The varying degree of virulence of the attacking organism is of supreme importance. The great majority of cases of tuberculosis are fortunately of low virulence, and, given suitable conditions, are favourable for treatment; but in some cases the virulence is so high as to destroy the person in a few weeks or months, and these are the cases popularly known as galloping consumption.

From my own observation I am inclined to think that in this country the virulence of the tubercle bacillus is less than it was thirty years ago. The number of deaths in England and Wales from tuberculosis in 1920 was 12,000 less than in 1919, a most gratifying record of progress in dealing with this terrible disease, which destroys 60,000 lives each year in England alone.

A large percentage of the population receive at some period of their lives a mild infection of tubercle which, in many cases, produces no definite symptoms. These persons recover, and are to some extent immunized against a further and more severe infection.

If we can induce some immunity by artificial means in children whose parents or relatives are tuberculous, and who by constant association with them are very liable to infection, we will have gone a long way towards stamping out tuberculosis. As Roemer says, "The most important problem in the prophylaxis of consumption is the saving of children in phthisical homes from severe tuberculous infection."

The vaccine which I have had prepared from these attenuated cultures is a bacillary emulsion of the bacilli, and contains all the products of the bacillus. It is non-toxic and avirulent, and produces no reaction even in large doses.

For purposes of immunization in susceptible children six injections are given at weekly intervals, and repeated in three months. The doses recommended are 0.001, 0.002, 0.003, 0.004, 0.005, and 0.006 mg. No symptoms whatever have been observed to follow these injections.

In the treatment of the active disease the doses used are much larger than have been possible hitherto; it is recommended that the treatment should consist of at least twelve injections given in increasing doses at intervals of seven days. The doses commence at 0.001 and increase to a maximum dose of 0.025 mg. The vaccine should be freshly prepared from the cultures, and should not be used after one month.

Our chief object in the treatment of active tuberculosis is to limit the spread of the disease in the organs. If we can locate a recent deposit in the apex of a lung, and prevent its extension throughout one or two lobes, the patient will have a good chance of recovery, and I maintain that we can only do this if we can provide his blood with some active immunity with which to resist the infection.

This vaccine, prepared as it is from avirulent cultures, can be used with complete safety in any stage of the disease, and even in advanced cases I have observed great relief from night sweats, toxic symptoms, and erratic temperatures. I have treated 118 cases of tuberculosis with various forms of the products of these attenuated bacilli, but I have decided that the bacillary emulsion is the best preparation.

The results in suitable cases are excellent, but it would require at least two years to gauge accurately the effect of the vaccine for purposes of immunization.

I have succeeded in completely immunizing highly susceptible animals against tuberculosis by the use of attenuated cultures which have required fourteen years' subculturing in the laboratory, and I firmly believe that if all children with a tuberculous history could be safely vaccinated in the manner I have described they would be placed in a better position to resist infection at home.

Prevention is better than cure; and if we are to eradicate consumption, as I firmly believe we will, it can only be by preventing infection of healthy people, and especially children, rather than by devoting all our energies to the cure of those already infected.

The amount of tuberculosis conveyed to infants and young children in milk derived from dairy cows suffering from tubercle is enormous. It is estimated that over one million dairy cows in this country alone are tuberculous, and there seems to be no improvement in this disgraceful state of affairs. The simple process of raising the temperature of the milk to 190° F. makes it perfectly safe,

and does not in the slightest degree impair its nutritive value. Sterilized and proprietary milks are quite safe, and free from tubercle, and should be used in preference to unboiled cow's milk.

THE SURGERY OF THE PERIPHERAL NERVE INJURIES OF WARFARE.*

BY

HARRY PLATT, M.S.LOND., F.R.C.S.ENG.,

SURGEON, AND SURGEON-IN-CHARGE OF ORTHOPAEDIC SERVICE, ANCOATS HOSPITAL, MANCHESTER; SURGEON-IN-CHIEF, GRANGETHORPE ORTHOPAEDIC HOSPITAL (MINISTRY OF PENSIONS), MANCHESTER.

ANALYSIS OF A PERSONAL SERIES OF OPERATIONS.

General Survey.

AN analysis of the total operations performed in my services in the period from March, 1915, to December, 1920, is given in Table I. The figures may be taken as representative of an average individual operative experience, and it is therefore safe to refer briefly to certain general information that the statistics themselves afford.

The frequency with which the ulnar nerve called for treatment, the infrequency of operations on the brachial plexus, and the complete absence of any operation on either the musculo-cutaneous or circumflex nerves in the upper limb, or the anterior crural nerve in the lower limb, are facts to be noted.

In the various types of operation the phases through which the operator passed are illustrated in the large number of operations of the bridge type, and those in which repair was abandoned.

Analysis of Results.

Of the operations in this series it has been possible to investigate the early and later results over periods extending from six months or more in 248 only.

It must be admitted at the outset that this study includes few if any *true* end-results. The most reliable records in our possession are those of the operations performed since 1917, when the advantages of a more efficient segregation of the patients, and the inauguration of the follow-up system were available. But though the conditions were such as in civil surgery might be considered ideal, the greater number of the patients could be kept in hospital for short periods only, and were then distributed in various parts of the country. This difficulty, which has been experienced by all surgeons, explains the comparative paucity of the operation statistics hitherto available.

TABLE I.—Total Operations.

	Suture.	Neurolysis.	Bridge.	Repair Abandoned.	Partial Suture.	Exploration: No Lesion.	Exploration: Nerve left in situ.	Injection.	Exploration: First Stage.	Total.
Brachial plexus ...	5	4	—	—	—	2	—	—	—	11
Musculo-spiral ...	51	15	5	14	—	1	—	—	—	87
Median ...	70	45	6	—	5	2	—	1	1	132
Ulnar ...	115	49	12	—	—	1	5	—	—	182
Posterior interosseous	1	—	1	—	—	—	—	—	—	2
Sciatic ...	51	9	3	—	2	1	—	—	4	70
External popliteal ...	14	2	—	6	—	—	—	—	—	22
Internal popliteal ...	—	2	—	—	—	—	—	—	—	2
Posterior tibial ...	—	1	1	—	—	—	—	—	—	2
Total ...	307	127	28	20	7	7	8	1	5	510

Operations for severe causalgia, 25—

Median ... 14

Sciatic ... 10

Internal popliteal ... 1

Operations in which end-to-end suture failed, 53.

Successful suture at second attempt, 1.

Failure of suture at second attempt, 3.

* Part of a Hunterian Lecture on The Results of Operations for the Repair of Nerve Injuries, delivered before the Royal College of Surgeons of England.

In this post-operative study the presence or absence of signs of recovery have been recorded after personal examinations only. Whilst many patients living at a distance have from time to time replied to inquiries as to their progress, suggestions in their reply indicating recovery or otherwise have always been ignored. It is perhaps unnecessary to lay stress on the fallacies of conclusions drawn from such impersonal investigations; my excuse is that one has occasionally seen in the possession of out-patients forms which were to be filled up recording the impressions of the man himself on the alterations in the sensory and general functional condition of his limb.

The 248 operations from which information as to results have been available include 150 cases of end-to-end suture, 80 of neurolysis, and 18 of bridge operations.

RESULTS OF END-TO-END SUTURE: 150 OPERATIONS.

In a preliminary report based on a study of 271 suture operations, issued a year ago by my colleague Stopford,¹ the bulk of my own operations up to date were included. The experience of a further period of twelve months has made it possible to collect additional evidence concerning the fate of a considerable number of the patients with whom we have been in touch.

TABLE II.—End-to-end Sutures: Total, 150.

	Total.	Proximal muscles only.	Proximal and Distal (incomplete).	Proximal and Distal (total).	Distal alone.	Associated Sensory Recovery.	Sensory Recovery alone.	Number of Recoveries.	Failures.
Musculo-spiral ...	35	10	11	5	—	all	—	26	9
Median:									
Upper arm ...	10	7	3	—	—	in 5	—	10	nil
Forearm ...	20	3	—	—	6	in 6	8	17	3
Ulnar:									
Upper arm ...	27	19	3	—	1	in 14	1	24	3
Forearm ...	20	—	—	—	10	in 14	7	17	3
Sciatic: Trunk ...	21	16	nil	nil	—	in all	—	16	5
Segmental ...	4	2	nil	nil	—	in all	—	2	2
External popliteal ...	9	4	nil	—	—	in all	—	4	5
Posterior interosseous	1	—	—	—	—	—	—	nil	1
Plexus ...	3	2	—	—	—	2	—	2	1

Recovery, 118 = 79 per cent.; failure, 32.

The frequency and type of recovery after nerve suture are illustrated by the statistics in the tables. The facts as to the recovery of motor function are arranged under the headings of the proximal and distal muscle groups, a classification which is found to be convenient, particularly for the upper limb. In the whole series there are no examples of absolutely complete and perfect recovery, excepting possibly in 5 of the cases of musculo-spiral and 2 of those of external popliteal suture.

The operations in which the existence of recovery is charted include every variety and type of incomplete restoration of conduction in the sutured nerve. It is not considered a logical procedure to classify such recoveries into further arbitrary special divisions, such as "slight," "marked," and so on, for the simple reason that the periods of post-operative observation are not constant for any one group of allied operations. Given long periods of time, many of the imperfect recoveries of to-day will progress, or have already progressed, towards the stage of complete recovery. The standard of failure adopted in my analysis is the complete and stationary absence of recovery after a year or more, in some cases confirmed by evidence obtained on re-exploration.

With regard to sensory recovery, in very few cases has there been more than a slight recession of analgesia or an incomplete restoration of protopathic sensibility.

The information and conclusions as to the late results of suture may best be embodied in a consideration of the main factors which have determined, delayed, or entirely prevented success.

1. The Period of Delay between the Original Injury and the Performance of the Operation.

In my own series the influence of the time factor has been definitely proved. As a general rule sutures performed within a period of eighteen months show little appreciable differences in the time of the onset of recovery, or the rate and ultimate completeness of the recovery. After a delay of two years recovery is often tardy or incomplete; in some cases it fails completely. This truth has long been established as a fundamental factor in prognosis in the older nerve surgery (Kennedy).²

My records confirm what has been pointed out in Stracker's careful analysis of the operations performed in the clinic of Hans Spitzzy of Vienna—that the degree of delay within the safe period does not influence the percentage of cases showing recovery, and does seem to prejudice the ultimate quality and type of the regeneration. In complete failure the time factor, quite apart from other influences, plays an important part. It is assumed that this is dependent on the development of permanent retrogressive changes in the spinal cells, and to a much less degree to peripheral degenerative changes in the muscles. On the other hand, it would appear from the analysis of the operation results in the service of Sir Harold Stiles of Edinburgh that this factor exerted a negligible influence (Forrester Brown).

2. The Recrudescence of Septic Infection in the Limb.

Recrudescence of infection at a period after the suture was seen in a number of cases in my series; where this arose spontaneously it does not appear always to have affected the regenerative process, but it has been my fate to see a definite recession in the regeneration which had already begun, after the exploration of an associated ununited fracture, followed by infection. This unfortunate sequela is one which could have been avoided, and perhaps is hardly to be cited as a fair test of the resistance or lack of resistance to sepsis of the regenerating nerve. In the recovery stage of a number of cases of suture of the sciatic nerve the trophic ulceration seen under the base of the fifth metatarsal, or in the terminal phalanx of the great toe, where definite necrosis has resulted, provides a continued source of infection, which might conceivably be absorbed and travel upwards towards the area of suture. Delay or cessation in recovery has been invariably associated with this complication, and I would suggest that it is in some way connected with the absorption by the regenerating nerve of distal sepsis.

3. Anatomical Situation of the Suture.

The distance of the line of suture from the spinal centres, or conversely from the distal extremity of the limb, is seen to be an important factor in determining the fate of the regenerative process. This is illustrated by a study of the time of onset of the appearance of recovery in the muscles supplied at successive levels, and in a comparison between the results of suture in the proximal and distal parts of the limb respectively. The times of the appearance of recovery in the chief muscle groups have been carefully charted in Stopford's recent contribution, and are seen also in the monograph of Stracker already referred to.

Recovery in the proximal muscles begins at an earlier or later date according to the proximity of the suture to the spinal cord, and occurs in regular descending fashion in accordance with the anatomical origin and distribution of the motor branches. Thus, for example, after suture of the musculo-spiral nerve in the upper, middle, and lower third of the arm, return of power is manifest in the supinator longus at about the seventh, sixth, and fourth months respectively. Distal recovery also shows these differences in time relation. In Stracker's figures no recovery was seen before one year after suture in the distal muscles of the musculo-spiral, median or ulnar supply, and this irrespective of the level of the suture. On the whole this is borne out by the records of my own operations. Thus the time taken in neurotization of the distal muscles is not entirely dependent on the distance which down-growing axons have to travel. It has been concluded from this that the results of suture are better in the proximal part of the limb than in the distal. Stracker states that, in general, sutures below the origin of the proximal muscle branches give bad results. This would appear to be correct as a broad statement, but on careful

examination requires certain qualifications. If the results of suture of the median and ulnar nerves in the upper arm and forearm are compared as regards distal recovery alone, both motor and sensory function combined, which means that a period of twelve months at least must have elapsed, the quantitative recovery appears to be roughly equal in each group.

4. Influence of Topography.

The inaccuracies of regeneration due to the shunting of motor fibres along sensory channels and vice versa are undoubtedly one of the causes of imperfection in the recoveries, and may be of such a degree as to determine complete failure. It has been impossible in a close perusal of one's operation records to correlate in each case the potential influence of this factor with the type of recovery seen. In the sciatic nerve sutures it has been easy to retain an accurate topography, whilst in the musculo-spiral the comparatively scanty sensory bundles, even when misdirected, have not prevented the transmission of a large proportion of motor fibrils along appropriate channels. The exact rôle of topographical errors, as applied to the individual operations, cannot be settled until it is possible to examine a large number of successful sutures of the median and ulnar nerves after a period of three years or more. In certain situations—for example, in the lower half of the forearm—where suture of either the ulnar or median nerves has been achieved with what might be claimed as faultless topography, little direct proof of its beneficial effect is obtained.

Topographical failure is best illustrated by the suture of a nerve of smaller calibre to a larger trunk, as in the case of suture of the posterior interosseous to the musculo-spiral, and of the anterior tibial and musculo-cutaneous to the external popliteal—operations which account for 8 cases traceable in my series, and in all of which complete failure resulted. The topographical factor in regeneration is, however, usually cited as an illustration of the apparent superiority of the results of suture of the musculo-spiral nerve over those of the median and ulnar nerves, and of the delay or absence of recovery in the distal muscles.

5. The Influence of Perineural Surroundings— The Nerve Bed.

It does not appear from my own observations that the perineural surroundings have influenced the occurrence of recovery after nerve suture in any way, except in a few cases where the nerve trunk has been subjected to the friction of a bony groove, as in the case of the ulnar at the elbow, or has been left in close relation to bare tendons—for example, median suture at the wrist. The deleterious effects of a nerve bed of this type have contributed to the complete failure of one case of ulnar and one of median suture, but such failures are to be regarded as preventable.

6. The Influence of Complications.

(a) *Vascular*.—In a number of upper arm sutures of the median or ulnar nerves or both, where ligation of the brachial artery has been performed in the early days of the injury, there has been little appreciable effect on the rate and degree of recovery. Where contractures and other signs of ischaemia have coexisted and the total mechanical disability is naturally great, the clinical evidences of the recovery of the nerve have often been masked.

(b) *Non-union of Fractures*.—The continued existence of non-union of a fracture without active inflammatory signs in the neighbourhood of the recovering nerve has retarded or prevented recovery in two musculo-spiral sutures in my series; one showed a failure of distal regeneration after four years, and the other a total absence of any sign of recovery. These failures are to be attributed to the effect of tension and friction.

7. The Continuance of Active Interstitial Neuritis in the Proximal Nerve.

This is a potent cause of delay or failure, which theoretically is avoidable by a free resection preparatory to suture. But it is certain that histological evidence of interstitial change may often be present in the proximal part of the nerve trunk when there is little or no macroscopical sign of its existence. Where there has been a long delay owing to the presence of inveterate sepsis in the limb, the interstitial neuritis finds its maximum

development. In my own operations complete failure or imperfections in recovery have been dependent on this factor, and particularly in the sciatic nerve, where the ill effects are manifested during the stage of tardy recovery by the development of the signs of irritation. In three cases, after a period of more than two years, the pain in the internal popliteal distribution is a most serious handicap to the patient and continues to defy every form of treatment. On the other hand, in one of the complete recoveries after musculo-spiral suture definite evidence of interstitial neuritis was seen in the proximal part of the nerve trunk at the time of operation, and, owing to the size of the gap, the suture was performed at a level which was considered far from ideal.

Qualitative Results of Nerve Suture.

It remains now to judge the results of these nerve sutures from a qualitative standpoint. In this estimation it is necessary first of all to eliminate from the total disability of the limb the contribution of the coexisting injuries of other tissues. But function dependent on a restoration of nerve conductivity alone is itself essentially complex. Success depends not merely on the simple restoration of adequate motor and sensory conduction, but on the development of co-ordination in the particular movements in which the efferent and afferent supply of the sutured nerves are concerned.

In the musculo-spiral sutures where full conductivity has been restored, and where recovered muscle groups have achieved considerable power, there has been as yet no perfect individual extension of the fingers, no synergic function in the extensor muscles of the wrist, and there is on the whole an imperfect control over the extensor muscles of the thumb.

In the median nerve poor function has been the rule, chiefly owing to the very limited sensory recovery. The helpless anaesthetic index finger, which is characteristic of most of these cases long after the operation, is a striking illustration of the importance in function of a restoration of the median sensory mechanism.

In the ulnar nerve, where there is often a mobile hand without contractures, the gross function is little diminished even in the presence of a complete syndrome of interruption, and full restoration is of little moment except for the skilled worker. To many of these hands the addition of conductivity in the ulnar nerve has made little or no difference in function.

The full sciatic syndrome in itself does not cause gross loss of function in the lower limb as regards the act of walking. It is difficult to estimate the increased value of the motor recovery, which at the best has been moderate power in the calf and a less complete and powerful action in certain muscles of the extensor group.

RESULTS OF THE OPERATION OF NEUROLYSIS.

Whilst it is possible to study the results of end-to-end sutures in a truly mathematical fashion, a scrutiny of the results of the operation of neurolysis is beset with many difficulties. It will be sufficient to reiterate and amplify from a consideration of the results in 80 cases what is regarded in my opinion as the legitimate scope of this operation.

In the results are seen both recoveries, partial and complete, and complete failures. There have been no rapid recoveries within the period of nerve regeneration, for the type of lesion in which this might have occurred has not been explored. Where recovery has been seen it has been on the conventional lines of the ordinary regeneration as regards time and general progress. A certain number of operations have been premature explorations for lesions of a low grade, in which spontaneous regeneration was at the time proceeding. Where failure of recovery has occurred the intraneural changes have been of such a nature and extent as to inhibit the down growth of regenerating axons, and the extraneural operation has failed to alter the intraneural conditions. Whilst improvement has occurred in the neurological syndrome after the operation of neurolysis in 75 per cent. of cases, it has been impossible to prove that the operation itself alone has determined this.

For these reasons I would urge that the limitations of the operation of neurolysis as a definitive factor in the surgical treatment of the warfare lesions of nerves are to be fully realized.

RESULTS OF OPERATIONS FOR CAUSALGIA.

My series includes 25 operations performed for severe causalgic manifestations, 14 on the median nerve, 10 on the sciatic nerve, and 1 on the internal popliteal nerve.

1. The median operations consisted of (a) resection and suture on eleven occasions (twice on the same nerve); (b) neurolysis on two occasions, and (c) one intraneural injection of quinine and urea. Of the resection and suture operations complete relief of pain followed immediately in nine; the pain was lessened but persisted indefinitely in the two resections performed in the same nerve in one patient. In this case there existed a grave contracture and a useless congealed hand when the man was first seen; ultimately the limb came to amputation. The cause of failure was the persistence of intraneural fibrosis in the nerve trunk, and its upward spread for many inches proximal to the line of suture.

Both neurolysis operations failed to produce relief and early re-exploration was necessary; in each, resection and suture was carried out with complete success.

The one intraneural injection for a mild case of causalgia produced a moderate degree of relief, and the pain showed signs of diminution with ultimate disappearance in a few months.

2. The results of resection and suture of the sciatic nerve were as satisfactory as in the case of the median, judging by the immediate relief afforded, but during the recovery stage, in three cases, the return of severe irritation has been a disappointing experience. The cause of this is also to be attributed to the progressive intraneural fibrosis.

3. The one neurolysis operation performed on the internal popliteal nerve, for what appeared to be a true severe causalgia, was followed by immediate cessation of the pain. In this particular case a strong functional element was present, and it is not certain that true causalgia existed, although the symptoms were mimicked very closely.

In the exploration of a nerve which exhibits a condition of profound irritation, the hyper-excitability of the nerve trunk and the muscles supplied by it, both above and below the lesion, is a striking phenomenon.

The efficacy of the operation of early resection and suture for severe causalgia is beyond criticism. It would appear to be a more exact procedure than the equally or even more destructive method of alcohol injection. It has not been my experience to meet the type of case in which still more drastic procedures have been inevitable, such as section of the posterior roots.

The operation of Leriche,³ stripping of the periarterial sheath, is founded on an erroneous conception of the anatomical situation of the vasomotor fibres of the limb, and is to be mentioned merely for the sake of completeness.

GENERAL CONCLUSIONS ON THE LATE RESULTS OF NERVE OPERATIONS.

References have been made from time to time to the results quoted in other contributions to the literature of the peripheral nerve surgery of the war. From this literature, already vast, it has been impossible to collect and compare on any recognized standards the total statistics as to the late or end results of the various forms of operations. From a wide study of this literature, and an intensive study of my own material, it is possible merely to enunciate broad generalizations influenced in particular by the consideration of the causes of failure and success.

During the past year it has become increasingly difficult in this country, at any rate, to keep in touch with the patients who have been operated upon, even during the last two years. The chances of acquiring further comprehensive knowledge regarding true end-results would therefore seem to be slender. This is a bitter disappointment after the labours of a number of years. But, for some little time, a small stream of patients with nerve injuries still unoperated on, or showing failure after previous operation, will continue to flow into the surgical centres of the Pensions Ministry. Such patients, on the whole, are now undesirous of submitting to operative procedures. But the surgical lessons gained from the amount of experience behind us are yet to be applied for the benefit of a few. And it is of great economic importance that clear indications as to the advisability at this date of the exploration or re-exploration of the injured nerves should be laid down.

Every lesion will date back at least two years, so that the optimum period for the surgical repair of the nerve is now past. But for perhaps a year longer it will be worth while advising operation in selected cases. Before doing so, the economic value of the restoration of nerve conduction to the future capacity of the limb must be gauged. In many limbs an operation is now a waste of time. From a serious consideration of the problem as it presents itself at the time, it is suggested that the exploration or re-exploration should be considered under the following conditions:

• 1. In complete lesions of the median or ulnar nerves in the upper arm restoration of function in the proximal muscles is to be expected, even after long periods of delay, but distal recovery may probably not take place. For lesions of these nerves, in which conduction is already present as far as the proximal branches, with the total failure of distal regeneration, exploration is on the whole advisable; but short of resection and suture, which may be unjustifiable, nothing can be done.

2. In complete lesions of the median and ulnar nerves in the forearm the potential restoration of sensation in the median is of such great importance as to warrant making every effort to ensure its occurrence. In lesions of the median in which partial sensory conduction is present, but with complete motor loss, resection and suture at this date should be strongly condemned. For the ulnar, where the intrinsic muscles are alone inactive, resection is always worth while.

3. In all complete sciatic lesions where end-to-end suture can be reasonably expected.

4. In musculo-spiral lesions exploration of the nerve should precede the performance of tendon transplantation.

ALTERNATIVE OPERATIONS.

Although a technical consideration of those alternative operations for the restoration of function where nerve repair has been deliberately abandoned, or has failed to ensure conduction or function, is outside the scope of the present study the question of the appropriate time and indications for their exhibition is one which is intimately concerned with the observations on the failures and successes of the suture operations.

Where the nerve lesion is declared to be irreparable after an exploratory operation, the indication for the performance of an alternative operation is clear. But in the case of imperfect function following the incomplete restoration of conduction the rôle of the alternative operation cannot be so readily defined. Many of the operations performed under the latter heading have been premature, and have been done early in the reconstructive surgery of the war when the normal prolonged stage of recovery of the injured or repaired nerve was not fully realized. The capacity for regeneration and ultimate function of the nerve after repair is apt to be minimized. Every surgeon who has lived close to this problem must have felt at times despondent. The immediate failures, or late failures, are easily explained, and many of the causes can be avoided. It is likely from what we have seen of the behaviour of the regenerating nerve that after long periods of time in a considerable number of instances there will be well marked recovery of function. It is to be admitted, on the other hand, that to wait for a future recovery of uncertain value is likely to be unsound. Again, the alternative operation itself may in no way jeopardize the recovery of the nerve, and therefore little harm can be done by its early performance. Few of the alternative operations have entered permanently into one's surgical repertoire. In the upper limb these are above all the now classical operation of tendon transplantation for irreparable musculo-spiral injuries, the results of which are extremely gratifying; the simple tendon transplantations for restoration of flexion of the fingers or thumb in median and ulnar injuries; and, in the lower limb, the destructive operation of tenodesis of the ankle as an alternative to the lifelong wearing of apparatus.

Recently a new procedure has been added to the alternative operations which belongs to peripheral nerve surgery itself. This is the implantation of the proximal end of the radial nerve into the median nerve at the wrist—an attempt to restore that lost sensory function in the median area which produces such a grave incapacity. This operation was introduced by Harris⁴ of Toronto, and is

supported by the report of one successful case. For the few irreparable lesions of the median nerve in the forearm this operation may be worth a trial.

REFERENCES.
¹ Stoptford, *Brain*, May, 1920. ² Kennedy, *Lancet*, July 5th, 1919.
³ Leriche, *Presse Médicale*, April 20th, 1916. ⁴ Harris, *Journ. Orthop. Surg.*, September, 1920.

HERPES AND VARICELLA.

BY

E. H. R. HARRIES, M.D., B.S.LOND., D.P.H.,
 MEDICAL SUPERINTENDENT, BIRMINGHAM CITY
 HOSPITAL, LITTLE BROMWICH,

AND

EVELYN DUNDERDALE, M.B., CH.B. EDIN.,
 ASSISTANT MEDICAL OFFICER, BIRMINGHAM CITY HOSPITAL,
 LITTLE BROMWICH.

THE following account of an outbreak of varicella in a ward, apparently originating in a case of herpes zoster, seems of sufficient interest to record.

W. G., female, aged 8 years, was admitted to a diphtheria ward on November 16th, 1920, suffering from a severe attack of that disease. Unfortunately she developed scarlet fever from another case admitted with diphtheria, who was also incubating scarlet fever. W. G. was transferred to a small ward, X, on the same day. Here were three other children, M. T., A. F., and L. Y. For administrative reasons these four children were moved on January 27th to a large ward, F., containing twenty-five beds and cots.

On February 4th, a week after transfer, W. G. developed what appeared to be a typical herpes zoster over the area supplied by the twelfth dorsal and first lumbar nerves on the left side. The distribution extended completely round the left side of the trunk, within the area indicated—that is to say, from the mid-line in front to the mid-line behind. The lesions were closely set and went through the usual changes of herpes zoster. As the question of the relationship of herpes and varicella was in our minds for investigation when opportunity should arise, a careful examination was made for scattered lesions elsewhere on the body, and none were found. The point that we should like to mention particularly is the fact that the child had absolutely no pain, either before or during the persistence of the lesions. Herpes zoster, of course, is commonly a painful affection. W. G. had no previous history of varicella and presented no scars of a former attack.

On February 17th—that is, thirteen days after—three children in the ward developed varicella; on the following day, the 18th, four more showed the typical lesions, and by February 27th another child had incubated the disease. The position of the children in the ward, their respective ages in years, and date of onset of varicella, were as follows:

South Side of Ward.

No. of Bed.	
1.	Died. S.F. and Diph.
2.	V.P. Aged 6.
3.	V.P. Aged 5½.
4.	X. Aged 6.
5.	W. G. Aged 8. Herpes zoster. February 4th.
6.	L. Y. X. Aged 7.
7.	V.P. Aged 9.
8.	V. Aged 7. February 27th.
9.	V.P. Aged 7.
10.	X. Aged 12.
11.	X. Aged 6.
12.	V. Aged 5. February 18th.
13.	V. Aged 6. February 17th.

North Side of Ward.

No. of Bed.	
14.	X. Aged 5.
15.	X. Aged 3½.
16.	M. T. V. Aged 4.
17.	X. Aged 5.
18.	X. Aged 4.
19.	A. F. V.P. Aged 6.
20.	V. Aged 2½. February 17th.
21.	V. Aged 4. February 17th.
22.	V. Aged 2. February 18th.
23.	V. Aged 5. February 18th.
24.	V.P. Aged 7.
25.	X. Aged 8.

V.P. = Varicella previously. X. = Exposed to infection.
 V. = Exposed to infection and developed typical varicella.
 L. Y., M. T., A. F. = three patients from Ward X.

No case of varicella had occurred in the hospital for some weeks previously, and certainly the case of herpes has not been exposed, as far as is known, to any risk of varicella infection. When W. G. developed herpes she had been in hospital about eleven weeks. There had not been a previous case of herpes zoster in the hospital for some months, and then it occurred in a ward far removed from W. G.'s, and, it should be noted, was not followed by varicella. W. G.'s herpes arose *de novo*. Did she originate the outbreak of varicella, or was there a missed case presenting only one or two lesions, the time relation ship being merely a coincidence?

Morphologically, W. G.'s lesions were typical of herpes zoster. She had no previous history of varicella, nor scars of a former attack, neither has she since developed varicella as a result of contact. The complete absence of pain or even of appreciable malaise are noteworthy. The incuba-

tion period of thirteen days is on the short side as compared with previous ward outbreaks of varicella in this hospital in the earlier part of last year. Previous outbreaks have had an incubation period of from seventeen to twenty-one days. The incubation period of varicella is of course very variable, and the present outbreak may be due to another strain of the virus. Varicella in this country is practically never fatal. The experience of one of us (E.H.R.H.) at a military infectious diseases hospital in Mesopotamia was that varicella in Indian troops and followers was very common and frequently severe, death from pulmonary complications being by no means unknown. Careful pathological investigation of such cases might lead to important information upon the etiology of the disease.

CHRONIC SUPPURATIVE OTITIS MEDIA:

FOLLOWED BY LEFT TEMPORO-SPHENOIDAL
 ABSCESS AND MENINGITIS.

BY

F. HOLT DIGGLE, F.R.C.S.,

SURGEON-IN-CHARGE, AURAL SERVICE, ANCOATS HOSPITAL,
 MANCHESTER.

THE following case deserves recording by reason of (1) the presence of pus cells and bacteria in the cerebro-spinal fluid, and (2) the reaccumulation of pus in the brain after having been once successfully evacuated, with extensive paralysis and ultimate perfect recovery.

L. P., female, aged 23 years, was admitted to hospital on October 27th, 1920, in a drowsy condition, with a temperature of 101.6°, pulse 82, respirations 20.

History.

The history was only obtainable from the patient, as she had no relatives or friends. When roused she stated that she had had ear trouble (doubtful on which side) since Christmas, 1919, the cause unknown. She had severe pain in the left side of the forehead and left temporal region in Whit week 1920, and visited a hospital in the district, obtaining some relief. The headache had been worse for the last three weeks.

Condition on Admission.

She was drowsy, but could be roused to answer questions. She was slightly aphasic, complained of headache on the left side of the head. She had vomited twice since admission.

Nervous System.—(a) Motor: There was slight weakness in the grip of the right hand, no other paresis or paralysis. The sphincters were normal. There was some rigidity of the neck muscles. (b) Sensory: There was nothing abnormal as far as one could ascertain in her drowsy state. (c) Reflexes: There was slight increase of the right knee-jerk. The right superficial abdominal reflex was brisk. No ankle clonus or Babinski reflex was present. (d) Eyes: The pupils were dilated, equal, reacting to light. The discs were not examined. There was no nystagmus, no photophobia. There was marked loss of the naming centre.

Ears.—The right membrane had a small central perforation with a viscid purulent discharge. The left had marked meatal stenosis, a large vascular polypus obstructing the already narrow meatus. There was no visible otorrhoea. There was no tenderness or oedema over the mastoid processes, no pain on percussion of the cranium. The tissues of the neck were normal.

Lumbar Puncture.—There was positive pressure and a cloudy cerebro-spinal fluid. (See pathologist's report below.)

Operation (October 27th, 1920).

A radical mastoid operation was performed on the left side. The mastoid antrum was full of pus under great pressure, and very foul. The dura mater of the middle fossa, exposed by disease, was covered with granulations bulging and pulsating, and the middle ear was full of granulations. The lateral sinus and dura mater of the posterior fossa, exposed by chisel, were found to be healthy. The remains of the tegmen tympani with a portion of the squamous portion of the temporal bone were removed, and the left temporal lobe was explored. A large abscess containing very foul pus was evacuated and drained by two rubber tubes side by side (diameter ¼ inch). The auricle was stitched forward and a buttress built around the margin of the wound with gauze so as to avoid pressure on the tubes.

Pathologist's Report (Dr. Renshaw).

Cerebro-spinal fluid: Pus cells were present. A large number of Gram-negative diplococci were in the film (? *Diplococcus mucosus*), present in culture, also in agar, in large numbers.

Pus from brain abscess: Staphylococci and streptococci were present in pus in large numbers, and some long thin curved Gram-negative bacilli (? anaerobes). Necrotic debris was present, but very few pus cells. Later, *Diplococcus mucosus* was found in a culture of the brain pus.