the ligaments is absolutely futile as a mechanical procedure. Natural cicatricial tissue, allowed to mature without being stretched, is the only reliable means of repair.

Fracture of the Spine of the Tibia.

The mechanism of this accident appears to be the following. The knee is subjected to violent torsion, such as might produce a dislocation or rupture of the crucial ligaments; at the time when the force is applied the condyle of the femur grinds across the surface of the tibia, and the sharp intercondylar margin shears off the spine. In some cases avulsion of the spine occurs instead of rupture of the crucial ligaments. The displaced fragment of bone may be lodged in the front part of the knee-joint, and so prevent its full extension. Diagnosis is verified by *x*-ray examination.

Symptoms.—The most constant symptom is a somewhat rigid block to full extension, usually accompanied by pain behind the patella.

Treatment.—If the knee can be fully extended the displaced fragment of bone being presumably pushed back somewhere between the condyles, the knee should be fixed in this position for a long period to allow the torn structures to reunite. On the other hand, if the displaced fragment

FIG. 2.—Showing patella split. A, Femur; B, tibia; C, transverse ligament; D, anterior crucial ligament; E, posterior crucial ligament; F, cut halves of patella.

longitudinally (Fig. 2), but if the *x* rays show that the offending fragment of bone could be reached by an incision at the side of the patella, this is a less severe method of procedure. As I am largely responsible for the split patellar route in dealing with unusual derangements, I am anxious to emphasize that it is only needed in exceptional cases.

THICKENED RETRO-PATELLAR PADS OF FAT.

Almost any injury of the knee which is associated with increased vascularity or bruising may give rise to swelling of the pad of fat situated behind the patellar ligament. Consequently this fat is liable to be nipped in full extension of the knee. In ordinary civil life, this forms one of the varieties of the initial stage of a local monarticular rheumatoid arthritis. The condition, however, is in no sense rheumatic. The patient complains of pain and tenderness in the knee after walking, and especially when going up and down stairs, or when getting up suddenly from a chair after sitting for any length of time. The condition is maintained by the repeated small injuries which occur every time the knee is fully extended. The treatment, therefore, is obviously to prevent the patient from inflicting small bruises on the tender fat and its covering of synovial membrane. This can easily be done by putting a cork pad, half an inch thick, inside the boot under the heel, to prevent the complete extension of the knee during walking, and by fitting the knee with a cage support (Fig. 3), which allows full flexion but limits extension by about 30 degrees. Wearing this boot and cage splint the patient cannot fully extend the joint and in this way bruise the post-patellar fat. The swelling

gradually disappears, and after a few weeks full extension can be performed without pain. The diagnosis of this condition is easy. The patient complains of pain in the knee, or, more often, in the front of the knee, not at the inner side. Passive extension of the knee by the surgeon produces the pain, which is definitely localized just below and behind the patella. On palpation the thickening of the pad of fat may be felt; it is enlarged and tender, but there is no sepsitiveness over the internal cartilage or the internal lateral ligament. In some instances the retropatellar pad of fat may be bruised in common with injury to the semilunar cartilage. The full tender point of the internal lateral ligament, cartilage, and fatty pad will be found in such a case.

In all the injuries of the knee which I have been discussing wasting and weakening of the quadriceps muscle is a characteristic feature, and no treatment can be regarded as sufficient which does not provide for the restoration of the efficiency of this muscle during the stage of convalescence. This is particularly to be noted in the condition which is now under discussion, for some of the deep short fibres of the subcrureus muscle are inserted into the synovial membrane of the joint, and when they contract they draw up the synovial membrane and help to pull the pad of fat out of danger when the knee is extended. Neglect, therefore, of the quadriceps muscle will leave the patient peculiarly liable to a recurrence of the injury.

If the reader has appreciated the regular gradation of disorders of the knee already described, he should have little difficulty in applying and adapting the method of diagnosis and treatment to unusual types which occur as a result of injuries in military service. Even bullet wounds through the joint, which sometimes chip off fragments of bone, can be dealt with on lines similar to those indicated for fractures of the spine of the tibia. The whole question of septic arthritis in and about the joints, with resulting ankylosis, is a larger subject, which cannot be dealt with in the present article.

FIG. 3.—Cage support for knee.

FURTHER OBSERVATIONS ON THE TREATMENT OF GAS GANGRENE BY THE INTRAVENOUS INJECTION OF HYPOCHLOROUS ACID (EUSOL).

BY

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(Report to the Medical Research Committee.)

In the BRITISH MEDICAL JOURNAL (1916, i, 83) we published a series of cases giving the results of treatment of the toxæmia of gas gangrene by the intravenous injection of hypochlorous acid. We have now had further experience of this method of treatment, and we submit the results which we have obtained.

CASE I.

Corpl. G. S. (Chart 1). Admitted January 28th, 1916, at 1.30 a.m., having received a bullet wound of the right forearm on the previous day. On being examined under chloroform at 9 a.m., the arm was found to be extensively infected with gas gangrene. This was spreading upwards along the brachial

artery to beyond the bend of the elbow. The wound was opened up and drained with a rubber tube, and a free incision was made over the brachial artery at the bend of the elbow; 50 c.cm. of eusol were injected intravenously at 2 p.m.

CHART 1.—A, Admission. o, Operation; gas found intravenously at 2 p.m. E, Eusol, 50 c.cm.

CASE II.
Pte. H. (Chart 2). Admitted January 27th, 1916. The patient suffered from a severe compound fracture of the left ankle, the bones being apparently badly damaged; the blood vessels, however, were not specially injured.

He was operated on immediately after admission, when it was necessary to remove a considerable amount of bone. The wound was partly closed with sutures. On the following day the patient's general condition was not good, there being restlessness and irritability, and a slight tendency to rise of temperature. On removing the dressing, the foot was found to be infiltrated with gas, the crepitation being especially marked round the malleoli and the blood vessels. Several sutures were removed and free incisions were made into the gas-infected areas; 25 c.cm. of eusol were given intravenously at 2 p.m.

The patient made a good recovery, there being no further sign of gas production.

CASE III.
Pte. C. (Chart 3). Admitted January 20th, 1916, having received extensive and severe wounds of both thighs two days previously. The condition of the right thigh was especially bad; the femur was probably fractured, and the soft tissues were distended with gas. In the left leg there was a wound of the soft tissues, and this was slightly infected with gas. The

CHART 3.—A, On admission. o, Operation of eusol intravenously, 70 c.cm.

general condition of the patient was unsatisfactory, there being signs of commencing gas toxæmia.

An operation was at once performed, the tissues being thoroughly opened up and drained; at the same time 70 c.cm. of eusol were given intravenously.

The patient made an excellent recovery, and there was no further evidence of gas production subsequent to the operation.

CASE IV.
Corpl. A. Admitted January 24th, 1916, suffering from a penetrating gunshot wound of the head. The temperature was 99.6° F., and an operation was performed at 6 p.m. The fragment of metal causing the condition was, however, not found. Within a few hours the temperature began to rise, until it reached 106.5° F., and the patient died at 4 o'clock the following morning. No eusol was given.

At post-mortem examination it was found that the brain was infected with a gas-producing organism. The gas was accumulating even in the space between the dura mater and the bone. This apparently was the cause of death.

CASE V.
Pte. C. Admitted January 24th, 1916. This man had been severely wounded in the right leg and thigh by a shell explosion, the soft tissues being extensively torn and infected with mud.

The case presented some difficulty, as, although no actual gas production was observed in the tissues, the patient's general condition on the second day resembled the toxæmia we have become familiar with in cases of gas infection. On the night of January 25th, when the patient was almost pulseless, he received, at our suggestion, 50 c.cm. of eusol in 200 c.cm. of saline. He, however, died about one hour later.

On considering this case we have arrived at the conclusion that it was not one of gas infection.

CASE VI.
Pte. D. (Chart 4). Admitted February 20th, 1916. There was a shrapnel wound behind the right knee, and the femoral artery was divided. The leg below the knee was, on admission, greatly swollen with gas. In addition there were wounds of the left leg and buttock, and also of the face and head. The general condition was bad, there being considerable toxæmia.

At 2 a.m. the right leg was amputated at the knee, and 60 c.cm. of eusol were given intravenously. Within six hours of the injection the pulse slowed to 112; at 3 p.m. it was 116. The temperature and pulse now, however, began to rise steadily, and at 10 p.m. the temperature was 103.8° F. and the pulse 140. On the following day the condition was much worse, and at 10 a.m. a second intravenous injection of 60 c.cm. of eusol was given. This was followed by a slight reaction. The temperature rose to 105° F., and the patient died at 6 p.m.

CHART 4.—E, Eusol, 60 c.cm. intravenously.

CASE VII.
Pte. E. (Chart 5). Admitted (under the care of Captain Bates) February 28th, 1916. On admission, there was found to be a bullet wound of the posterior part of the right thigh; this was associated with a compound fracture of the femur, but no large vessel was injured. Though the patient was admitted within four hours after being wounded, the development of gas had begun to be manifest in the wounds.

The wounds were opened up, doused with eusol, and drained. Fragments of loose bone were removed, and several counter openings were made to secure free drainage. The patient had an uncomfortable night, and at 6 a.m. on February 29th the pulse suddenly rose from 92 to 130. There was increasing restlessness and evidence of commencing toxæmia. At 10 a.m. the pulse was 136, and at 11 a.m. free incisions were made and an injection of 60 c.cm. of eusol in saline was given. There was very little reaction after this procedure; the pulse increased slightly, and in the afternoon the temperature was inclined to fall. Throughout the day saline was administered subcutaneously and by the rectum, and adrenalin was given in 10 and 15 m doses.

In the evening the patient was decidedly better, and though the pulse was scarcely perceptible he passed a comfortable night. On March 1st the temperature had fallen to normal, and it was thought that there was a distinct improvement in the general condition. The leg, however, was rapidly becoming gangrenous, and thus the question arose whether it was not advisable to take advantage of the improvement to remove the limb. It was decided to do this. The operation was performed at 11 a.m., and the patient stood it wonderfully well. Within half an hour of its conclusion he was sufficiently recovered to take some stimulant. In the afternoon, however, he collapsed somewhat suddenly, and died at 2.30 p.m.

CHART 5.—o, Operation. 7.15 p.m. m, Hypodermic injection, morphine gr. 1. L, Leg amputated. Saline 3x, C adrenalin m xv. Died at 2.30 p.m.

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CHART 6.

CASE VIII.
Pte. J. F. (Chart 6). Admitted March 7th, 1916, having been wounded by a shell the same day. There was extensive

laceration on the outer side of the right thigh; the femur was fractured, but the large vessels were not involved. The whole wound was infected with gas, and the muscles were crackling with it. There was also already evidence of commencing gas toxæmia.

The patient was operated upon at 5 p.m. on March 7th. The wound was opened up, the bones were placed in apposition, drainage was secured, and the whole wound thoroughly washed out with eusol. Immediately after the operation 75 c.cm. of eusol were given intravenously. There was an immediate reaction; the pulse rising within the following three hours to 140.

On March 8th there was some evidence of gas on the inside of the leg, but no sign of a spreading condition. By 10 a.m. the pulse had fallen to 108, but in the evening it rose again to 140. The limb was dressed every four hours, day and night.

On March 9th the condition in the morning was somewhat better, but during the evening a relapse took place. Sickness came on, and there was suppression of urine. Two pints of saline were administered subcutaneously during the day, and a similar quantity during the following night. The patient received two ounces of champagne every four hours.

On March 10th the condition was much improved in the morning; the temperature fell to normal, but in the afternoon again reached 103° F. The general condition was, however, good. The patient complained of pain in the left axilla, at the site of the last saline injection. On March 11th and 12th the general improvement was maintained, the temperature falling steadily.

On March 13th an abscess in the left axilla was opened, and a quantity of thin, foul-smelling pus was evacuated. Unfortunately, however, by an oversight, it was not examined.

Thereafter the patient made an uninterrupted recovery.

Of these eight cases, three call for special comment. In Case iv, at the time of the operation evidence of the presence of gas gangrene was not present, and therefore treatment by hypochlorous acid was not applied. There is no doubt, however, as was shown by the results of the *post-mortem* examination, that during the ten hours succeeding the operation a gas-producing organism had been at work in the brain. The rapidity of the fatal issue may to some extent be explained by the origination by the bacterial products of mechanical effects such as so frequently play a part in ordinary infections of the brain and meninges. Case v also presents points of interest. Although from the clinical observations the patient's condition suggested a gas gangrene toxæmia, no evidence of infection with organisms of gas gangrene was available, and we are therefore of opinion that some other factor must have been at work in the patient. In Case vii, although death occurred, there was definite evidence that the treatment with hypochlorous acid had a beneficial effect; in fact, it was the improvement which occurred, and which we attributed to the treatment, that led us to undertake the amputation of the gangrenous limb. We are inclined to attribute the death to the shock of the operation which was performed. Looking at the series of cases as a whole, and excluding Case v, where evidence of the presence of gas gangrene was wanting, and Case iv, in which eusol was not given, we found that in four cases where evidence of serious toxæmia existed improvement and ultimate recovery followed the administration of hypochlorous acid. The other two cases resulted in death, but, as already stated, in one of these definite improvement followed on the treatment which was adopted. Thus there remains only one case in which the failure of the treatment has not been explained.

Our further experience of wounds which become infected with the organisms of gas gangrene confirms the view expressed in our previous paper that the absorption of toxic products from the gangrenous tissues constitutes a serious menace to life. The bacteriological data do not as yet justify the position that the earlier symptoms of a general effect on the body are due purely to the absorption of poisons from the original site of bacterial infection. There can be little doubt, however, that the organisms concerned in the disease do produce definite toxins, as has been shown by the work of Weinberg and Séguin and others. Our experience justifies us in saying that the effects of these toxins can be combated by the use of hypochlorous acid, and when neutralization of these effects occurs the patient's body is in a better position to throw off the infection. The recognition that a patient is suffering from the absorption of toxic products to a dangerous degree must obviously rest upon clinical observations, but we think that those who have had experience in the field will admit that the recognition of a danger point in a patient's condition is possible. The appreciation of an improvement in a patient's state must also rest upon clinical experience.

Sometimes it is reflected in a slight rise in temperature, at other times in a rise in the pulse-rate; while in yet other cases an improvement in the general condition and appearance of the patient indicates that the danger from the toxæmia is passing off.

CONVALESCENT PARATYPHOIDAL AND DYSENTERIC CASES CONSIDERED FROM THE PREVENTIVE STANDPOINT.

BY

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(Report to the Medical Research Committee.)

THE period of convalescence which follows acute infections presents many features of interest. It permits an insight into the severity of the infection, exhibits the results of the treatments adopted, and provides an opportunity for detecting the persistence of the infective organism and for the segregation of temporary or possible permanent carriers of the infection.

In this laboratory a number of typhoidal and dysenteric convalescents have been examined during the last eight months, and a record of some of the findings and failures may prove of value to other workers.

The cases grouped themselves roughly into three batches. The first extended from September to December, 1915, and contained some acute and subacute infections. The second covered the period from December, 1915, to February, 1916, and comprised cases of early convalescence; while from February to May the men forming the group were to all intents fit again for work.

The main features may be summarized as follows:

Paratyphoid Convalescents.

	No. of Cases.	Bacilli Present in Excreta.	<i>E. histolytica</i> Present in
Period I	297	3.7 per cent.	—
Period II	156	1.3 per cent.	10.06 per cent.
Period III	217	None	—

Dysentery Convalescents.

Number of cases	...	...	605
Bacilli present in excreta	...	...	1.1 per cent.
<i>E. histolytica</i> present in	...	...	9.68 per cent.

Methods.

The first investigation carried out in each convalescent case consisted of the (1) estimation of the agglutinin content of the blood, (2) the microscopical examination of the stools, and (3) cultural isolation from urine and faeces. In a number of instances blood films were obtained and counted; the results will form the subject of a further paper.

1. The agglutinin estimations furnished data for confirmatory diagnosis and indicated the method of enrichment which should be adopted in the examinations of the excreta. They were carried out to their end titre in each instance and included tests for *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *B. dysenteriae* (Shiga and Flexner types). The macroscopic method and the Oxford standardized emulsions, supplied by the Medical Research Committee, were used throughout. Incubation at 52° C. in a moist atmosphere for two hours was followed by standing at room temperature for twenty hours. The results were then read off and checked by a second worker.

2. The microscopical examination of the stools was carried out on the lines recommended by Wenyon and a record kept of all the protozoal forms observed.

3. For the isolation of bacteria three comparative methods were used:

(a) *Enrichment Period*: September to November, 1915.—The stool was emulsified and added to brilliant-green peptone solutions after Browning and his co-workers, or to dulcitate peptone when the agglutinations indicated a *paratyphosus* B infection. After twelve to twenty-four hours' growth, warmed bile-agar and endo plates were spread. Twelve to twenty-four later suspicious colonies were picked off and transferred to tubes containing glucose, or mannite, lactose, dulcitate, gelatine, milk. Those giving typical reactions twenty-four hours later were agglutinated with specific serums, and when the result