either of the polyvalent variety, or it may be a specific antiserum for the particular causative organism, the latter having first been determined by bacteriological examination.

In conclusion my thanks are due to Dr. J. Menton, director of the Staffordshire County Bacteriological Laboratory, for his kindness in performing the many bacteriological examinations necessary during the course of this case, and for many useful suggestions as to its treatment.

REFERENCES.

- ¹ Simonds, J. S.: Rockefeller Monograph, No. 5, 1915. ² Weinberg and Seguin: *La Gangrène Gazeuse*, Masson et Cie, 1918. ³ Christopher, F.: Gas Gangrene in Civil Surgery, *International Clinics*, 1922, vol. i, p. 129. ⁴ Baldwin and Gilmour: *Annals of Surgery*, vol. 85, p. 161. ⁵ Brickner and Milch: *International Clinics*, 1926, vol. 4, p. 226.

GAS GANGRENE FOLLOWING A MOTOR ACCIDENT.

BY

EDWARD C. ELLIS, M.B., CH.B., D.P.H.ED.,
COCKERMOUTH.

As the opportunity seldom arises in civil practice for observing gas gangrene, the following case is, I think, worthy of record, occurring as it did after a motor accident, cases of which are now so frequent both in town and country districts.

A youth, aged 18, ran into the rear of a motor car, sustaining a punctured wound of the left leg, produced by the projecting arm of the luggage carrier on the car. The head of the fibula was torn away from its articulation, and the arm of the carrier passed through the interosseous space, tearing the tibialis anterior, the extensor digitorum longus, and the posterior tibial vein, to reappear in the calf of the leg. The tibia was not fractured, but the fibula was cracked just below the head. The posterior tibial artery was intact.

On admission to the cottage hospital the wound was enlarged, thoroughly cleansed with hydrogen peroxide, and bruised skin and tissue removed. The posterior tibial vein was ligatured at its commencement, and the muscle and sheaths repaired. The wound was closed anteriorly, drainage being provided through the wound in the calf of the leg. A prophylactic injection of antitetanic serum (1,500 units) was given locally. The limb was cold, but in a few hours became warm and comfortable. Within eighteen hours of the accident a foul acid smell from the leg was noticed and the toes were cold. Twenty-two hours from the time of the accident the whole limb from just below the knee was cold, discoloured, and swollen. The patient was delirious, with a high temperature and a rapid feeble pulse. After consultation, amputation was decided upon and carried out forthwith just below the knee. On cutting the stitches, the underlying tissue was seen to be discoloured and swollen, and the injured muscles were of a dull brick-red colour, and of putty-like consistence. On cutting the muscles, bubbles of gas were seen to escape; gas also escaped from portions of the vein distal to the ligature. The stump was left open and irrigated by the Carrel-Dakin method. The patient had a relapse about a week after the amputation, accompanied by a rise of temperature and delirium, the cause of which is described below. Eventually he made a good recovery.

I am deeply indebted to Dr. J. T. Selby, Cockermouth, and Mr. Richardson, Keswick, by whose courtesy I am able to publish these notes.

Bacteriological Examination.

A small piece of vein and tissue which showed the presence of gas was sent for examination, and the report stated that two types of Gram-negative bacilli were present in large numbers, the one short and plump, the other much larger and exhibiting, in many cases, terminal or subterminal spore formation. Gram-positive cocci were also present in small numbers, chiefly in chains resembling streptococci. The following facultative organisms were isolated from the vein and tissue: staphylococci, *Streptococcus faecalis*, and *B. coli*. A large Gram-positive, pleomorphic, non-motile bacillus (*B. welchii*) was isolated also. No spore or capsule formation could be demonstrated. It was a strict anaerobe, and actively saccharolytic. No *B. tetani* were recovered, nor any proteolytic organisms of the malignant oedema type.

There is no doubt that the emphysematous condition of the wound was due to the activity of the *B. welchii* in the tissues, but additional interest was given to the case because a slough taken from the wound a week after the accident, when the patient had a relapse with rise of temperature, etc., showed on cultural examination the presence of a motile spore-bearing bacillus, which produced acid and gas in carbohydrates, but failed to coagulate milk, and did not liquefy gelatin. It was therefore not a typical organism of the *B. welchii* group, but resembled the clostridium *B. multifementans*. It was not pathogenic to guinea-pigs, but produced in them a large amount of oedema.

The question arose as to where the contaminations had arisen. The road surface had been recently tarred and was comparatively clean, but the patient was wearing his farm trousers, part of which had been driven into the wound. Examination of blood-stained and non-blood-stained portions of the trousers showed the presence of *B. welchii*, *B. coli*, *Streptococcus faecalis*, *Staphylococcus aureus*, and *B. megaterium*, no anaerobes other than *B. welchii* were recovered.

This case is of interest from several points of view. One is the exceedingly rapid onset of gangrene and the presence of terminal and subterminal spore-forming organisms, emphasizing the need for prompt prophylactic inoculation of antitetanic serum in all street accidents; although no typical *B. tetani* were isolated, the inoculation may have inhibited their growth. Secondly, we have the presence of two gas-forming bacilli, the typical *B. welchii* being evident in the region of the wound, while *B. multifementans* was demonstrated in a slough removed a week later.

Furthermore, it points to the advisability of treating all punctured and contused wounds occurring in street accidents and in agricultural districts by open irrigation and dressings, although a somewhat similar case recently treated by primary suture of muscle and sheath resulted in complete functional recovery without sepsis or complications.

My partner, with thirty-three years' experience in an agricultural district, tells me that he has never had a case of gas gangrene, but has had four cases of tetanus. Of these four cases three were punctured wounds: one was an abrasion of the elbow received in a cycle accident; in this case the wound was covered over with adhesive plaster by the patient himself as a first dressing and neglected for a few days; he died. In this district a large number of wounds received by farm labourers and road workers in the course of their work come under my care, and it is only in punctured and contused wounds that any complications have to be feared. Simple incised wounds lend themselves to easy cleansing.

The nidus of infection was here provided by the clothing, and the pabulum for growth by the injured yet viable muscle, assisted by stasis of the circulation and lowering of the temperature of the limb due to shock.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

DIABETES MELLITUS TREATED WITH
GLUKHORMENT.

At the request of the Medical Research Council the clinical effect of a preparation called "glukhorment," introduced by Professor von Noorden in May, 1927, for the treatment of diabetes, has been investigated. It was stated to be obtained by "strong tryptic digestion of fresh pancreas substance," and to contain no synthalin or related guanidine compound. This statement, however, has been shown to be incorrect in the recent article by Drs. Dale and Dudley (*JOURNAL*, December 3rd, p. 1027).

In two cases of diabetes the effect of glukhorment has been observed on sugar and ketone excretion, on the blood sugar concentration, and on the general clinical condition. Four tablets a day were given after meals. In both cases definite reduction of the glycosuria and the blood sugar was obtained without any appreciable effect on the ketosis, weight, or general clinical condition. Similarity in the action of glukhorment to synthalin was at once noticed, in regard to the slow onset of action, its prolonged action after omission, and the production of toxic symptoms of vomiting and depression.

CASE I.

A man, aged 57, a moderately severe diabetic requiring no insulin, was fed beyond his carbohydrate tolerance until a glycosuria of some 30 grams was produced (diet: carbohydrate 140 grams, protein 75 grams, fat 150 grams). Glukhorment reduced his blood sugar concentration slightly and his sugar excretion from 30 to 15 to 10 grams. No nausea or depression was produced.

CASE II.

A girl, aged 11, with very severe diabetes. The dose of insulin was reduced sufficiently to allow glycosuria of about 25 grams. She was receiving 20 units of insulin twice a day and a diet of carbohydrate 60 grams, protein 60 grams, and fat 100 grams, throughout the test and for ten days previously. She had been in coma five weeks before, and I think her metabolism was not entirely stable and her carbohydrate tolerance still improving slightly at the time of the experiment. Four tablets of glukhorment a day produced vomiting on the third and fourth days, and the sugar excretion fell from 25 to 1 or 2 grams. The number of tablets was reduced to three for two days, after which she again tolerated four without nausea or vomiting; the glycosuria remained low, and the blood sugar was reduced. On omitting