would appear, therefore, that in the case of this particular meningococcus the endotoxin was either exceptionally potent, or more easily extracted than usual, the observation nevertheless furnishes a striking illustration of the great pathogenic importance of the endotoxin of this micro-organism.

It is generally agreed that exotoxin is not formed by the meningococcus in culture. On several occasions virulent specimens of the meningococcus have been cultivated at the Central Laboratory, in flasks of broth enriched by horse serum or by diluted rabbit's blood, and after incubation at 37° C. for a time, varying from a fortnight to a month, a portion of the broth was removed, the cocci contained by