The Hunterian Oration,

ON

RECENT SURGICAL METHODS IN THE TREATMENT OF CERTAIN FORMS OF PARALYSIS.

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By A. H. TUBBY, M.S., F.R.C.S.,

SURGEON TO WESTMINSTER HOSPITAL AND IN CHARGE OF THE ORTHOPAEDIC DEPARTMENT; CONSULTING SURGEON TO THE EVELINA HOSPITAL; SURGEON TO THE NATIONAL ORTHOPAEDIC HOSPITAL.

[AFTER thanking the Society for the honour conferred on him, the speaker referred in suitable terms to the significance of this anniversary in connexion with the life and work of the great John Hunter, and then said:]

The types of cases which will be used to illustrate the remarks about to follow are those arising from anterior poliomyelitis, spastic paralysis, ischaemic paralysis, and some traumatic lesions of the nerves.

We all feel acutely the limitations of treatment expressed by the words, massage, electricity, and apparatus, and we realize too often how inefficient such measures are to effect satisfactory results. The administration of drugs has been of little or no avail, and therefore workers in this field have perforce turned themselves, and have asked, What can surgery do? The modern methods of treatment which will be discussed are tendon and muscle transplantation, arthrodesis and nerve anastomosis.

Tenotomy, lengthening and shortening of tendons, are tales which have been oft told, so that we may at once pass on to discuss tendon and muscle transplantation, and to inquire into (1) the history, (2) the methods by which they are carried out, (3) to which forms and effects of paralysis they are applicable, (4) how far have the attempts made proved successful, (5) what have been the causes of want of success, and how can such be remedied? We shall then speak of recent work in nerve anastomosis, and give some hints as to its possibilities in surgery.

TENDON AND MUSCLE TRANSPLANTATION.

By tendon transplantation is meant the reinforcement of a paralysed muscle by attaching to its tendon either a part or the whole of the tendon of a healthy muscle. The modern history of tendon grafting dates from just twenty-five years ago. In 1881, Nicoladoni, in cases of talipes calcaneus, implanted the severed central end of the peronei into the tendo Achillis (Figs. 1 and 2). The immediate

Fig. 1.—To illustrate Nicoladoni's method of direct tendon grafting. A, Tendon of peroneus longus; B, tendo Achillis; C, aperture in tendo Achillis.

Fig. 2.—To illustrate Nicoladoni's method of direct tendon grafting. The ends of the peroneus longus, A, are sewn to the posterior surface of the tendo Achillis, C, at D and E after having been drawn through the tendo Achillis.

results of Nicoladoni's operation were promising, but it is stated by Maydl¹ that the anastomosis finally separated, and all the benefits of the operation were forfeited. The operation was revived by Drobni² in 1892, and simultaneously and independently by Parrish of New York³ in a modified form. Drobni introduced tendon splitting (Fig. 3), providing a reinforcing strip without entirely suppressing the reinforcer in its normal sphere. Other workers in the same field are Milliken of New York,⁴ Bradford of Boston, and many American surgeons; Mr. F. S. Eve, who I believe performed the first operations of this kind in England; and with it in this country are associated the names of Sinclair White, Montgomery, E. M. Little, and Robert Jones; Professors Hoffa and

Vulpinus and Lange in Germany, and Kirmisson and others in France have done good work. A great advance was that of Goldthwait of Boston,⁵ who extended the

Fig. 3.—To illustrate Drobni's method of tendon splitting. A, Tibialis anticus; B, extensor proprius pollicis; C, strip from ext. prop. poll. into tib. ant.

The first application to the arm of the periosteal method of insertion was carried out by the speaker for spastic

Fig. 4.—Indirect method of tendon transplantation (after Mainzer). A, Tibialis anticus; B, extensor proprius pollicis; C, extensor longus digitorum; D, extensor prop. poll.; E, ext. long. dig.

important, muscle to fill in the gap when the reinforcing tendon was too short. In 1897 Franke led the attack on spastic paralysis.

METHODS OF TENDON TRANSPLANTATION.

As a preliminary to treatment it is essential that all secondary deformities be corrected. It is of importance, before deciding to operate, carefully to study the case, and map out a definite plan of campaign. The electrical reactions of the muscles should be previously ascertained, movements present and absent should be carefully noted, and the muscular power remaining in the limb should be registered by means of a dynamometer. The reinforcing muscles or tendons are as far as possible to be taken from synergic muscles, for the two obvious reasons that they are nearer, and the difficulty of after-education is not so great. A reinforcing tendon should not be bent round at an angle. As a rule opponents of the paralyzed muscle are not to be selected, because if that is done the action of the reinforcing muscle is neutralized. And, lastly, cases of extensive paralysis are totally unfit for any form of this operation.

TECHNIQUE.

Very many methods of splitting and transferring tendons have been devised, but to speak of them all would lead to confusion, and for the sake of clearness we may speak of Nicoladoni's operation as the old method, and Lange's periosteal insertion, with extensions by silken cords, as the new method. The older method may be either total or partial. Total (Figs. 1 and 2) consists in completely dividing a tendon, and inserting its central end bodily into another tendon, while its peripheral end is inserted into the same or yet another tendon. This is decidedly better than Nicoladoni's original operation on the tendo Achillis and peronei, where the peripheral ends of the reinforcing tendons are left free, so that the whole of the normal actions of the reinforcers are obliterated. Another way by which this undesirable result is avoided is by the partial method (Fig. 3) of Drobni. Here a strip

is made from the reinforcer, which is implanted into the weaker tendon. But it will be quite clear that unless the strip is of sufficient length, either we shall fail to obtain functional independence of the strip, or matting and cicatrization will occur at the site of operation, and the result be negatived. The difficulty of securing a strip of satisfactory length is often great, and to prevent fusing together of the parts it is necessary to preserve and interpose as much as possible of the tendon sheaths and areolar tissue, and fix them between the strips. Drobnik pushed his method to an extreme by prolonging the incision from the tendon well up into the muscle, so as to form a separate muscular belly. In doing so there is a risk of dividing some of the nerve supply to the muscle, and causing paralysis.

Two other devices are worthy of notice, which combine the active and passive methods as described by Hoffa. A strip is taken from the reinforcing tendon and joined to a strip from the paralysed tendon (Fig. 5), or an exchange of strips is effected (Fig. 6). The value

Fig. 5.—Strip from reinforcing tendon to strip from paralysed tendon. The paralysed tendon is in light shading and the reinforcing tendon in dark shading.

Fig. 6.—A downward strip from the reinforcing tendon is inserted into an upward strip from the paralysed muscle. A, of the paralysed muscle.

of the interchange method is this: It neither completely suppresses the action of the healthy muscle, nor does it throw away any power which may be left in the paralysed muscle, a power which often increases when the strain on the muscular belly is eased by the reinforcement. As to the material for suture, the best is fine twisted silk, previously boiled for half an hour, and soaked in biniodide of mercury solution (1 in 1,000) for a week. It is quite evident, however, that these older methods—except in cases where one or at the most two muscles are affected and a graft can be taken from a neighbouring muscle—will give place to the periosteal mode of implantation. The tendon should be firmly sewn on to the periosteum, or the wall of a joint capsule, cartilage, ligaments, or laid in a groove in the bone.

A noteworthy point is that a reinforced paralysed tendon often degenerates and becomes slack. Lange made experiments on the cadaver, and found that in a particular instance a periosteal attachment will bear a weight of 14 to 15 kilog., whereas an intertendinous attachment will not carry more than 2 to 3 kilog. Lange at first was mistrustful of silk tendons, but later, when he began tendon transplantation and found that silk sutures remained quietly embedded, he argued that if a short piece remained quiet, why should not a longer piece, and in the last five years he has done this form of operation in over 200 cases.⁸ He lays stress upon the fact that the silk must be impregnated with an antiseptic material. If the silk be boiled in water only, the wound heals well, but later on abscess often develops, and the silk comes away; and therefore Lange recommends that the silk should be sterilized with 1 in 1,000 perchloride of mercury, which possibly is retained in the silk for months and years, and by that time the living tissue has invaded the silk. At any rate, he has never seen an abscess form if the artificial tendon has remained embedded for a year. Lange uses four strands to lengthen a tendon, but in attaching two or three muscles six or eight strands are used. Sometimes the strands are from 20 to 25 cm. long. The kind of silk he uses is Turner-Seide, Nos. 3 to 12 (obtainable from Katsch, Schillerstrasse, Munich). He insists on drainage for the first forty-eight hours, and keeps the part absolutely at rest in plaster for six weeks. There must on no account be too much tension of the artificial tendon at any time, and movement must be allowed gradually. In Lange's article in the *Handbuch der Orthopädische Chirurgie*, edited by Joachimstal, pages 341,

342, and 343, there are illustrations of sections showing the infiltration and envelopment of the silk by tissue elements. The new material thickens under the influence of function, and in several cases it has increased from the thickness of a pin to that of a lead pencil or a little finger; rather an undesirable result when tendons play in osseo-fibrous grooves.

TO WHICH FORMS AND EFFECTS OF PARALYSIS ARE THESE METHODS APPLICABLE?

In the treatment of the results of infantile paralysis, most of the work, so far as tendon-grafting is concerned, has been done on the foot. The best results have been obtained in the removal of talipes varus and valgus. Thus in a case of equino-varus, where there was paresis or paralysis of the dorsiflexors and the peronei, section of the tendo Achillis, and transplantation of the tibialis anticus into the base of the fifth metatarsal bone, gave a good foot.⁹ And in another case the tibialis anticus, or rather part of it, was grafted on to the peroneus tertius for varus. There was strong power of eversion, and the position was much improved. For paralytic talipes valgus the peroneus longus was transplanted into the periosteum of the scaphoid, and the peroneus brevis into the Achillis. A useful foot resulted, with good power. Mr. F. J. Steward,¹⁰ in equino-varus, inserted one-half the tendo Achillis into the peroneus longus, and the other half was lengthened; a successful result was reported by the operator two and a half years later, as follows:

The equinus has been completely corrected, and shows no tendency to recur. He can use both the posterior and anterior muscles well; there is still some slight varus when the foot is off the ground, but he walks with the foot flat. He has voluntary power of moving the foot outwards, which is increasing. So that the additional strength of the external muscles has enabled the patient to combat the tendency of the tibialis anticus and posticus to keep up the varus; and he has therefore no need to wear heavy expensive apparatus.

CASE I.—Grafting of the Extensor Proprius Pollicis into the Tibialis Anticus and Part of the Extensor Longus Digitorum into the Internal Cuneiform Bone.

In a case of paralytic equino-valgus, which was associated with paralysis of the tibialis anticus, and was seen by me on May 16th, 1902, an incision 3 in. in length, with its centre about 2 in. above the ankle-joint, was made on June 17th, 1902. A strip of the extensor proprius pollicis tendon was then detached, and the free end inserted into the tibialis anticus. A second incision was made obliquely across the dorsum of the foot, and the two outer tendons of the extensor communis digitorum were severed and brought inwards and attached to the periosteum of the internal cuneiform bone. The tendo Achillis and plantar fascia were divided at the same time. The foot was put up at a right angle, and somewhat inverted, in a Scarpa's shoe for six weeks, and after the wound had healed massage was applied to the grafted muscles. Since the date of operation the boy has worn a boot with an outside steel brace to prevent stretching of the grafted portions, and has had massage and electrical treatment. When the apparatus is removed the action of the foot is excellent. He walks toe and heel on the ground; the outer border of the foot on standing presses firmly on the ground, and the inner border is raised; he has a good arch, and there is no eversion. In addition he can voluntarily invert the front part of the affected foot.

CASE II.—Paralytic Talipes Valgus: Grafting of the Outer Tendons of Extensor Communis Digitorum on to the Tibialis Anticus.

In another case of paralytic talipes valgus, in a child aged 4 years, there was good power in the peronei and extensor communis digitorum, but the tibialis anticus was paralysed. The proximal parts of the outer two tendons of the extensor communis digitorum were grafted on to the tibialis anticus. When seen on July 18th, 1902, the result was good. He could raise the inner border of the foot when he stood up; there was a distinct arch of the foot, and very little eversion was left.

In talipes equinus better results are obtained by section of the tendo Achillis than by grafting. It is not advisable to divide the tendo Achillis into three parts to correct this deformity and bring the two outer strips forward, because, when the latter are attached to the dorsiflexors, they become direct opponents of the middle strip at the back of the leg, and the result is diametrically opposed actions; so that the procedure merely results in the formation of additional ligaments to the ankle-joint. Pure talipes calcaneus is the condition for which Nicoladoni originated the modern era of tendon transplantation; but, as has been already stated, his cases relapsed. When we come to consider the disparity in size and power of the peronei

muscles and of the great muscles of the calf we are not surprised to find that the results are not satisfactory. According to Fick,¹¹ the work done by the calf muscles expressed in kilogrammetres is eleven times greater than that done by the peroneus longus and brevis. It is therefore unreasonable to expect the peronei when grafted into the tendon of the paralysed calf muscles to take their place entirely. In my experience of six cases in which I have performed this operation the result is that patients can extend and dorsiflex the foot when the weight is off the ground; but they have not, except in one instance, been able to raise the body on the toes of the affected foot. So that the transplanted peronei merely become additional posterior ligaments of the ankle-joint in steadying the foot in standing.

After watching cases for several years afterwards it has been found that the best and most satisfactory results in this branch of surgery have been obtained by Goldthwait's procedure for paralysis of the extensor muscles of the knee, where, as he pointed out, the sartorius frequently escapes. If left intact this muscle aggravates the condition by increasing the flexion of an already bent knee, but if it be divided opposite the upper part of the patella, and the central end brought forward and inserted into the periosteal covering of that bone, and thoroughly massaged afterwards, in most cases it effects this result, that the patient is able to stand with the knee firmly braced up, and in some exceptional cases the power of complete voluntary extension is gained. The latter is more likely to follow if additional muscles are transplanted. I have on several occasions used the biceps, or part of it, in addition to the sartorius, and where the biceps appeared to be much wasted, the ilio-tibial band, or part of the hamstrings, has been inserted into the extensor tendon or upper border of the patella (Fig. 7).

The following are illustrative cases :

CASE III.—Grafting of the Semimembranosus Tendon into the Extensor Cruris for Paralysis of the Extensors of the Leg.

E. C., female, aged 13, was seen for paralysis of the extensor cruris on September 5th, 1901, and equino-varus. The position of the parts was as follows: The leg hung at a right angle at the knee, and there was no power of extension. The heel was slightly raised, and the fore part of the foot was adducted and inverted. The plantar fascia was tense, and there was contraction of the sole of the foot. On October 17th, 1901, a curved incision was made across the upper part of the patella, and along the inner margin of the thigh, extending about 6 in. The sartorius was found quite atrophied, so a large strip of the semimembranosus muscle was made, and attached at its lower end to the rectus femoris tendon. Improvement set in by December, 1901, and she was able to offer considerable resistance when an attempt was made to forcibly flex the knee. She continued to improve, and in January, 1903, she could stand firmly on the limb without support, raise the heel, advance the leg in walking, and when lying down she was able to flex and extend the leg voluntarily.

CASE IV.—Partial Paralysis of Extensor Cruris: Insertion of the Ilio-tibial Band into the Patella: Complete Recovery of the Power of Extension of the Leg.

Lizzie B., aged 18, came under my care in September, 1904. She had a flail-like paralytic foot, and had lost apparently all power of extension of the leg. On October 6th, 1904, an arthrodesis of the right ankle was performed, and on January 26th, 1905, a grafting about the right knee was made. The sartorius was found to be pale and atrophied, and was useless, so that the ilio-tibial band was detached near its distal extremity, and a long strip brought forward, and extended by means of silken cords 1½ in. long to the patella. The cause of the paralysis was undoubtedly anterior polio-myelitis, and the limb was wasted, blue, and cold, especially below the knee.

Fig. 7.—Operation of muscle transference for the relief of paralysed extensor cruris by reinforcement of paralysed muscle from the inner and outer hamstrings. At *a* a strip is brought forward from the biceps; at *b* the proximal part of the sartorius is brought forward, and the muscular slips *a* and *b* are inserted in the patella at *c*. At *d* is seen the distal part of the biceps, and at *c* is the distal part of the sartorius.

She was kept on a back splint from the thigh downwards after the operation for six weeks, and then massage and electricity applied. In three months she had gained the power of extending the limb to an angle of 45 degrees, and on May 19th, 1905, she left the hospital wearing an apparatus which allowed of movement of the knee from the straight position to an angle of 45 degrees. Subsequently the range of movement was increased to the normal, but a light spring was added to relieve the strain on the knee in walking. When seen on February 1st, 1906, she could voluntarily extend the limb to the fullest extent both in sitting and standing, and walk without any instrumental support. What has happened in this case is that the degenerated and apparently entirely paralysed extensor cruris muscle has had time to recover, owing to the absence of strain on it, effected by the fixation of the nearly non-extensible ilio-tibial band on to the patella.

CASE V.

was that of a boy aged 5 years, the subject of infantile paralysis in the extensors of the left knee, who was seen on February 24th, 1902, with almost entire loss of extension at the left knee; the sartorius, however, had escaped, as was shown by the electrical reactions. It was separated at its lower third, brought forward, and attached to the upper border of the patella. In three months it was noted that when the sartorius was thrown into action the ligamentum patellae was tightened, and the child could stand unaided with the knee extended, and opposed considerable force to the passive flexion of the leg.

CASE VI.

In another case of infantile paralysis affecting the quadriceps extensor, where the sartorius and biceps had escaped, the central portion of the sartorius and a long strip from the biceps were brought forward and anchored to the margins of the patella (Fig. 11), and the patient regained the power of voluntary extension of the leg, and was able to walk with the aid of a light steel support.

Goldthwait¹² reports on 6 cases operated on by him—4 with decided improvement—and he gives striking details of the results of the operation in the case of a woman of 20 years of age:

At the time of the report she has apparently a normal amount of extension of the leg and the knee, as contrasted with an entire inability to extend the leg before the operation. When sitting she is able to support the leg and hold it straight, and she is able to bear the weight of the body on the lame leg without artificial assistance, the leg being extended normally when a step is taken. No apparatus for the thigh is now necessary, but she has been doing regular housework for the last eight months, whereas previously to the operation she had to depend on a crutch or a stick.

It is in paralysis of the extensors of the leg that Lange's method of elongating the transposed tendons of the inner and outer hamstrings finds its particular use. We gather that up to 1901 Lange had employed silken tendons in 56 cases, in all of which healing by first intention was obtained. The use of the silken tendons is to secure an attachment to the tubercle of the tibia, instead of to the upper margin of the patella, as in Goldthwait's procedure, and Lange says that in only two of his cases were the results unsatisfactory. Several of the artificial tendons were 8 in. long, and the functional results were excellent. Patients in whom the semitendinosus and biceps were made to replace the quadriceps femoris often obtained almost normal powers of extension. During the last five years Lange states that he has operated upon 200 cases in this way, and he gives excellent illustrations of a very interesting and successful case.¹³

Recurrent Dislocation of the Patella.

In the treatment of recurrent dislocation of the patella, due to paresis of the extensor muscles of the knee, I have in three cases been successful in correcting and completely preventing the return of the displacement by making a transverse incision 1 in. above the patella, dissecting the superficial tissues back, and pleating the whole width of the quadriceps tendon and muscle to an extent of ½ in. to ¾ in., until the patella is firmly braced into position.

Paralysis of the Upper Extremity.

On patients affected with infantile and traumatic paralysis in the upper extremity the amount of operative work performed has not been so great. The most difficult cases are those where either the lower cervical nerve roots or the brachial plexus are damaged, either during birth, as in the Erb-Duchenne type, or by the traumatism incidental to daily life.

In the year 1903 a case was described by me¹⁴ of injury to the fifth cervical root, resulting in paralysis of the Erb-

Duchenne type about the shoulder, and the loss of the flexion power at the elbow, due to traumatism of the fifth nerve root. In this case a long strip of the outer head of the triceps was brought forward and inserted into the biceps, and the power of flexion at the elbow was restored. But the efforts made to restore the deltoid by transplanting the distal part of the clavicular portion of the pectoralis major were not successful. The case was shown at the Clinical Society, and the action of the transplanted muscle in flexing the elbow was demonstrated.

And in another case of Erb-Duchenne paralysis, in a boy aged 10 years, from birth palsy, similar results were obtained.

But, so far as I know, all attempts to replace the deltoid by means of muscle-grafting have not been effectual, although it has been suggested that a portion of the trapezius should be used for this purpose instead of the pectoralis major, yet much may be hoped from nerve anastomosis. In a case of paralysis of the serratus magnus, due to acute anterior poliomyelitis, and resulting in scapula alata, the distal end of the lower half of the pectoralis major was grafted by me into the serratus magnus with so much effect that the deformity disappeared, and the girl was able to advance the scapula fully, as in the thrusting movement of the upper extremity.¹⁵

Operations for dropped wrist from infantile paralysis have been devised and carried out, notably the conversion of the carpal flexors into carpal extensors, as practised by Mr. Robert Jones; but it is highly probable that nerve transplantation will give better results in this form of paralysis than tendon grafting.

In ischaemic paralysis, or Volkmann's contraction of the upper extremity, tendon elongation has been successfully carried out to overcome the contraction of the wrist and fingers. It is a tedious procedure, but it is a more scientific form of treatment than shortening the bones of the forearm, which, if done sufficiently to relieve an advanced degree of contracture, is likely to be followed by a pseudo-paralytic condition of the muscles. It seems that if more than $\frac{1}{2}$ in. of the bones be taken away the muscles may become useless.

Spastic Paraplegia and Cerebral Diplegia.

Spastic paraplegia and cerebral diplegia have been attacked by surgeons. It is only within the last few years that tenotomy of the tendo Achillis in these cases has been sanctioned by medical opinion, but abroad further procedures have been attempted and carried out with varying results. Apart from tenotomy of contracted tendons, such as the tendo Achillis, the hamstrings and adductors, the operations for the relief of these distressing conditions are not many; although in connexion with the adductor spasm mention must be made of Mr. Robert Jones's plan of excising a considerable portion of the adductor tendons and muscles, which is followed by much greater effect than tenotomy.

In the upper extremity I have operated for the relief of pronator and flexor spasm of the forearm, by detaching the tendon of insertion of the pronator radii teres, passing it through the interosseous membrane and refixing it on the outer side of the radius, so that it may assist in supination. This was repeated by E. H. Bradford of Boston,¹⁶ who three times transplanted the pronator radii teres, and in one case the ultimate benefit was great. The difficulties to be overcome are considerable. At the time of operation the chief one is the shortened state of the muscle, with its often ill-defined and broad tendon, which is difficult to insert again into the radius satisfactorily. In order to overcome this trouble, I have grafted the central end of the separated pronator radii teres into the flexor carpi radialis, then brought the central end of the latter tendon, after section below the junction of the tendons, through the interosseous membrane, and fixed it on the outer side of the radius. Despite this improvement, the range of pronation and supination was not so great as was expected. Acting on a hint from Mr. H. A. Ballance, the interosseous membrane was split from above downwards, and the range of movement then increased. The most important part of the treatment is after-education. It is certain that these cases require years, and even then can only carry out the movements of pronation and supination with difficulty. It is useless

to attempt this operation in very severely marked spastic conditions; and equally so when the child's mental condition is below the average of this class of case, because it is found impossible to educate them sufficiently.

For a contracted and entirely useless spastic hand I have adopted the following procedure in a gentleman aged 26:

CASE VII.

The carpal flexors were divided, and their tendons lengthened by means of silk attachments, and then transferred to the extensor surface of the bases of the second and fifth metacarpal bones; and subsequently the tendons of the flexors sublimis and profundus digitorum, and the flexor longus pollicis, were lengthened at the wrist by the Z method.

*Post-card, that I send
back to you*

Fig. 8.—Specimen of handwriting after operation upon a hand that was previously useless.

Whereas before the operation the patient's right hand was useless, and he could only passively extend the fingers with the left hand, he is now able to use it in dressing, and it assists the left, but cannot entirely take its place. He is now engaged as a clerk in a bank, and writes moderately with the right hand. (Fig. 8.) The patient in writing added that "nearly every movement which I can perform now, I could not do before."

For flexion of the knees in spastic paraplegia Bernard Bartow,¹⁷ depending on the gastrocnemii to supply the flexion power, wove the semitendinosus and semimembranosus and the gracilis into one cord, and anchored this cord to the aponeurosis of the vastus internus as near to the patella ligament as possible. He records that there was some improvement.

It is evident that not so much benefit can be expected from tendon transplantation in spastic paralysis as in infantile and other forms. We are often unable to differentiate the factors causing the contraction, how far it is due to gravity and position, and how far to shortening of the muscles. Again, we have no certain proof in most cases that the spastic process has ceased. But it is quite certain that simple tenotomies and tendon lengthening, provided that the position of the limb is sufficiently guarded for a considerable time after the operations, result in benefit. And in all these cases an immense amount of after-education is essential. Nevertheless, the outlook is hopeful for surgical procedures.

HOW FAR HAVE THE ATTEMPTS AT RELIEF AIMED AT BY TENDON AND MUSCLE TRANSPLANTATION SUCCEEDED?

As with all new forms of operation, great expectations of their practicability and usefulness were formed at their inception, and very often the value of an original operation consists, not in that it fulfils the object for which it is performed, but in the fact that it is a new departure and contains the germ of originality, which in other hands blossoms out into a satisfactory, recognized and useful procedure. But it behoves us to be as brief and as concise as possible.

To take the case of paralysis of the muscles supplying the foot, it is quite clear that where a single, or at the most two, synergic muscles are paralysed—especially if they be concerned in the production of valgus and varus—tendon transplantation yields very satisfactory results in the senses that the lost movement is frequently restored, the position of the part is rectified, and the patients are subsequently able to do without instrumental support. In cases of talipes calcaneus the results have not been so successful, for the simple reason that a weak muscle has been expected to do the work of muscles normally more than ten times stronger; that is to say, muscles whose function is merely to invert or evert the foot have been expected to lift the whole weight of the body, and at the same time to maintain the foot in a correct attitude. Such cases are best treated by a combination of tendon transplantation and arthrodesis.

The results of transference of power from the sartorius and the hamstrings are certainly very satisfactory and in every way encouraging, not the least important point being that many patients are able to stand, and even to walk, without cumbersome apparatus about the knee.

The treatment of infantile and other forms of paralysis in the upper extremity, when it is not very extensive, and if not more than one joint is involved, and that joint either the elbow or wrist, has proved very encouraging, and even if one of these joints be hopelessly involved and the other partially, much aid is obtained by fixing the flail-like joint. The admirable results of grafting a portion of the triceps into the biceps, and portions of the pectoralis major into the serratus magnus, and transference of the carpal flexors to extensors, for paralysis of these muscles, have been adverted to.

In estimating the success of these operations it is necessary to consider how far an apparently paralysed muscle is capable of recovery if aided by removing the harmful effects of constant stretching, and by reinforcing its tendon. Even when muscles give the reaction of degeneration we have no means, so far as I know, of measuring exactly what is the extent of the degeneration, whether it is entirely distributed throughout the muscle, or is in patches, or to what degree it has proceeded. On these points accurate and original observations are required. J. Koch¹³ has shown that when the fatty degeneration of a paralysed muscle is scattered throughout it in small areas a large amount of regeneration of the muscle fibres may take place in each area; but when the entire muscle has been transformed into fat no such regeneration can follow. The process of regeneration sets in some time after the paralysis and fatty degeneration have occurred, the latest time being seven to nine months. If this be true—and the observation requires confirmation—it affords a very hopeful outlook and a strong justification for the reinforcement of partially paralysed muscles. Looking at the question of tendon transplantation as a whole, much more successful results are obtained by insertion into the periosteum of reinforcing tendons than by anastomosis; by the former method the point of insertion from which the best results can be secured is obtained, and Lange's method of lengthening tendons renders effectual periosteal insertion all the more decisive.

The operative treatment of spastic paraplegia and cerebral diplegia is making but slow progress because the difficulties are so much greater, chiefly on account of the mental condition of the patient and the character of the contracture. But when medicine has said its last word, it is surely time, and quite justifiable, to try surgical procedures, which have so far met with a moderate amount of success, in that the position of the limbs has been improved, the range of movement increased, and the patient often enabled to walk upright, whereas before he grovelled. If, as has been shown above, the operations of tendon transplantation and tendon lengthening can render a useless hand partially useful, then such measures are to be welcomed and tried.

THE CAUSES OF WANT OF SUCCESS, AND HOW CAN SUCH BE REMEDIED?

These are many and various, but by ascertaining their nature and character we shall place these operations on a more satisfactory footing. In the first place too much was expected to be accomplished, and a limb extensively paralysed has been submitted to operation and tendons transplanted, where it is now evident to us that little or no improvement could have been expected.

If the secondary deformities of the limb are not rectified before operations on tendons are done, then the result is unsatisfactory. Deficiencies in technique, defects in perfect asepsis, are responsible for many failures. Cicatrization at the point of division of the tendon slip has accounted for some bad results; subsequent yielding of the tendon of the paralysed muscle has accounted for others; and the employment of too much or too little tension of the graft is again responsible for failure. If there be too little, all the power of the reinforcing tendon is expended in picking up the slack of the weak muscle; if there be too much, sloughing may follow. Yielding of the new attachment of the tendon to either muscle or bone, owing to imperfect fixation, has occurred and neutralized expected benefits. When a paralysed muscle or muscles passes over flail-like joints, as, for instance, a flail-like ankle and mediotarsal joints, with relaxed ligaments, it is hopeless to expect any tendon, however strong it may be, to control such joints, and it is just in these cases that Royal Whitman's operation of combined arthro-

desis and tendon transplantation is so useful. Another cause of want of success is not starting with a proper plan of campaign. To take a simple example. In the case of the foot, in transferring tendons, those which go to the toes should, as a rule, be sacrificed to those which control the ankle and mediotarsal joints, since the loss of the greater part of the control over the toes does not have very disastrous effects in the case of boot-wearing people. Whereas, in the case of the wrist and hand, those muscles which act upon the carpus should be sacrificed to those which act upon the fingers. There are few forms of operation which require so much consideration and experience, and their very difficulty gives them a charm to thoughtful surgeons.

At the knee-joint, Lange advises that all three hamstrings be transplanted to the front; the reason being that if one alone is used it may fail to learn to contract independently of its group, and voluntary movement is impossible, or it takes years to re-educate the muscles. In paralysis of the extensors he depends solely on the gastrocnemius to secure flexion at the knee. But if the gastrocnemius be paralysed the semimembranosus must be left, otherwise genu recurvatum will result. Lange hints that transplantation of the hamstrings is an improvement on even Nature itself, because, while the normal quadriceps muscle extends the knee, it flexes the hip, but the artificial muscle extends both the knee and the hip. If the hamstrings are useless the tensor vaginae and the sartorius may be used; but he criticizes the use of both biceps and sartorius, because, although they can both be made into knee extensors, they are naturally one a flexor and the other an extensor, and normally have antagonistic actions.

Other causes of failure consist in not keeping the part immobile sufficiently long after the operation. At least six weeks are required, and too much work must not at once be thrown upon the newly-fashioned muscles, which rapidly become tired and exhausted and fail to do the work which is expected of them.

ARTHRODESIS.

Arthrodesis finds its place in the treatment of infantile paralysis when a joint is hopelessly flail-like, and it has the effect of making the part stable, lessening the amount and weight of apparatus, and affording a position of steadiness, as in the ankle, for the finer movements of the front part of the foot. With the latter object, Whitman¹⁹ has performed arthrodesis of the ankle at the subastragaloid joint, and in necessary cases at the mediotarsal joint, followed by tendon transplantation; so that in his procedure tendon transplantation occupies a subordinate place. These operations are not designed with the object of securing perfect functional cure, but restoration of stability to such a degree as to enable the patient to discard apparatus. In the foot stability is the first essential; finer movements may be sought afterwards. Arthrodesis is not so suitable for the knee as for the ankle, because a long, straight rod of bone in these paralysed limbs invites fracture. In this connexion we must also consider what amount of after-care our patient can secure. In the case of one who can be under the direct personal care of the surgeon, aided by the intelligent co-operation of nurses and patients for a long period, tendon transplantation will probably result in securing a more mobile and useful part than can be expected with out-patients; and, excepting perhaps in the case of the simpler forms of paralysis of the foot, the combined operations of arthrodesis and tendon transplantation are preferable to transplantation alone for hospital patients.

NERVE ANASTOMOSIS AND TRANSPLANTATION.

Operations with this object have undoubtedly grown out of the feeling that in extensive plastic operations on the tendons a considerable amount of healthy muscle material cannot be used economically nor serviceably, and our regret is increased by the knowledge that the wasted muscles in infantile paralytic cases are secondarily diseased, owing to changes in the spinal centre. If we can succeed in re-establishing a connexion we ought to be able to refresh the muscle substance, so that it can do its work, since it is clearly shown by a case quoted later by Spitzky²² that muscles which have been in a state of atrophy for eight years may be regenerated.

According to Kilvington,²⁰ Fleurens crossed the two

nerves supplying the upper and lower surfaces of the wing in a cock. After a time co-ordinated movements resulted. But such an experiment is inconclusive unless some method is adopted to prevent the union between the cut peripheral and central ends of the same nerve.

The first authentic case of nerve grafting in man was by Sick and Sanger,²¹ who transferred the distal stump of a paralysed musculo-spiral nerve into the neighbouring intact median, and obtained a good result. Faure and Furet²² in 1898 sutured that portion of the nervus accessorius which supplies the trapezius into the divided facial without success. In the same year Manasse²³ performed a similar operation on five dogs; three of these experiments were successful, the regenerated fibrils being subsequently seen crossing the point of suture.

On May 4th, 1899, Robert Kennedy²⁴ performed the first successful case of the Faure-Furet operation of facio-accessory anastomosis in man. Cushing,²⁵ in a traumatic case of facial paralysis, transferred the proximal stem of the divided nervus accessorius *in toto* into the distal facial. In six months the patient is described as being nearly normal. Cunningham,²⁶ in dogs, crossed the musculo-spiral with the whole of the nerves supplying the flexor muscles, and isolated the junction by wrapping round the nerves at the point of suture a layer of fascia, thus preventing the tendency of some of the central fibres to join on to the distal ones in the same nerve. Seventeen months later electrical stimulation showed the union to be effective, but volitional movement was unsatisfactory. When, in the same way, the median and ulnar nerves were crossed, the results were good, thus illustrating the important point that, in order to obtain good co-ordination, the nerves utilized must have a synergic function; whereas, if they are antagonistic, the result will be poor.

Kennedy²⁷ crossed the musculo-spiral with the median and the musculo-cutaneous with the ulnar, so interchanging the whole of the nerve supply of the flexors and extensors. Precautions were taken to avoid confluent union in a common cicatrix by interposing the internal anconeus muscle between the two sets of nerves. Co-ordinated voluntary movements were very completely restored, and a subsequent dissection showed no confluent union. Stimulation of the musculo-spiral nerve above the line of suture resulted in flexion, and vice versa. He²⁸ found that the cortical areas for flexion and extension were interchanged after nerve crossing, and stimulation resulted in co-ordinate muscular action. This point is of the utmost importance, not only in

Fig. 9.—Slip of nervus accessorius into facial (after Faure and Furet). End to end anastomosis. A, Accessory; B, facial.

Fig. 10.—Facial nerve into hypoglossal. Lateral anastomosis. A, Hypoglossal; B, facial.

connexion with nerve grafting but with the cerebation of muscle transplantation. So far we have dealt with either end-to-end junction (Fig. 9), lateral approximation (Fig. 10), or crossing experiments. Another kind of nerve anastomosis is the suture of the central end of one nerve to the peripheral ends of two or more (Figs. 11, 12, and 13). This has been successfully practised by Kennedy²⁹ and by Kilvington.

Langley and Anderson³⁰ from their experiments concluded that (1) the central end of an efferent fibre can make functional connexion with the peripheral end of any other efferent fibre of the same class, whatever be the normal action produced by the two nerve fibres; (2) efferent fibres do not make functional connexion with sympathetic fibres arising from ganglia; (3) afferent fibres cannot unite with efferent or post-ganglionic fibres to produce a functional result.

Kilvington³¹ experimented by making one nerve supply antagonistic muscles, for example, the internal and ex-

ternal popliteal nerves were divided, and the central end of the internal popliteal was sutured to the central end of the external and internal popliteal nerves (Fig. 11). The results of his experiments were that a functional result was obtained in both nerves; that good co-ordination resulted, at any rate so far as regards the coarser movements,

Fig. 11.

Fig. 12.

Fig. 13.

Other methods of grafting (Kilvington). I.P., internal popliteal; E.P., external popliteal. The reinforcing nerve is completely cut across, and the distal ends of both internal and external popliteal are sutured to it.

and that a better result was obtained when the supplying nerve is large. He also noted that the action of the muscles supplied normally by the central nerve trunk preponderate, and lastly that if the nerve fibrils below the junction were counted, they were greater in number than those above, thus showing that division of nerve fibres takes place. Anastomosis of the popliteal nerves is obviously applicable to the treatment of talipes resulting from infantile paralysis.

To return to the facial nerve. Hackenbruch³² reports a successful case of facio-accessory anastomosis in a girl, aged 8 years, who had had facial paralysis for seven and three-quarter years. Two-thirds of the spinal accessory nerve were implanted in the facial, and nine months after the child could voluntarily draw the right angle of the mouth outwards. Korte at the same congress³³ showed a patient in whom, one and a half years previously, he anastomosed the peripheral stump of the facial to the hypoglossal with much benefit.

While Messrs. Ballance and Purves Stewart³⁴ have performed experiments of junction of the spinal accessory and facial, yet such cases are open to the criticism that at first the associated movements of the face and shoulder are marked, but later³⁵ experience shows that independent voluntary and emotional movements return. Therefore they prefer facio-hypoglossal to facio-accessory anastomosis. They further recommend that the operation be carried out if the case shows no signs of spontaneous recovery after six months. Messrs. Ballance and Purves Stewart's cases of facio-hypoglossal anastomosis were done before Korte's in Germany.

In a case of facial paralysis due to an operation wound, I grafted the distal facial into the hypoglossal.

CASE VIII.—Grafting the Distal Facial Trunk for Traumatic Facial Paralysis into the Hypoglossal: Successful Result.

J. P. B., male, aged 19, was admitted into Westminster Hospital on October 3rd, 1905. The patient has been a militiaman, and some months ago a large swelling appeared behind the left side of the jaw. This was opened on April 27th, 1905, and it was immediately after the operation that the palsy was found. On admission the face was seen to be paralysed on the left side. The left half of the mouth dropped; the left palpebral fissure was larger than the right; the left side of the forehead was unwrinkled; the cheek was flattened; the tongue deviated slightly to the right; the palate moved normally, the uvula being in the middle line, but food accumulated on the left side. There were also epiphora and dribbling of saliva on the left side. He could not whistle, nor draw in the cheek involuntarily. The appearances before operation are seen in Figs. 14, 15, and 16.

On October 16th the anastomosis was carried out. An incision was made from the tip of the mastoid process to the greater cornu of the hyoid bone, and then a dissection was undertaken to find the cut distal end of the facial nerve. This was done with much difficulty. It was traced forwards in the parotid for about $\frac{1}{2}$ in. A further dissection was then made to expose the hypoglossal nerve. The greater parts of the digastric and of the stylohyoid muscles were removed, and the hypoglossal nerve freed and brought upwards as near to the facial as possible. An incision was made with a tenotomy knife deeply into the hypoglossal nerve, and the distal end of the facial was then inserted into it by lateral implantation (Fig. 10). On October 23rd—that is, a week after the operation—it was noted that the palpebral fissure was lessened in size, and the eye could now be temporarily closed. On October 28th

the palpebral fissure was still smaller, and the patient began to move the left angle of the mouth. He was seen last on February 7th, 1906, when the following conditions of voluntary movement were noticed: Action of the corrugator supercilii in wrinkling the forehead, firm action of the orbicularis palpebrarum, and closure of the eye on that side with control over the muscles of the cheek. He could also voluntarily draw the left angle of the mouth upwards to a higher degree than the right when the latter was at rest, but in repose the left angle was slightly dropped. The left ala nasi moved simultaneously with the mouth, and there was flickering of the muscle of the chin. The appearances after the operation are seen in Figs. 17 and 18. It was striking to observe that the tongue was more drawn over to the right side, and there was a little thickness of speech, but the patient said that when he moved his face he was not compelled to move his tongue at the same time. There was some wasting of the left side of the tongue. When both sides of the face were thrown into action, the right side still overpowered the left.

This is, I venture to think, a very successful case of nerve grafting.

J. K. Young³⁶ reports a case of infantile paralysis where the tibialis anticus had been paralysed for three years. The proximal extremity of the nerve supplying the anterior tibial muscle was divided, and a slit having been made in the musculo-cutaneous nerve, the cut extremities were inserted into this, and secured with fine formicized catgut. A year and a half afterwards all the muscles of the anterior tibial region gave a good response to a slowly interrupted faradic current, the tibialis anticus being fainter than the others. But, unfortunately, Young gives no details as to volitional movement or the return of co-ordination. In the discussion on J. K. Young's case, Spitzzy of Gratz said that recent investigation showed that regeneration in quite degenerate muscles took place if connexion were again made with the centre, which he instanced by a case of paralysis in the facial area, where recovery took place after nearly eight years as the result of operation. He pointed out that the seat of co-ordination is in the brain, and that this can be re-educated, and further alluded to the two theories of regeneration: one that it is by the growth of the axis cylinders alone downwards into the degenerated nerve that the connexion is made; and the other view, which is held by Messrs. Ballance and Stewart, that regeneration can take place in the distal part by the development of the cells in the sheath of Schwann as well. Other recent work on the subject has been done by Henriksen,³⁷ Spiller,³⁸ Müntz,³⁹ and Bethé.⁴⁰ Hans Spitzzy⁴¹ has carried out in children transference from the superficial branch of the obturator nerve to the anterior crural for paralysis of the extensor muscles of the thigh. Reference must be made to his papers on the subject.

I have performed four operations for infantile paralysis of the leg, and one for palsy of the fifth and sixth nerve roots.

CASE IX.—Paralytic Talipes Calcaneus: Grafting of the Nerves to the Soleus and Gastrocnemius from the Internal Popliteal to the External Popliteal: Recovery.

F. R., aged 9, was admitted to Westminster Hospital on October 21st, 1905, for paralytic talipes calcaneus of seven years' standing, with contraction of the plantar fascia. The electrical reactions were as follows: All the muscles of the left leg below the knee reacted to faradism, excepting the gastrocnemius and soleus. With regard to galvanism, so far as the gastrocnemius and soleus are concerned, A. C. C. > K. C. C., but in the remaining muscles of the leg K. C. C. > A. C. C.

On November 4th the plantar fascia was divided as a preliminary measure. As to nerve-grafting, it is known that the external head of the gastrocnemius is supplied by one branch from the internal popliteal, and a separate branch supplies the internal head of the gastrocnemius and soleus. The operation on November 13th was accordingly planned on this arrangement of nerve supply. A median incision was made in the middle of the popliteal space, and the internal and external popliteal nerves exposed, and then the two heads of the gastrocnemius and the soleus, with the nerves supplying them. These nerves were traced up into the internal popliteal trunk, and as the bundles remained visibly distinct in that trunk for a considerable distance, there was no difficulty in dissecting them off the main trunk of the internal popliteal nerve for 1½ in. The branches to the paralysed muscles were then separated from the internal trunk, an incision made into the external trunk until white

matter exuded, and the two nerve branches were inserted into the external trunk at a distance of ½ in. from each other. The wound was then closed, and it healed without difficulty, the leg being put up in splints to prevent movement at the knee-joint.

On December 18th the electrical reactions of the muscles were as follows: None to faradism of the gastrocnemius and soleus, and to galvanism A. C. C. > K. C. C., but the contraction was

very slight. On December 29th there was slight evidence of return of power in the calf muscles, and the tendo Achillis was felt to become slightly tense on voluntary effort. On January 9th the electrical reactions were: To galvanism A. C. C. > K. C. C., but very slight reaction, and to faradism nothing, yet the boy had acquired the power of extending the foot, and the tendo Achillis was distinctly felt to harden. On January 31st the power of extension had increased, and on February 7th the improvement in the power of extension was very marked, a considerable effort on the part of the surgeon being required to neutralize it. It will be noted that in this case, within nine weeks of the operation, power had commenced to return in the paralysed muscles. It is striking to notice that on February 7th, the last day on which the reactions were tested, no reactions could be obtained in the gastrocnemius and soleus to faradism. This shows that the only reliable tests applicable

are return of movement and visible tightening of the tendon when movements are attempted.

CASE X.—Complete Paralysis of Gastrocnemius and Soleus: Talipes Calcaneus: Nerve Grafting: Recovery.

Willie T., aged 9, was admitted to Westminster Hospital on May 19th, 1905. He had infantile paralysis when aged 2½, but recovery took place, except in the gastrocnemius and soleus and in the right erector spinae. He could dorsiflex and evert the ankle, but inversion movements were not quite so powerful as normal, and he was totally unable to extend the ankle. He had been treated at Queen Square by massage and electricity

for three months, and had worn leg-irons for three years. At Westminster Hospital efforts were made to improve him by massage and electricity, but no results followed. On June 5th the muscular branches of the gastrocnemius and the soleus were dissected out and stimulated by sterilized electrodes. A precisely similar operation was carried out as in the previous case, but for a considerable time no effect was noticed. On September 13th he was tested electrically by Dr. Purves Stewart, and no reaction to either faradism or galvanism was found. On October 1st it was noticed that voluntary extension of the ankle had appeared, but he could not extend the foot beyond a right angle. In this case four and a half months elapsed before any sign of voluntary power was seen. Since then the power has increased, and exceeds that of the previous case. On standing with the whole weight of the body on the foot, he can raise the heel ½ in. off the ground.

CASE XI.—Paralytic Talipes Equino-Varus: Insertion of External Popliteal into the Internal Popliteal Nerve.

W. H., aged 5, suffered from paralytic talipes equino-varus.

Fig. 14. Before facio-hypoglossal anastomosis (Case VIII). Fig. 15. Left side of face paralysed. In Fig. 16 the face is seen at rest.

Fig. 17. After facio-hypoglossal anastomosis. James B., aged 19. Operated on October 16th, 1905. Appearances presented on February 7th, 1906 (Case VIII). Fig. 17, showing the return of power on the left side of the face. Fig. 18, the face in repose, showing traces of the facial palsy.

The tibialis anticus and posticus on the right side were divided, and on July 31st, twenty days after this operation, the external popliteal nerve was divided across and its distal end inserted into the internal. On October 25th it was noted that no definite recovery of the affected peronei had taken place, and so far the result is not satisfactory; but he is under observation, and the case will be reported on later.

CASE XII.

In a similar case I also inserted the external popliteal into the internal popliteal on July 3rd, 1905. In this instance the peripheral and central ends of the external popliteal were inserted into the internal popliteal (see Fig. 19) for talipes varus, and this boy, on February 7th, showed no satisfactory signs of recovery, seven months after the operation.

Fig. 19.—Insertion of external popliteal into internal popliteal, both central and peripheral ends of external popliteal inserted into internal popliteal. A, Central end; B, peripheral end.

CASE XIII.

I may also refer to a case of Erb-Duchenne paralysis of the fifth and sixth nerve roots in a child aged 2½, where I inserted on October 24th, 1905, the outer cord of the brachial plexus into the middle cord. So far, no results have followed, except that the general use of the parts, especially the forearm and the extensors of the wrist, is greater, but on February 7th, 1905, no definite results have followed.

Thus, in 6 cases of nerve grafting during the past year, 3 have proved successful; 2 of the successful cases were shown at a meeting of this Society in October.

In nerve grafting it is evident that there must be a grave risk of the mingling of fibres of antagonistic muscles, so that few co-ordinate movements of a fine nature can result. It all depends upon the question of division of fibres. If a cut nerve fibre in the proximal end divides, and one branch goes down the main trunk of the original nerve and the other down the nerve which has been grafted in, then some antagonism will result; but if the two branches of a cut nerve fibre go down in one trunk, then antagonism will probably not take place. And the question is, What really does happen to the fibres? Kilvington* has suggested that it is better to divide the reinforcing nerve completely across, and to insert the distal part of the reinforcing nerve and the distal part of the nerve to be reinforced into the central end of the reinforcer (Figs. 11, 12, and 13).

Surgical interference in paralysis of the brachial plexus is a very difficult matter. Wilfred Harris and Warren Low⁴² read a paper insisting upon the importance of accurate muscular analysis in lesions of the brachial plexus, and they have proved by experience and experiment that in Erb-Duchenne paralysis the sixth nerve root is usually unaffected.

Sufficient has been said to show that nerve anastomosis is well within the range of operative therapeutics. In Spitz's operations, up to the time of writing in 1905, only 50 per cent. of cures or improvements had been recorded. We have to consider how far the operation is justified. It seems a bold procedure to cut a paralysed nerve, and implant its peripheral end into a sound nerve, and a still bolder procedure to cut a slip from a healthy and important nerve. We wish to know what is the effect of these procedures on healthy muscles, and Körte remarked, in his case of implantation of the paralysed facial nerve into the hypoglossal, a slight atrophy of the tongue, so that we must weigh carefully the chance of injuring a sound nerve. The next point we must know is whether the muscle which has been again brought to life by this operation can learn to functionate independently. The drawback of some of the facio-accessory anastomoses has been the appearance of movement simultaneously in the trapezius and the face. What is required is to create independent muscle function, so as to be able to obtain truly co-ordinate movements. I venture to suggest that great care should be taken to ascertain in any nerve the exact position of the nerve bundles supplying certain muscles and groups of muscles. This appears to me an essential step.

CONCLUSION.

In conclusion, we feel that in attacking paralytic affections, either by tendon grafting, muscle transplantation, or nerve anastomosis, we are confronted by most intricate

* Most valuable suggestions are made in Kilvington's paper on Regeneration of Nerves (BRITISH MEDICAL JOURNAL, 1905, vol. i, p. 935, and vol. ii, p. 625), and to him I am indebted for much information.

problems, but the early results, considering the comparative failure of all the preceding measures, seem to justify a very careful and well-considered trial in suitable cases.

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A CASE OF MYXOEDEMA.

DEMONSTRATED TO A MEETING OF THE EDINBURGH AND OTHER SCOTTISH BRANCHES OF THE BRITISH MEDICAL ASSOCIATION.

BY SIR THOMAS FRASER, M.D., F.R.S.,

PROFESSOR OF MATERIA MEDICA AND CLINICAL MEDICINE, UNIVERSITY OF EDINBURGH.

ALTHOUGH cases of myxoedema cannot now be regarded as rarities, I have been induced to show this patient because he very completely exhibits the typical symptoms of the disease, and also because the effects of the well-known thyroid treatment have been well displayed in his history.

He is a carter and labourer, 42 years of age. The typical symptoms are manifest in the broad, congested face, dull heavy expression, elevated and wrinkled forehead, swollen lips, large broad tongue, and double chin. The skin is dry, thick, and rather scaly. The neck is massive, with lump-like elevations at the base above each clavicle, and the hands and fingers, and to a less extent the feet and toes, have the broadened, thick, and spade-like appearance which adds to the outward typical symptomatology of this disease. The hair, though scanty, is now much more abundant than it was earlier in the course of the illness. The less conspicuous manifestations—such as the slow rate of the heart and of the respirations, the sluggish mental processes, the lowered temperature, and the recurring cramps—are also present.

The patient first came under observation in 1901, when he had already been ill for at least three years, so that the affection has lasted for at least eight years. In 1901 his appearance was similar to that which he now presents.

He was treated with thyroid gland; speedy improvement occurred, and in a few weeks all the symptoms disappeared, the weight diminishing from 13 to 10 st.

For several years he has taken thyroid gland regularly, and has thereby maintained a nearly normal standard of health. About three months ago straitened circumstances prevented him from buying thyroid glands or their preparations, and a fortnight after their deprivation several of the original symptoms—such as feelings of coldness, huskiness and slowness of speech, and swelling of the face—returned, and in less than two weeks thereafter nearly a complete picture of myxoedema was reproduced, with, however, scarcely so advanced a development of the symptoms as in the original state and before he had received any thyroid treatment.