this particular method no local treatment was applied to the ulcer, the eye merely being kept clean with simple antiseptic lotions. After a month's treatment the glands had become very much smaller, and those that were breaking down were hard. The conjunctival ulcer was cleaner and smaller, whilst the remainder of the conjunctiva showed obvious improvement.

Light treatment was continued, and in four months no trace remained of either the ulcer or the lymphatic involvement. The child's general condition had improved out of all recognition.

This is the only case of tuberculous conjunctivitis that has been subjected to light treatment, but the result is extraordinary when it is remembered how very unsatisfactory treatment has usually been in these cases.

Tuberculous Keratitis.—In a case which was probably tuberculosis of the cornea, occurring in a child aged 10, in which there were present a small central corneal ulcer, with grey infiltrations in the substance of the cornea, iritis, and enlarged cervical glands, the tonsils and adenoids were first dealt with, and subsequently ultra-violet light was used as an adjuvant to local treatment. The progress was slow, but there was a gradual and very marked improvement in the child's general condition, which we had not been able to obtain by any of the usual methods of treatment. The enlarged cervical glands have disappeared, and except for some corneal scarring the eye has cleared up and remains quiet.

Injuries to the Eye.—Ultra-violet light appears to be useful for cases in which the eye remains irritable after an injury, particularly if the cornea has been involved.

In one patient, a young adult who had lost one eye in childhood and received a severe injury in the other by an explosion of a detonator, ultra-violet light was tried after all local treatment had failed to allay a mild iritis and vesicular condition of the cornea. In spite of treatment the patient's general condition had been below par after the accident. He responded splendidly to ultra-violet light, the eye became quiet, and the improvement in his general health marked. The use of light seemed to give this patient just that improvement in his general condition which we had not been able to attain with other methods.

There is no doubt that ultra-violet light is of considerable value in dealing with many ocular conditions seen in children. The progress of the eye depends very largely on the condition of the child's general health, and it is in this direction that we have found ultra-violet light very helpful. Used in suitable doses it will certainly give good results where other methods have failed, but patience is needed by the operator and patient, nothing being gained by trying to speed up recovery by big doses. Nor is it a "cure-all" in diseases of the eye; further work will, no doubt, very soon show us the type of case in which we may or may not expect good results.

GAS GANGRENE FOLLOWING A MOTOR ACCIDENT.

BY

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CASES of gas gangrene are comparatively rarely met with in civilian surgical practice, and the following case is therefore thought worthy of record.

A strong healthy youth, aged 19, employed as a gardener, was admitted to the Lichfield Cottage Hospital on July 23rd, 1927, with a history of having been knocked off his bicycle by a motor car.

On examination there was a transverse laceration, about two inches long, of the left shin in its lower third; it exposed a portion of the tibialis anticus, which was lacerated. There was also a piece of skin, about the size of the palm of the hand, missing from the outer aspect of the left ankle, and the extensor tendons were thus exposed. Both wounds were ingrained with road dirt.

Under a general anaesthetic the wounds were cleansed by means of biniodide solution and a scrubbing brush, and were then swabbed with spirit. The wound edges and all obviously dead tissue were excised and a glove drain was inserted into the shin wound. Antitetanic serum, 1,500 units, was given.

At 10 a.m. on July 25th the temperature was 101° F. and the wounds were very painful, although their outward appearance was much as before. Swabs were taken from the shin wound, for bacteriological examination, and the leg was dressed again. At 7 p.m. on the same day the temperature had risen to 102° F. and the inner side of the leg was swollen and brawny. Slight crepitus, as of surgical emphysema, was noted, just above the internal malleolus. Under general anaesthesia a long incision was made on the inner aspect of the leg, dividing the skin and subcutaneous and deep fascia. Carrel's tubes were inserted, and Dakin's solution was subsequently injected every two hours.

On the morning of July 26th the patient was somewhat better.

The wounds, however, looked unhealthy, and the bacteriological report was that the swabs yielded a profuse growth of *B. welchii* and *B. pyocyaneus*. At 7 p.m. his condition was much worse. The temperature was 101° F., he was looking very toxic, and both the inner and outer aspects of the leg were swollen, brawny, and acutely tender. There was a peculiar sour odour from the wound.

The patient was therefore anaesthetized, and the wound previously made was extended. The muscle was brick red and very friable, and on squeezing bubbles of gas could be expelled. All infected muscle was therefore excised. A similar knee to ankle incision was made on the outer side of the leg, down to the muscle, a portion of which was excised. The wounds were swabbed with hydrogen peroxide and Carrel's tubes inserted; 30 c.cm. of anti-gas gangrene serum were given intramuscularly.

On the following day he was much better; 60 c.cm. of anti-gas gangrene serum were given.

On July 28th he was still improving, and a final dose of 30 c.cm. of serum was given. The wounds were still very offensive and were covered by greyish-black sloughs. They were being swabbed with hydrogen peroxide twice daily, and Dakin's solution was being injected through the tubes every two hours.

On July 30th he was still doing well, and a second dose of antitetanic serum was given. Bacteriological examinations showed *B. welchii* and *B. pyocyaneus* to be still present.

On August 5th both wounds were comparatively clean and granulating, and a bacteriological examination on August 8th showed a profuse growth of *B. pyocyaneus*, but none of *B. welchii*. The wounds were being swabbed daily with hydrogen peroxide and dressed with gauze soaked in Dakin's solution. The Carrel's tubes were removed, as they were becoming embedded in granulation tissue.

On August 31st both wounds were covered with Thiersch skin grafts obtained from the thighs. They subsequently did very well, and on September 22nd, as they were almost healed, the patient was allowed to get up.

The serum used in this case was supplied by Messrs. Burroughs Wellcome and Co., and I am informed by Dr. R. A. O'Brien of the Wellcome Research Laboratories that "it contained a large amount of *B. welchii* antitoxin and probably a small amount of *B. tetanus* antitoxin, but it was not the polyvalent antitoxin against *B. welchii*, *Vibrio septique*, and *B. oedematiens* which was used during the war."

The literature on this subject previous to the war period is somewhat scanty. Simonds¹ in 1915 collected 175 cases from the literature, 111 of which were classified as follows: Compound fractures 61, lacerated wounds 20, operation wounds 11, gunshot wounds 10, and hypodermic needle punctures 9. It will be seen that in this series compound fractures and lacerated wounds form at least 46 per cent. of the cases.

The most authoritative contribution to the subject covering the period of the war appears to have been made by Weinberg and Seguin,² who produced the condition experimentally in the guinea-pig, and definitely established the anaerobic group of organisms—of which *B. welchii*, *B. oedematiens*, and *Vibrio septique* are the chief—as its cause. They advocated serotherapy in the treatment of the condition, but insisted that radical surgical measures must also be taken, and all diseased tissue thoroughly excised.

In civilian practice Christopher³ reported nine cases from the literature, covering the period 1915-22; they were all traumatic in origin. Baldwin and Gilmour⁴ collected 64 cases by twenty-six authors, during the period 1922-27. Of these, 26 were traumatic in origin, 20 complicated obstetrical and gynaecological states, and the remaining 18 belonged to that class in which the causative organism had been derived from the patient's own intestinal canal. These authors also record two personal cases, each due to *B. welchii*, and each treated energetically by anti-gas gangrene serum and by appropriate surgical procedures. In each case the end-result appears to have been excellent.

Brickner and Milch⁵ report three fatal cases, from two of which *B. welchii* was isolated, and in the third *B. subtilis* was identified. In each case a tetanus-perfringens (Welch bacillus) serum was given in large doses and radical surgical procedures instituted.

It would seem, then, that our best hope in dealing with this condition depends on three main factors. (1) Early diagnosis is, of course, essential; (2) it is necessary to adopt the operation of épluchage, as developed during the war—that is to say, the excision of all contaminated tissue regardless of the amount of mutilation caused; (3) the condition appears to some extent controllable by the early and energetic use of antitoxic serum. This serum may be

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.

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GAS GANGRENE FOLLOWING A MOTOR ACCIDENT.

BY

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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