My colleague, Mr. Woodman, made a thorough examination of the nose and accessory sinuses. Transillumination showed nothing pathological, and there was no evidence of any intranasal disease. The pharyngeal ends of the Eustachian tubes were enlarged and oedematous. A radiograph showed nothing definite, but the orbital roof on the right side was not as well defined as on the left.

There was a faint haze of albumin in the urine. The Wassermann test was negative. The pulse-rate was normal, but fell once after admission to 64. The temperature on admission was 99.4°, and afterwards fluctuated between 97° and normal. He was admitted with the diagnosis of orbital growth, probably sarcoma growing from the region of the sphenoid.

There was never any sickness nor complaint of any headache. He died on November 5th with typical respiratory failure. For about forty-eight hours before death he was rather peculiar mentally, and got up during the night and wandered about the ward. He never displayed any general symptoms to suggest intracranial trouble.

Post-mortem Examination.

I was present at the *post-mortem* examination, which was made by the pathologist, Dr. L. Walker. No abnormality was found apart from the central nervous system and orbit. The meningeal coverings over the orbital surface of the right frontal lobe of the brain were almost a quarter of an inch thick. The membranes were vascular and adherent both to the brain and roof of the orbit. The bone here, as well as in the neighbourhood of the nasal sinuses, was eroded, soft, and friable, being largely replaced by fibrous-looking tissue. The orbital roof was considerably displaced downwards. Tissue of fibrous character was present in the orbital cavity, involving the contents. There was nothing present definitely resembling sarcoma. The nasal cavities were quite healthy. Tissues from the orbit were removed for microscopical examination, and the brain removed and hardened in formalin. The orbital surface of the frontal lobe was very firm, and a piece was removed for microscopical examination. When the hardened brain was examined, the right frontal lobe was found to contain a tumour about the size of a Tangeine orange; the swelling projected mesially and caused a considerable depression in the left frontal lobe. The edge of the growth was ill-defined, and there was no capsule. Microscopically, it was a typical round-celled sarcoma, and the tissues removed from the right orbit showed a sarcomatous infiltration of the same nature. In my opinion the growth started in the brain and extended to the orbit.

In the *American Journal of Obstetrics* for October, Foskett reports the case of a single woman, aged 22, employed in an hotel, who was advised to take a bichloride douche. She dissolved three tablets of 7.3 grains each in a cup of water, and used a whirling spray syringe for the douche. At once a severe local burning sensation was experienced, and the patient went to a physician, who promptly ordered albumin water to be taken by the mouth; douches and ointments were prescribed for the external parts. Three days later Foskett was called in, and found the vagina and vulva covered with a white slough; the mucous membrane of the mouth, uvula, and pharynx was likewise white and sloughy, and there was salivation. For the first few days there was almost complete suppression of urine; what was passed contained albumin, and granular and hyaline casts, but no mercury could be detected, nor could any trace of that metal be found in blood taken from a vein. Hot packs were applied every six hours, and high colon irrigations were employed four times daily; saline aperients given by the mouth caused free catharsis. The patient, in spite of all care, became worse; bleeding from the mouth and epistaxis occurred on the fifth and sixth days, and separation of sloughs and haemorrhage from the vagina on the seventh, with dysphagia and hiccup. Blood clots were vomited on the ninth day and the throat was sore, and the fauces oedematous from separation of sloughs. The mental condition was bad, the patient being irrational and restless. The urine was excreted in normal quantities but could not be retained. There was more haemorrhage from the mouth and vagina, and on the eleventh day melaena was observed, and recent clots were also passed from the bowel. Haematemesis followed, and the patient died early on the twelfth day. In many other recorded instances of poisoning when bichloride had been used for douches in the puerperium and in operations on the pelvic organs, salivation was absent but profuse diarrhoea occurred.

Notes on Military Orthopaedics.

II. ON SUTURE OF NERVES, AND ALTERNATIVE METHODS OF TREATMENT BY TRANSPLANTATION OF TENDON.

BY

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(Continued from p. 643.)

In the first part of this paper I considered some general principles which should guide the surgeon in the treatment of limbs disabled by injuries involving nerves. I pointed out the importance of giving the muscles ample time and opportunity to recover by keeping them in a relaxed position for a sufficiently long period, and I began the discussion of tendon transplantation as an alternative method of treatment where nerve suture was not possible. I now propose to consider the transplantation operations my experience leads me to recommend in various injuries.

UPPER LIMB.

Irreparable Injury of Musculo-spiral Nerve.

1. In cases of musculo-spiral injury the deformity is a dropped wrist, with loss of the power of extending the fingers. The uncontrolled action of the flexor group causes the fingers to curl into the palm, and the hand to become useless.

In such a case:

- (a) The flexor carpi radialis and the flexor carpi ulnaris can be transplanted into the paralysed extensor of thumb and fingers; and
- (b) in addition the pronator radii teres may be affixed to the two radial extensors.

Transplantation of Pronator Radii Teres and the Radial and Ulnar Flexors in Musculo-spiral Paralysis.

I would recommend for this condition of musculo-spiral paralysis the double operation (a) and (b), and I will briefly indicate the method of its performance.

With the forearm midway between pronation and supination an incision is made along the radial border of the forearm in its middle third. Under cover of the tendon of the supinator longus the pronator radii teres will be found where it becomes inserted into the outer border of the radius. From this it is detached, and is then inserted into the tendons of the extensor carpi radialis longus and brevis, which lie closely applied to it on the dorsal surface.

A horseshoe incision, with the convexity resting on the back of the carpus, with the two straight sides extending along the radial and ulnar borders, is now made. Through the lateral aspects of this incision the tendons of the carpi ulnaris and radialis are identified, and are detached from their insertion as near the carpus as possible.

The tendons are brought round the ulna and radius respectively in very slanting fashion, and are then attached to the extensors of the fingers and thumb, the carpi ulnaris being attached to the tendons of the three inner fingers and the flexor carpi radialis to those of the thumb and index finger. The method of fixation should be neat and workmanlike.

Injury to Median and Ulnar Nerves.

In the case of great damage to the median and ulnar nerves, operations on tendons alternative to those on the nerves will be very rarely required as compared with those on the external popliteal and the musculo-spiral, for the reason that by means of flexion of the elbow a gap of two or three inches in the median may be closed up; by flexing the elbow and displacing the ulnar to the front a similar space in this nerve can be obliterated. End-to-end suture, therefore, is much more easily secured in these two nerves than in the case of the musculo spiral and external popliteal.

In cases of complete and irreparable paralysis of the muscles supplied by the median nerve the only active muscles on the flexor aspect of the forearm are the flexor carpi ulnaris and the inner half of the flexor profundus digitorum.

Operation of Transplantation of Tendons in Median Paralysis.

(a) The outer tendons of the flexor sublimis are inserted into the inner tendons of the flexor profundus digitorum.

(b) The inner tendons of the flexor sublimis are inserted into the tendon of the flexor carpi ulnaris. The extensor carpi radialis longior is attached to the flexor longus pollicis.

Method.—A curved incision is made convex downwards with the apex just above the anterior annular ligament of

FIG. 8.—Tendon of peroneus longus divided in its course, and identified at the outer border of the foot.

FIG. 9.—Tendon of peroneus longus drawn out through the lower incision.

the wrist. After retracting the flexor sublimis tendons, the outer two tendons of the flexor profundus are inserted into the two active inner tendons of the same muscle. The flexor ulnaris is then divided close to its insertion, and between the two portions of its split end the tendons of the flexor sublimis to the four fingers are inserted. The tendon of the extensor carpi radialis longior is now found at the outer border of the incision, and after division is inserted into the tendon of the flexor longus pollicis round the outer border of the radius.

Operation of Transplantation in Complete Paralysis of the Ulnar.

The two inner tendons of the flexor profundus are attached to the two outer.

The palmaris longus is inserted into the tendon of the flexor carpi ulnaris.

After-Treatment.

After operations for musculo-spiral paralysis the hand should be kept dorsiflexed until recovery of the muscle is complete. When the grafted muscles are acting sufficiently

FIG. 10.—Tendon of peroneus longus about to be drawn through the incision opposite the annular ligament under which it has to pass.

FIG. 11.—Tendon of peroneus longus about to be drawn under the annular ligament to be inserted in the tibia.

well and strongly to lift the hand and fingers, the time will have come for gradual training in co-ordination and balanced movement. Even after the patient has learnt to use his hand it is still necessary that he should continue to wear a dorsiflexion splint at night to prevent contractures of the flexors during sleep.

LOWER LIMB.

Paralysis of the Anterior Crural Nerve.

Transplant the sartorius and biceps into the patella.

An alternative measure would be the application of a knee cage with an extension spring to take the place of the paralysed quadriceps. This should be worn permanently.

PARALYSIS OF MUSCLES SUPPLIED BY EXTERNAL POPLITEAL NERVE.

The anterior group of muscles and the peronei are paralysed. The deformity is a dropped foot with varus due to gravity and the uncontrolled action of the muscles attached to the tendo Achillis and of the tibialis posticus.

Tendon Transplantation.

There is not much scope for effective tendon transplantation in this injury, except in cases in which only particular branches of the nerve have been picked out. For instance, an injury paralysing the two peronei muscles, but leaving the anterior tibial nerve intact, would result in a deformity consisting chiefly of inversion of the foot at the mid-tarsal joint—that is, pes varus. In such cases, transplantation of the insertion of the tibialis anticus into the dorsum of the cuboid or into the base of the fifth metatarsal, replaces the loss of the evertors, and restores the balance of the foot.

Tendon Fixation.

In cases of more extensive paralysis there is not sufficient muscle power remaining for it to be effectually distributed; there is, so to say, not enough power to go round. Tendon fixation is then the best operative procedure, for it establishes a firm barrier against drop-foot, and yet allows useful mobility. Tilanus, of Holland, suggested tendon fixation for certain types of flail-foot many years ago, and I am hoping that it will prove increasingly useful in military surgery.

The object of tendon fixation is to utilize the tendons of completely paralysed muscles as accessory ligaments to hold a paralysed foot in a correct position. This can be brought about in an endless variety of ways, and will supply the ingenious surgeon with many interesting and useful problems for reflection. Personally, after many successful operations, I would recommend this method of treatment to meet the disabilities of paralysis due to injury of the external popliteal.

FIG. 12.—Tendon of tibialis anticus being drawn taut, the foot being kept at right angles; tendon is then cut and passed through a tunnel in the tibia. The tendon of the peroneus longus is shown drawn up through the same opening.

FIG. 13.—Tendon of peroneus longus about to be drawn through the hole drilled in the tibia.

An Operation for Tendon Fixation in Drop-foot due to Injury of the External Popliteal Nerve.

Two small incisions are made along the course of the peroneus longus tendon. The first is placed over the tendon, just before it turns round the outer border of the foot (Fig. 8) on to the sole, and the other about three to

FIG. 14.—Tendon of peroneus longus drawn through the tibia.

FIG. 15.—Tendon of peroneus longus about to be stitched to the periosteum of the tibia.

FIG. 16.—Tendons of peroneus longus and tibialis anticus inserted into a groove made on the surface of the tibia, showing the periosteum raised and drawn aside before being sewn in place.

FIG. 17.—Lower divided portions of the tendons of the peroneus longus and tibialis anticus inserted into the tibia. The upper end of the tendon of the tibialis anticus sutured to the lower end below its insertion in the bone.

four inches above the tip of the external malleolus (Fig. 8).

The tendon is now divided through this upper incision, and the lower freed portion is then pulled out of its sheath through the lower opening while its normal attachment to the sole remains undisturbed (Figs. 8 and 9).

An incision 2 to 3 in. above the tip of the external malleolus is made just external to the anterior border of the tibia, and the divided lower portion of the peroneus longus tendon is passed up from the lower incision to this new one. In its new course the tendon should pass under the anterior annular ligament (Figs. 10 and 11), but if this cannot be done it may be passed in the deep fascial layer (Fig. 19).

FIG. 18.—Diagram to show the anatomy of the area concerned; the three parts of the annular ligament are shown, the tendon of the tibialis anticus is hooked inwards, the tendon of the peroneus longus has been passed under the annular ligament and brought into contact with the tibia.

beneath the periosteum in front of the tibia, in a manner similar to that first described, by nailing, or through a hole bored in the substance of the bone after the second method.

When this has been done the cut end of the upper part

of the tibialis anticus tendon is inserted into the lower part of the tendon distal to its insertion into the tibia (Fig. 17).

The peroneus brevis tendon may then be shortened and inserted into a gutter along the anterior surface of the external malleolus, by another short nail.

If the patient refuses operation he may wear a leather band above the ankle and one round the instep. These leather bands are connected by indiarubber bands sufficiently strong to keep the foot at right angles. The boot can be worn over this.

FIG. 19.—Alternative operation in which the tendon of the peroneus longus is pulled through the subcutaneous tissue without regard to the annular ligament. A, First stage. B, Tendon of peroneus longus drawn upwards and inwards.

Injury to Sciatic Trunk.

If the whole sciatic nerve has been divided high up in the thigh there is total loss of power below the knee and in certain muscles governing the knee-joint. In such cases the patient can walk quite well in a jointed caliper splint with a filling inside the boot to keep the foot at right angles. Another useful plan is to fit a jointed knee cage with a spring and a right-angled support for the ankle. This really means that we make the paralysed distal part of the leg into a species of artificial limb, and this, in actual practice, has proved much better than any artificial limb that I have ever met with.

The idea of rushing to amputation of a limb merely because the sciatic nerve is destroyed and therefore

theoretically the nutrition of the foot must go wrong, is too horrible to be contemplated. Actual experience has proved that, in many cases, the errors of nutrition which ought in theory to occur do not occur, or, at worst, are not nearly so serious as might be expected.

CONCLUSION.

Surgeons will glean from what has been written that there are many ways in which the disabilities following nerve destruction can be met, and that hardly any case is bad enough to justify a counsel of despair. Our knowledge of what can be done in poliomyelitis will invite us to take a cheerful outlook in traumatic paralyses.

This article is intended not merely to indicate ways in which the ground can be prepared for the operations of nerve suturing, or to point out the value of keeping a paralysed muscle relaxed by opposing the force of gravitation, but to indicate the great and ever-increasing field of usefulness that is opened up by utilizing tendon, whether that of an active or a hopelessly paralysed muscle, for the restoration of movement or the correction of deformity, thereby restoring to a greater or less extent the economic efficiency of an individual who will otherwise sink into the position of a non-productive and dependent member of the community.

THE IMPORTANCE OF METHOD IN THE ISOLATION OF PATHOGENIC ORGANISMS OF THE TYPHOID GROUP FROM FAECES.

A FURTHER NOTE ON THE VALUE OF TELLURIC ACID COMBINED WITH BRILLIANT GREEN.

BY

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THE employment of brilliant green in fluid medium as a means of isolating typhoid and paratyphoid bacilli from faeces, which was originally suggested by Browning, Gilmour and Mackie, and independently by Torrey, for paratyphoid organisms, has now found wide acceptance (Clarke and Stokes, Dreyer, Tidy, as well as other workers whose results are not yet published). The general experience has been that, when used in conjunction with the ordinary direct plating of the faeces on a differential medium like MacConkey's or Endo's, a substantial increase in the number of positive results has been obtained as compared with the latter method alone. As Clarke and Stokes note, however, this statistical result

leaves out of the picture the relative ease of the two methods so far as finding the colonies is concerned. The balance from this point of view is strongly in favour of the brilliant green method, in which it was common to get a practically pure plate of the typhoid group organism.

Accordingly our statement is confirmed that when these specific organisms are found they usually occur in abundance in the subcultures from the brilliant green medium, thus saving much of the time which is taken up in testing a variety of "likely" colonies from the direct plates.

As regards the procedure which has been followed by other workers who have employed brilliant green, it is to be noted that for the most part they have cut down the series of tubes of peptone water containing varying amounts of the dye, which we originally recommended. Thus a single tube containing 0.4 to 0.5 c.cm. of brilliant green 1 in 10,000 in 10 c.cm. of peptone water has been generally employed as representing the optimum concentration. The adjuvant procedure in the form of a further series of tubes containing telluric acid along with brilliant green, in addition to green alone, which was suggested by Browning, Mackie, and Smith, does not appear to have been extensively tested by other investigators. It is, of course, recognized that exigencies of work set a limit to the time which can be devoted to such examinations; but as the paramount importance of leaving no carriers undetected is now generally recognized, it seems desirable that methods should be adopted which will expose the maximum number of cases. The results of others have shown that the use of a single tube of

brilliant green medium will contribute a large proportion of the extra positives detectable by means of this reagent; but in view of the epidemiological significance of carriers it would be an unwise economy of time to rest content with the detection of those carriers which could be found by abbreviated methods and to neglect the further number of cases which could be discovered by suitable means, and which, if overlooked, are probably quite as likely as the rest to constitute foci of infection later on. Thus, provided that there is a definite prospect of adding to the number of positive results, a moderate increase in the amount of attention devoted to the examination of the faeces beyond the inoculation of one direct plate and one tube of brilliant green medium is highly advisable.

The question is, What extension of procedure is likely to yield the best return of further positives? On the basis of our own routine investigations of suspected typhoid-group infections in a large general hospital we would submit that of the means at present available, in addition to direct plating, the employment of a series of tubes of fluid medium containing varying amounts of brilliant green along with a series containing green and telluric acid will probably afford the largest yield of positive results.

As has already been emphasized in these pages (Browning and Thornton), we believe that the employment of a series of doses of the differential reagent in the medium is of the greatest importance. It is obviously a difficult task to arrange such conditions that scanty specific bacteria in a mixture with a large number of biologically similar organisms may undergo selective proliferation so as to enable the former to be isolated in pure culture. The method of making very large surface inoculations on a solid differential medium direct from the faeces, as was done some years ago by Harvey in his important work on the detection of carriers in the army in India,* involves the use of much agar and the search among large numbers of likely colonies, a serious matter where coliform bacilli, which do not produce typical appearances on the differential medium (for example, pale growth on MacConkey's agar), are present. Therefore the use of a simple fluid medium containing differential antiseptics probably yields the best return for the time spent.

In the case of *B. paratyphosus* B the disparity in behaviour between the specific organism and most of the accompanying coliform bacilli is such that brilliant green by itself, in the proportion of 0.5 c.cm. 1 in 10,000 per 10 c.cm. of peptone water, seems to constitute usually a highly suitable medium for isolation. But where one has to deal with smaller differences between the specific organism and the concomitants, as is especially the case with *B. typhosus*, a single concentration of green does not yield the best results (as Clarke and Stokes's figures indicate), and a finer adjustment of the medium becomes necessary. Hence appears the value of using a series of amounts of the differentiating reagent (brilliant green) in the culture of a single specimen of faeces, as the optimum concentration of the dye depends on factors which vary from case to case. Torrey, in employing brilliant green for the isolation of paratyphoid bacilli from faeces, also recognized the importance of the quantitative factor; thus he adopted a fixed concentration of green in glucose bouillon, but added varying amounts of faeces to a series of tubes; subcultures were then made after twenty-four hours' incubation at 37° C. He found that

if the paratyphoid or enteritidis bacilli are fairly numerous in the faeces, pure or nearly pure cultures will develop in all of these tubes. If, however, they are present in very small numbers, the specific growth occurs rather more often in the lightly than in the heavily seeded tubes.

We also employed a relatively light inoculation and found that positive results might be obtained in subcultures from the fluid medium after forty-eight hours' incubation, although the subcultures at twenty-four hours had been negative. Clarke and Stokes, on the other hand, made much heavier inoculations, and found it advisable to subculture earlier (after nine hours).

Here, again, the optimum conditions cannot be determined beforehand, hence the advisability of employing a series of concentrations of the reagent so as to afford a range within which the optimum is likely to lie.

* Harvey used three 9-in. plates of Conradi's medium for each sample of faeces. Each plate required approximately 30 c.cm. of medium, and every likely colony was picked off and investigated.