encephalitis of syphilitic origin. On May 26th, 1913, epileptiform convulsions and coma occurred. May 29th, 0.9 gram of neo-salvarsan was given. Collapse occurred three and a half hours later, and death in four and a half hours.

Analysis showed:

	Milligrams of Arsenic per 100 grams.
Liver	0.8
Kidney	1.0
Bone	0.07
Muscle	0.06
Blood	0.05
Brain	0.02

CASE VIII.—Dog, weight 24 lb. 3 oz. Neo-salvarsan 0.3 gram was given, and the animal killed twenty-four hours later. Specimens kindly sent by Dr. McIntosh and Dr. Fildes. Arsenic (As_2O_3) was found in the organs as follows:

	Milligrams of Arsenic per 100 grams.
Liver	1.0
Kidney	0.4
Muscle	0.08
Blood	0.1
Brain	Trace only
Bone	Trace only

CASE IX.—Specimens kindly sent by Dr. McIntosh and Dr. Fildes. The patient was admitted to hospital suffering from secondary syphilis and acute nephritis on May 27th, 1913. On June 20th 0.9 gram neo-salvarsan was given; no ill effects followed. On June 27th 0.9 gram neo-salvarsan was given. On June 29th there was severe headache; on June 30th restlessness and drowsiness; on July 1st convulsion, coma, and death.

Analysis showed the presence of arsenic in the organs as follows:

	Milligrams of Arsenic per 100 grams.
Liver	0.2
Kidney	1.55
Muscle	0.03
Blood	0.02
Brain	Trace only
Bone	Trace only
Suprarenal gland	? Trace
Skin	Nil
Aorta	Nil

It is interesting to note that in this case, in which acute nephritis was present, a very high relative percentage of arsenic was found in the kidney.

CASE X.—Specimens kindly sent by Dr. McIntosh and Dr. Fildes. An infant, aged 3 weeks, suffering from severe symptoms; there was a marked nummular eruption on the arms and legs, and pemphigus was present on the hands and feet. There was ulceration and discharge from the nose. On March 28th, 1911, salvarsan 0.02 gram was given; on March 30th 0.04 gram; and on March 31st 0.04 gram, on each occasion intravenously. Death occurred on April 1st, 1911.

Analysis showed the presence of arsenic in the organs as follows:

	Milligrams of Arsenic (As_2O_3) per 100 grams.
Liver	0.4
Kidneys	0.49
Spleen	0.39
Suprarenal gland	0.17
Lung	0.03
Brain	Absent

For kindly co-operation and help in the work detailed in this paper we are greatly indebted to Dr. J. McIntosh and Dr. Paul Fildes, of the London Hospital; to Dr. B. H. Spilsbury, of St. Mary's Hospital; and to Dr. A. Fleming, of St. Mary's Hospital, London.

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MAJOR W. L. KELLER, Medical Corps, U.S.A., has, we learn from the *Military Surgeon* for February, sent to the Surgeon-General of the United States Army a communication in which he says that he treated many varieties of sciatica during the past year, and has found no treatment so useful as the injection of novocain into the sacral canal through the hiatus sacralis; 4 c.cm. of a 5 per cent. solution was dissolved in 100 c.cm. of normal salt solution and sterilized by boiling. The patient was placed in the knee-chest position, and the region of the sacrum and coccyx rendered sterile by iodine. A needle from 6 to 10 cm. long, attached to a large glass syringe, was used to inject from 60 to 120 c.cm. of the solution. One injection gave absolute relief in the majority of cases, but three or four might be required. The effect was immediate, and the patient could usually walk without pain or limping when he left the table.

A CASE OF GAS GANGRENE EXHIBITING UNUSUAL PROOFS OF A BLOOD INFECTION.

BY

G. T. MULLALLY, AND J. W. McNEE,
F.R.C.S.ENG., M.D.

CAPTAINS R.A.M.C.

(From a Casualty Clearing Station and a Mobile Laboratory, France.)

THIS case is reported because it presented, in an unusual and convincing way, proofs of the occurrence of a blood infection with gas-forming organisms. No similar case has occurred in our considerable experience of gas gangrene, nor have we heard of any other like it. The essential facts may be given at once:

Private —, Argyll and Sutherland Highlanders, was wounded late at night on March 18th, 1915, by a bullet which entered the right arm, fracturing the humerus. Gas gangrene developed in this wound on March 21st—that is, two and a half days after the injury. As the man passed through a field ambulance on March 19th he received the usual antitetanic injection, below the left nipple, and was thereafter evacuated at once to a casualty clearing station. On March 20th he complained of pain at the site of the serum inoculation, and by March 21st a definite patch of gas gangrene had appeared there. On March 20th, the day after admission to the casualty clearing station, a hypodermic injection of pituitrin was made into the left forearm to combat collapse. By March 22nd the site of this puncture showed also an area of gas gangrene.

From these three places (right arm, left pectoral region, and left forearm) and also from the blood the same type of gas-forming organism was isolated by cultures made on March 22nd. This organism was of the "malignant oedema" type, most of the bacilli showing central spores.

The arm was amputated on March 24th, and the man made a good recovery, being evacuated to the base on March 27th. Subsequently information was received that he made good progress for some time, but later developed "pneumonia," from which he died on April 17th, a month after the original wound.

A brief account of the clinical features and the bacteriological findings are given below, in detail, to complete the record of the case.

The important facts in this case seem to be:

1. The rapid appearance of gas gangrene at three distant sites in the body. It is evident that the slight local injuries caused by the antitetanic injection at the field ambulance and the hypodermic injection of pituitrin at the casualty clearing station, offered suitable foci for organisms circulating in the blood stream to come to rest and develop.

2. Bacteriological evidence was obtained of what had been proved to us in nature—namely, that the gas-forming organisms had invaded the blood stream.

3. The fact that the man recovered from this severe infection sufficiently to be transferred to the base three days after the arm was amputated is in itself remarkable.

Private —, Argyll and Sutherland Highlanders, was wounded in the right arm on March 18th, 1915, and admitted to a casualty clearing station next day. When admitted he was in a state of profound collapse and almost pulseless. The bullet had entered the back of the right upper arm, and emerged in front and to the inner side, making a large ragged wound. The humerus was fractured, and the brachial artery torn across. Antitetanic serum had been injected at a field ambulance before admission. On the following day he was rather better, and the wound was thoroughly syringed out with peroxide solution. Towards evening he collapsed again and became almost pulseless. The wound was dressed, and at this time showed no definite evidence of gas gangrene. Although somewhat delirious, he now began to complain of pain in the left pectoral region, where the antitetanic injection had been given. Next morning a little crackling was felt over this area, but this was at first put down to air having, perhaps, been injected along with the serum. Owing to the collapse, he was given during the night a hypodermic injection of pituitrin into the left forearm. On March 21st his general condition was unchanged, but a large patch of gas gangrene was now evident on the inner side of the right arm and forearm, below the exit wound. Another patch of gangrene was also found on the left side of the chest, including the area of the antitetanic injection. Both gangrenous areas were freely incised and dressed with peroxide solution. The affected area on the chest wall

included skin and subcutaneous tissue only, the structures below the deep fascia not being invaded. On March 22nd he

was not so well, and a further patch of gas gangrene had appeared on the outer side of the left forearm, where the pituitrin had been injected. This new area was incised, and treated as in the other cases. Cultures from all three wounds, and also from the blood, were made on this day (*vide infra*).

He now began to improve, in spite of a certain amount of spread of the gangrenous condition on the left chest into the axilla, which necessitated further incisions. The right arm was amputated above the wound on March 24th, after which the man made a good recovery, being strong enough to be evacuated to the base on the 27th.

The following are the details of the bacteriological examination:

Films were made from all three wounds, and stained by Gram's method. In all the films bacilli of malignant oedema type, showing central spores, were recognized, along with a variety of other organisms. Cultures were made from all three wounds and from the blood in the following media:

1. Shake culture in large tubes of glucose agar.
2. Broth cultures made partly anaerobic by placing a wad of cotton-wool, soaked in a mixture of pyrogallol acid and caustic soda, in the tube below the rubber stopper.

By both of these methods growth was readily obtained of an organism, which later showed central spores, and was morphologically identical with the bacillus of malignant oedema. The same organism was obtained in the cultures from all the wounds, and from the blood as well. As regards the blood, 5 c.cm. of which was used to inoculate the tubes, the broth culture yielded the better result. In all the glucose agar tubes inoculated there was marked production of gas, splitting up the medium.

We are indebted to Major H. Rogers, R.A.M.C., for permission to record this case.

AMPUTATIONS AT BASE HOSPITALS IN FRANCE.

By C. GORDON WATSON, C.M.G., F.R.C.S.,

LIEUT.-COLONEL R.A.M.C.(TEMP.);

O.C. No. 1 RED CROSS (DUCHESS OF WESTMINSTER'S) HOSPITAL.

From time to time letters have appeared in the medical press from surgeons at home criticizing the methods of their surgical *confrères* on this side the Channel, and no small share of this criticism has fallen on the flush amputation. Nevertheless, this method, after a run of eighteen months, is still the operation of choice in the class of case for which it came into use—severe sepsis threatening life. Our methods, especially in cranial and joint surgery, have varied from time to time, and the pendulum has swung to and fro between the radical and conservative, but our methods of amputation in cases of severe sepsis have throughout been governed on "coalition" lines: radical in the relief of sepsis and gangrene, conservative in saving life.

Flush Amputation as a Life-saving Device.

The flapless or flush amputation, the method of Antyllus, was revived in this war as a life-saving device, to deal with a special class of case seldom seen in civil life (emphysematous gangrene), because it was found to be the most efficient method, and not because of the ease of its performance, as some critics have suggested. In dealing with these cases, when amputation is decided on, three main points have to be kept in view:

1. To keep the patient alive during and after the operation.
2. To perform an operation which will check the spread of infective gangrene and prevent septicaemia.
3. To save as much of the limb as possible.

Gas Gangrene in Civil Practice.

In civil practice, amputations for crushed and mangled limbs are usually performed early, before the onset of serious sepsis, and can in most instances be conducted on

orthodox lines, without the prospect of re-amputation. In rare instances, however, acute spreading traumatic gangrene follows rapidly on fractures of the "run over by motor bus" variety. The infection is then usually streptococcal and anaerobic, with the formation of gas. Emphysematous gangrene, once it commences in the damaged tissues, spreads like lightning. Immediate amputation is required to save life, and any attempt to secure primary union will not only be useless but probably fatal. Anyone who has met with a case like this in civil practice must have been profoundly impressed.

Gas Gangrene in Gunshot Wounds.

"Gas gangrene" following gunshot wounds in this war, instead of being a rare occurrence, as in civil practice, is quite common. The onset and progress of the gas distension of a limb which precedes the gangrene is rapid beyond belief, unless seen.

In one case of wound of the thigh under our care, within six hours of the first signs of the onset, gas had extended up to the axilla and down to the ankle.

In another case of a wound in the region of the great trochanter, at 9 p.m. the wound (which had been freely laid open) showed no signs of gas. In under ten hours the man was dead, having suffered much agony, and the opposite thigh, which was uninjured, was blown up with gas to an enormous size.

The toxæmia is so fatal as to be unparalleled. Within a few hours of the onset of physical signs of gas, extensive gangrene may develop in the wounds, and life will hang upon the slender thread of an immediate and rapid amputation, with the minimum of shock.*

As the gas distends the fascial planes, pain becomes very severe, and the limb may swell to an enormous size, but with the onset of gangrene the pain usually disappears. The mental faculties may remain unclouded (despite profound toxæmia) on the very threshold of death.

When infection becomes general, on auscultation, gas may often be heard circulating in the heart, like the sound of a boiling kettle. This gives rise to great distress, and often to a sallow, contorted, almost tetanic facies. Extreme pallor is a marked feature of general infection. This may come on so suddenly as to raise the suspicion of internal hæmorrhage, and I have known a tourniquet applied to a thigh (where there was no wound of exit) until the diagnosis could be cleared up. A general infection is usually fatal from cardiac failure or gas embolism. After death not only the damaged limb but the entire body, including the great veins, liver, etc., may be distended with gas.

With this pitiful picture surgeons in France are only too familiar. Fortunately experience has taught that if the case is seen early the patient, if not the limb, can in most instances be saved. In the earliest stage, when the typical gas odour appears and a few bubbles can be squeezed from the wound, heroic incisions and the freest possible drainage, followed by constant lavage with sodium hypochlorite, will usually succeed; but if the case has come under observation when gas has begun to spread into the intramuscular planes beyond the site of injury and the limb has begun to swell, amputation is imperative. Any attempt to perform a complete amputation (that is, with flaps to cover the bone) must be made through uninfected tissues, which would not be possible in most instances, as the majority of these are thigh cases. Even when the conditions may appear favourable for a primary flap amputation clear of existing infection nothing will be gained by this procedure in the great majority of cases, for the following reasons.

Disadvantages of Flap Amputation.

1. There will be less chance of ultimately saving the patient's life because there will be less chance of checking the infection.
2. There will be more chance of the patient losing his life at the time from shock.
3. For the amputation to succeed it will have to be performed as high or higher in the limb than the second stage of a primary flush amputation.
4. Healing by first intention cannot be expected. (The cases must be seen on the spot to appreciate this.)
5. The risk of secondary hæmorrhage (a very grave danger in these cases) is greatly increased. Since the

* Intravenous ether anaesthesia is invaluable in these cases.