evacuated. The lung was not damaged. The chest was closed without drainage.

Aspiration was performed on November 20th, 24th, and 30th. On the last occasion pus with faecal odour was evacuated. Aspiration was performed again on December 1st, and on December 12th he was admitted to a general hospital. He was very upset by his journey from the casualty clearing station, and was received in a state of collapse. There was an obvious empyema. The thorax was reopened, Tuffier's spreader inserted, pus evacuated, and adherent and collapsed lung stripped from the paravertebral fossa. Considerable immediate expansion of lung occurred. A silver irrigation cannula was placed in position anteriorly. The thoracotomy wound was tightly sutured around a long drainage tube. The patient was propped up in bed on a bed-rest, the drainage tube passing out through the dressings between the bands of the bed-rest into a bottle. The pleural cavity was irrigated every two hours with dichloramine-T, 3 per cent., through the silver cannula.

From the beginning there was very little discharge. The dressings were not disturbed for five days; the wound was then healed except at the point of exit of the tube. The dressings remained dry until the large tube was removed on the eleventh day and replaced by a smaller one. The silver cannula was removed and reinserted from time to time. The patient's general condition rapidly improved; the temperature, after some oscillations, fell to normal.

On December 29th, 1917, it was noted that the right lung was markedly expanded, and that breath sounds were heard down to the level of the tube. After the silver cannula was removed the small remaining cavity was irrigated through a Carrel tube inserted through the drainage aperture.

The further progress of this case was uneventful. A note received early in February, 1918, was to the effect that his general condition was excellent, and the lung completely expanded; a small sinus remained at the site of drainage.

CASE VIII.—Chronic Empyema: Repeated Thoracotomy: Stripping of Lung.

Pte. J. M. L. was wounded by a piece of shell on October 25th, 1917. The missile passed into the left chest and penetrated the diaphragm. Thoracotomy was performed at the casualty clearing station, the diaphragm sutured, and the chest closed. Laparotomy was performed, but no intra-abdominal lesion detected. On November 5th 1½ in. of rib was excised and a fragment of shell removed from the pleura. The cavity was washed out with flavine and closed without drainage. On November 9th 2 in. of rib were resected and one pint of stinking pus evacuated; drainage. On November 13th 2 in. of the third rib were removed. A cavity containing serous fluid was opened, washed out, and closed. A note on November 28th stated that the left lung was completely collapsed, and that the tube drained a large cavity.

When admitted to a general hospital on December 1st there was a large quantity of discharge and the lung was collapsed. X-ray examination showed a small fragment of shell lying beneath the inner end of the clavicle. Culture yielded streptococci, staphylococci, and coliform bacilli. Thoracotomy was performed by Major J. H. Cobb through the old wound over the seventh rib, the cavity wiped out, and adherent lung stripped; some immediate expansion occurred. A silver irrigation cannula was inserted.

On December 31st, 1917, there was practically no discharge from the cavity, but it was still of some size, and extended upwards towards the clavicle. Some expansion of the lung had occurred. The general condition was very markedly improved.

A further note of this patient's condition was received in February, 1918. He was very well, and the lung was completely expanded; a small sinus remained at the site of the first operation.

It is extremely important in every case of chronic empyema to have a radiograph of the chest taken, not only to discover the presence of a missile, but to exclude the possibility of a lost drainage tube. On three occasions in the last six months I have removed a lost drainage tube from the chest; one case was one of my own. An infected haemothorax was drained after resection of a rib under a local anaesthetic. The tube was secured to the skin by two silkworm-gut sutures. The following day it was missing. A radiograph showed it to lie inside the chest, whence it was easily removed. In another case (a man evacuated from a casualty clearing station, and put off the ambulance train as unfit for further transport) the patient complained of great pain in the chest. Five inches of half-inch drainage tube with a safety-pin attached was extracted from the pleura. Both these cases did well.

In another case a drainage tube was removed from the track of a missile through the substance of the upper lobe of the right lung. It had probably been lost for several days. This patient ultimately died from gangrene of the upper lobe of the lung.

The question arises whether it would not be better to provide adequate drainage and to sterilize the cavity by irrigation before separating the adherent lung, which could be done at a later stage. In very septic cases, in

exhausted and debilitated individuals, and in patients with signs of incipient amyloid disease, this would no doubt be the better course.

The Late Removal of Foreign Bodies from the Lung and Pleura.

If an operation is performed for infected haemothorax or empyema the foreign body, whenever accessible, should be removed if the patient's condition will permit it.

CASE IX.—Removal of a Foreign Body in the Absence of Sepsis.

Pte. C. W. was wounded on October 8th, 1917, by a piece of high explosive shell which entered the left chest close to the nipple.

On October 14th he was admitted to a general hospital. The note stated that he had had a pneumothorax on the left side, but no active treatment had been necessary. His general condition was good. X-ray examination showed a foreign body—a long, ragged piece of shell—in the lower lobe of the left lung.

On October 25th thoracotomy was performed, 4½ in. of the eighth rib being resected. Tuffier's spreader was inserted. The foreign body was felt in the lower lobe of the lung; the lung was incised, and the foreign body extracted. The wound in the lung was sutured. Complete collapse of the lung was prevented by adhesions. The patient was not at all disturbed during the operation, the pulse remaining quiet throughout. The wound was completely closed by suture in layers—pleura, muscles, and skin.

On November 16th he was evacuated to England. The wound had healed by primary intention, the lung had expanded well, and his general condition was excellent.

The question of the necessity of removing the foreign body in such a case as this has still to be determined. I have heard it seriously advanced by an administrative officer that any foreign body, however small and wherever situated, should be removed from the chest, for the reason that no man who knows he has a foreign body in the chest ever goes back into the front line. The same can probably be said of men upon whom thoracotomy has been performed. There are definite indications—haemoptysis, abscess of lung, etc.; pain and dyspnoea are also indications, but it is not always easy to be sure when these complaints are genuine.

My thanks are due to Colonel T. Gowans for permission to publish the details of the cases mentioned. I am also greatly indebted to Captain T. S. Parkinson and Captain M. J. Stewart for their invaluable assistance.

REFERENCES.

- ¹ Gask and Wilkinson: *BRITISH MEDICAL JOURNAL*, December 15th, 1917. ² Anderson: *Ibid.*, November 3rd, 1917. ³ Roberts and Craig: *Ibid.*, November 3rd, 1917. ⁴ Lockwood and Nixon: *Ibid.*, January 26th and February 2nd, 1918. ⁵ Pierre Duval: *Les plaies de guerre de Poupon*, Paris, Masson et Cie., 1917. ⁶ Gray: *BRITISH MEDICAL JOURNAL*, November 3rd, 1917. ⁷ Bradford and Elliott: *British Journal of Surgery*, vol. iii, No. 10, 1915. ⁸ Rose Bradford: *BRITISH MEDICAL JOURNAL*, August 4th, 1917. ⁹ Campbell: *Ibid.*, January 26th, 1917. ¹⁰ Depage: *Medical Bulletin of American Red Cross Society in France*, vol. i, No. 1; quoted from *Arch. de Méd. et de Pharm. Militaires*, April, 1917.

WAR SCARS AND THEIR PAINS:

WITH SPECIAL REFERENCE TO PAINFUL AMPUTATION STUMPS.*

BY

EDRED M. CORNER, M.C., F.R.C.S.,

MAJOR R.A.M.C.(T.F.).

SURGEON 5TH LONDON GENERAL HOSPITAL, ST. THOMAS'S HOSPITAL, ETC.; CONSULTING SURGEON TO ROEHAMPTON.

CIVILIAN and pre-war scar tissue was made up of fibrous tissue in which there were few foci of round cells and fewer organisms. These round cells represented areas of repair and did not exist for long. In consequence they were of little importance. In war scars all these conditions were increased and exaggerated, the round cells of the inflammation being more numerous and polynuclear, the neighbouring connective tissue cells proliferating and some also becoming oedematous and distended with fluid, whilst organisms, as long as three years after the wound had healed, have been grown from the ends of the nerves in a painful amputation stump. The nerves were removed at operation and dropped straightway into a culture medium. In such ways cultures of staphylococci, colon bacilli and diplococci have

* An address delivered at the Welsh War Hospital, Cardiff.

been obtained. This war scar tissue is, then, an irritant of the first water, containing contracting fibrous tissue, inflammatory foci, varying in number, and pathogenic organisms. It is like a fire, and as the smoke from that ascends the chimney and finds its way through cracks in the bricks where the mortar is bad, so the irritation of this collection of war scar tissue ascends the stump, starting infective inflammation in muscles, arteries, veins, bones, connective tissue, and nerves. There are at least three points of importance here: the pain is of composite origin, the pain need not be of nervous origin, but from the osteomyelitis of bone or the arteritis of an artery, in which case it is folly to confine the treatment to the nerve trunks.

FIG. 1.—An inflammatory focus of round cells from an amputation neuroma.

How do the organisms get up into the painful stump? Do they go by direct extension or are they carried up in the neural lymphatics, like the toxins in a case of tetanus? Some months ago Professor Marinesco and I were investigating the painful nerves of an officer whose arm had been shattered about the elbow, and had been amputated below the shoulder-joint. The amputation wound was well healed, and had been so for some months. No other wound was present. Not until the nerves had been removed and embedded in a paraffin block for section cutting did we discover a macroscopic piece of metal in the nerve, about the size of a pin's head. How did this metal get there? Did it enter the wound near the elbow, had it been blown past the site of the future amputation and ended up in one of the nerves of the future stump, or was it carried up by the neural lymphatic stream?

Then Professor Marinesco and I were often finding dark patches, due to some powder, on our sections, and at first these were regarded as artefacts due to our faults or carelessness, such as dust. However, some were shown to be iron dust. In addition, these powder patches were too frequent to be always our fault. Finally, it was concluded that the powder was shrapnel pulverized by the action of the body juices on masses embedded in the wounds and carried upwards by the lymph stream. Then we found particles of fibres, probably silk, also carried up into the structures, including the nerve ends, in these painful stumps. These particles varied in size and shape, and they were regarded as relics of the fragmentation by the body fluids of silk ligatures afterwards carried away by the lymph stream. Then there were the cultures of organisms.

This train of evidence is enough to teach us of the upward lymphatic stream and the irritative effect of silk; it is a kind of internal seton. That some silk is carried inward by the lymph stream and some is shed outward from abscesses, sinuses, and discharges of the wound, shows that war time scar tissue is utterly unable to encapsulate surely an unabsorbable suture. It should never be used in war wounds. The great pathological characteristic of painful stumps was the presence in them of foreign bodies, usually multiple, some put there by the enemy, and others, perhaps most, by ourselves—such as the silk.

When a nerve is divided it always regenerates. In general it regenerates so as to reinnervate the deinnervated

parts. But if the deinnervated parts have been removed by amputation then the fibres of regeneration seem to innervate all structures they meet—arteries, veins, bones, muscles, and connective tissue. As they do this they sooner or later must come across the inflammation infested scar tissue, when we have the simple algebraical equation:

$$\text{Nerve} + \text{inflammation focus} = \text{pain}.$$

The particular function of the nerve affected—motor, sensory, vasomotor, etc.—does not seem to matter.

To make this worse, as they regenerate the nerve fibres branch and branch, increasing manifold the chances of trouble. No one can do more than delay regeneration, which is like the flow of a river. None can stop it. The lesson is therefore that this war scar tissue must be done away with before, at least, much regeneration can take place. This is to be accomplished by heat, light, x ray, radium, vibration, electricity, and ionization. The duty of carrying it out belongs to a special, not a general, hospital.

Should the regenerating fibres encounter an obstruction, they pool up like a river, forming a tumour—a *regeneration neuroma*. Then they flow on.

If this infective scar tissue is not removed by art or craft, reamputation will become necessary, involving a serious loss of power and usefulness to the patient. This reamputation must be done much higher, as the following case shows: A man had had an amputation just above the knee. He had an obstinately painful stump. I removed the whole contents of Hunter's canal, up which the smoke of irritation had ascended from his wound. The internal saphenous nerve was examined microscopically 6 to 8 inches above the amputation. It showed signs of infective inflammation. It would have been very hard on the man to amputate above the inflammation. Such a case is only too likely to prove unsatisfactory, as there were no clinical signs to guide the surgeon—such as a swollen tender painful nerve. One must never judge harshly. Not all have played games and learned to deny self for the benefit of the whole—true team work. How, then, is such a case usually to be judged? The team who worked on the patient are judged harshly. This should not be.

Often before fitting an artificial limb a stump appears all right. To fit an artificial limb or apparatus is sometimes like putting a poker into a fire. It stirs it up to a blaze, making patent its irritations and imperfections.

In the nerve end the irritation may cause arteritis, endarteritis, phlebitis, lymphangitis, and thrombosis in the intraneural vessels. The irritative process travels up more freely and further along the vessels than along the nerves. The neuromata on the inner side of arm stumps illustrate this. Therefore should the vessels be cut short at every amputation.

A CASE of intussusception in the jejunum 10 inches from its commencement, due to an adenoma of an accessory pancreas, is reported by Benjamin (*Ann. Surgery*, 1918, lxvii, 293). There was a cauliflower-like mass 2 by 1½ by 1 in., projecting from the mucous membrane by a stem. The literature of accessory pancreas is summarized, and 17 other cases in the jejunum are collected from various sources. Though it is recognized that an accessory pancreas by traction may produce a diverticulum of the intestine, it does not appear that an intussusception has been previously reported.

FIG. 3.—The infected contents removed from Hunter's canal.