

Section of Neurology

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DISCUSSION ON REHABILITATION AFTER INJURIES TO THE CENTRAL NERVOUS SYSTEM

Professor Geoffrey Jefferson (*in absentia*. Read by Colonel Riddoch): In peace-time most doctors were fully aware that a problem existed in the after-care of those who had suffered a head injury. It was a problem that interested not only the neurological fraternity who saw only a fraction of the cases that existed in the country as a whole, for it was not then, nor is it now, a matter in which any single type of specialist is concerned. The general practitioner is deeply interested, or at least heavily involved, and has a vital part to play. If we disagree sometimes with what he teaches his patients we have ourselves to blame for our teaching to him and, more generally, for our acquiescence with a state of affairs that has vaguely troubled our consciences without our becoming sufficiently aroused to excite concerted action. In civil hospital practice there have been great difficulties (and I fear that they will for some time continue) in pursuing a more rational policy, the chief being the lack of control over the conduct and welfare of his patient once he leaves hospital. One chief difficulty has been the deficiency in bed accommodation in first-class hospitals in which the patient might have been kept until his first stage of convalescence was completed. This has led to the patient rehabilitating himself as best he could under his doctor's supervision. And in an industrial population, which has formed the major part of my own material, this has proved to be a slow process, how slow the following figures testify. I looked up a consecutive series of 50 head injuries seen in private practice during the last two years to find out how soon these cases had been referred for specialist advice for the first time: The average time was six months (from three weeks to two years). Many were not seen until seven, eight or nine months or more after injury. By that time a neurosis had become firmly established in a number of the cases, and few were within measurable distance of returning to their work, although most were free from organic nervous defects. The worst offenders are the Insurance Companies, who allow the cases to drag on inconclusively for long periods, before asking advice from a neurological specialist. It is rarely that a case is settled in the High Court or Assize Courts in less than a year.

As to the validity of all headache after a head injury there are many honest doubters (and be it admitted, we have doubts ourselves). We are learning steadily about the mechanism of headache and are abandoning some time-honoured creeds, notably the relationships between pressure and headache as against local distortions of dural septa and traction on, or pulsation of, vessels. We do not yet know with certainty how to apply this knowledge to those with head injuries, except that we have comparative knowledge that pain that continues with unwavering intensity for months on end rarely has an organic cause. But we appear to be at length on the right lines. Attractive as the "unresolved contusion" of Trotter was, it seems unlikely to survive critical scrutiny either as an entity in itself or, it follows, as a cause of persistent pain. I must avoid speaking too much about the well-known post-contusional syndrome, and we must beware, also, of the danger of coming to regard all who have had a head injury as neurotics, though it would not be far wrong to regard all of them, as I believe that we do, as potential neurotics. Too rigid a belief in such a generalization would place the post-traumatic invalids under the shadow of suspicion and medico-legal abuse from which Trotter did so much to rescue them.

What plan can we evolve to rationalize the treatment of these cases, what can we do to improve the lot of those with head injuries? Anything that we, as a profession, do must have as its first aim the benefit of the patient. I do not think that we need have any qualms of conscience on that point. Rehabilitation serves the patient primarily; it protects the social fabric indirectly. I mean that we are not sacrificing him to the needs of the State, and my experience of our own people is that they are resisting sacrifices at any such altar. Gross abuses have occurred in the past, but they have been wholly in the patients' favour; they are likely to occur again if we find ourselves unable to agree upon a plan and to act accordingly. There is first, the treatment of the patient himself; second, the bringing in of the general practitioner and regimental or unit officers; thirdly, the re-education of the general public which makes up the patient's family, his friends, his employers, his lawyers, and his judges.

Rehabilitation of the patient: after head injury.—Rehabilitation may be defined as: "The planned attempt under skilled direction by the use of all available measures to restore or improve the health, usefulness and happiness of those who have suffered an injury, or are recovering from a disease. Its further object is to return them to the service of the community in the shortest time." Although it is a new word, rehabilitation is an old purpose. All medical treatment has basically no other aim. In the early stages of hospital treatment the ministrations and supervision of the physician and surgeon, with their staffs, is to the forefront. It was well recognized in peace-time practice that the discharge of the patient did not denote the end of treatment and by the use of convalescent homes, out-patient follow-ups, and especially by the co-operation of lady almoners, a basis for subsequent supervision was present. It was, however, most used for the purpose of scientific follow-up, much less with the object of placing the patient back in work, and so was imperfect. It would be untrue to say that rehabilitation in the sense in which the term is now used would start only at the point where ordinary in-patient treatment ends, for it should have begun before. But it begins especially at the convalescent stage if we speak of measures which our hospital system has, except in special instances, hitherto lacked. And, what is more, it is carried on until the patient returns to work. It is a continuum closely interwoven throughout with the general medical care of the patient. It is a work in which all can help, and does not fall within the ambit of any one man or of any one speciality. It is planned so as to give the patient a sense of his own importance as an integral part of the social structure, to give him not only physical but mental employment day by day, and throughout the day to ensure a sense of accomplishment, of achievement. It gives him the opportunity to discover that he is, however much he is damaged, an individual with powers that he can still usefully employ. It affords him the chance of discovering that his wage-earning capacity is not lost and it should allow him to turn to other trades or means of livelihood more fitted to his powers, if that be necessary. Rehabilitation has hitherto been applied only sporadically and there are great inequalities. Indeed, as a national and planned effort rehabilitation cannot as yet be said to exist and the present fluid state of the hospital system makes it a favourable time for an experimental beginning on a reasonably wide scale. These measures should be regarded as an essential part of treatment and should be commenced, in a graded way, *as soon as the patient's condition allows*. Thus, occupation in bed and in the ward is as important as occupation elsewhere for the ambulant patient. In this way the boredom, laziness and loss of adaptability, so often acquired during a prolonged stay in hospital, will be prevented. From the first the patient must be made to realize that he is an active collaborator in his own treatment and that he must accept some responsibility in his progress towards a successful result. At this point it would be as well to emphasize the need for discipline in the E.M.S. Hospitals which varies not only from one centre to another, but from ward to ward in the same place. Complaints about indiscipline reflect on the hospital as a whole.

We do not advocate the imposition of dictatorial rule, believing that co-operation of the patient can be achieved by explanation and reasoning and that habits of tidiness and punctuality can be inculcated without hardship and by example. This is an essential principle in treatment and applies to the relationship between doctor and patient in all hospitals, whether E.M.S. or not. The methods to be employed in such treatment should include:

(1) *Diversional and also constructive occupations* of sufficient variety and varying degrees of difficulty for those still confined to bed, as well as for those who are ambulant.

- (2) *Hospital maintenance work* in the ward and outside.
- (3) *Physiotherapy*, remedial exercises, massage, physical training.
- (4) *Intellectual and recreational pursuits*.

STAGES IN REHABILITATION

Rehabilitation may be divided up into stages corresponding with the progress of the patient from his original admission to hospital, through to his discharge and back to his home and employment.

Stage 1

This covers the period during which the patient is in hospital—confined to bed or ambulant and is undergoing the early treatment appropriate to the local repair of his injury. Both Service and civilian casualties are included in this period under the agreement by which the E.M.S. cares for the injured, whatever their employment. In this stage the actual time at which the patient's interest is specifically aroused cannot be laid down definitely, because it will vary with the severity of the injury, the speed of recovery, the patient's age and intelligence, and the degree in which mental alertness and ability to co-operate have been depressed by the injury. But it should be laid down that rehabilitation in a diversional form should be instituted early whilst the patient is confined to bed. It will take the form of: Reading or being read to; jig-saw, cross-word, and other puzzles; drawing or colouring; needlework, string net and basket making; sewing, knitting, rug-making.

Speech therapy.—The retraining of speech by a Speech Therapist will be required in most cases of dysphasia. This treatment should be started when convalescence is well established, about the third or fourth week. For ambulant patients and those in wheel-chairs rehabilitation will be continued by book-binding; string and basket work; leather and metal work; simple carpentry, &c. Entertainments by concerts and films and, for the walking cases dancing is already available in some Brain Injury Centres. Patients after head injuries are often disturbed by noise and especially by general conversation. They may become distressed in a room where a gramophone is playing and other people are talking or playing games. A silence room of fair size and attractiveness should be set aside for them.

One of the most important services which rehabilitation will perform is that by instituting occupation to a time-table, the patient's day, or a considerable part of it, is dedicated to some pursuit. Clearly all such arrangements must be suited to the clinical state of the individual and the time-table will be most applicable to those advancing well in their convalescence. No doctrinaire rigidity is intended in any of the suggestions here advanced, which are to be applied with insight and judgment and modified from day to day, as needs be.

The scheme of rehabilitation above outlined refers to the patient with an uncomplicated head injury. If serious injuries exist elsewhere they might predominate and necessitate such modification of the plan as common sense dictates.

Physiotherapy will be required (it has of course already been provided in all the Brain Injury Centres). Physiotherapy should not dominate the general rehabilitation scheme which is a co-operative affair in which all branches play a helpful part. Undue emphasis has come to be laid on physiotherapy (massage, medical electricity in its various forms, and remedial gymnastics) because it has been the only kind of treatment commonly provided hitherto. Our hospitals, whilst well equipped for these treatments have lacked any organization for other convalescent pursuits, especially those that retrained the mind and took account of the personality and idiosyncrasies of the patients. It is our belief that of the two kinds of treatment, mental occupation and encouragement to do things, to make things, to use the whole body, is much the more important. Physiotherapy occupies a very small part of the patient's day and, except for remedial exercises, does not demand his co-operation. He is free for the rest of the day to follow the path of least resistance so that he tends to become the passive recipient of occasional treatment, dependent on others to get him well. However skilful physiotherapy may be, and it is commonly technically very skilful, many patients (not surprisingly) make slow progress.

The patient convalescent from head injuries is something very different. He should be urged to use his mind and to take an active part in his treatment, which will, without his interested co-operation, surely fail. With the other types of occupation included in rehabilitation there are things which excite interest over many hours of the day. In

several, e.g. where things are made with the hands, the important stimuli of competition and mimicry come into play, whilst in his constructive attempts he makes those very movements of his own with which physiotherapy teaches him for such short times and at intervals.

That the benefit of physiotherapy is often chiefly psychological cannot be denied, but this very fact calls for its intelligent use and the avoidance of misuse. During that stage of rehabilitation which coincides with the earliest stages of recovery, massage and encouragement to move paretic limbs will be the chief function of physiotherapy. Electrical methods are not advisable in the upper neuron lesions which form practically the whole of the material—the only exceptions will be the occasional facial nerve injuries and injuries to a limb or to peripheral nerves.

Stage I will last for about six weeks. This time might have to be extended in patients with chronic infections, cerebral fungus and the like, and those needing extended speech retraining. Modern surgical methods, and especially the new antiseptics give us grounds for the belief that long residence in hospital for purely surgical reasons connected with the wound will be uncommon.

The place of psychology in rehabilitation.—A bold statement on this question is necessary, and my belief is this that the proper use of the psychologist is that he should give reports on cases of head injury in much the same way that reports are given by other specialists, such as the radiologist and pathologist.

Whilst it is often instructive to know the intelligence quotient of a patient, it is more important for our purpose to assess his character, his emotional qualities, his recognition of values, his reactions to problems, his aims in life.

In the more serious injuries, where some degree of traumatic dementia has occurred, the psychiatrist's experience will fortify us in estimating the degree of mental damage.

Stage II

After some six weeks have elapsed since the injury we should be in a position to gauge the prospects of a case. Judged by experience from neuro-surgical operations, where variable degrees of considered and carefully inflicted damage is done to the brain, we know that in some six to eight weeks the effects of the operation have passed away. Reflections of this kind are important. Who can doubt that the two to three week period of invalidism that follows a section of the trigeminal root for neuralgia, or the slightly longer period after an operation for a pituitary adenoma, would be enormously extended in time were it the result of accident. Most scars are healed in two months, and after that period has elapsed the pain of a fractured skull (and I believe that most clinicians underrate bone pain) should have faded away.

Once symptoms have abated, the second stage or period of hardening commences. It seems desirable that military cases should be taken over by the respective Services for this purpose, since this gives an opportunity for canalization towards the specific goal of their line of work, whichever it may be. I shall leave discussion of the management of Service cases to the proper authorities. I will, however, outline the types of activity which are useful once the patient is fully ambulant and relatively free from complaints.

It is at this point, when daily medical and surgical supervision is no longer needed, that we advise separation of the military or Service casualties from the civilian, and it is here that the chief reconstruction and replanning between the E.M.S. and the Services will be advisable. Service patients recoverable for Service purposes ought to be rehabilitated in Service Depots under discipline and in Service pursuits.

Invalided Service and civilian patients.—The methods of treatment to be employed will be, in the main, the same as in Stage I, but with additions such as: (1) Gymnastics and physical training. (2) Continuation of physiotherapy when necessary. (3) Basket making, leather and metal work, the patient being allowed to keep the finished article on paying the cost of materials. (4) Speech-training for those with dysphasias. (5) Work in the garden. (6) Work in the carpenter's and engineer's shops. (7) Organized games—cricket, football, netball, baseball, rounders, and open-air games. (8) Walks outside the hospital grounds. (9) Visits to the town, shops and cinema, but usually with the purpose of finding out how the patient reacts to the jostle of people and the noise of traffic, to navigating himself as an entity amongst his fellow men. The same of visits to the cinema—how well does he sustain visual and auditory attention over a period of two hours or so and is he upset by the incidental noise? No patient with a head injury should go on

a bus or train journey until he has proved his ability to look after himself in this way.

It is not intended that these visits should be purely educational or therapeutic, but it is important that the doctors, in whose charge the patients are, should realize the lessons to be learned from these extramural activities. The patients must therefore be questioned about their reactions to these excursions, and progress notes made.

Physiotherapy will be applied where it is needed. The recreational side, such as attendance at dances, will be more in evidence.

An essential of rehabilitation is that it should be planned to a time-table each day. Patients should continue with a pastime or constructive work only for definite periods; he should be stopped whilst he still wishes to go on. In that way interest is maintained. Hence application at any one thing should be relatively short, especially in the earlier days of convalescence. The best plan will be to arrange 6 sessions for each patient in the day, of from forty-five to sixty minutes each, say from 9 to 12 and from 1.30 to 4.30. Everyone should be told his duties for the week with, say, Wednesday and Saturday afternoons free.

After six weeks or so in hospital with plenty of interest during Stage I he might feel himself quite well enough to return to home and to work without further preparation. It may be objected that patients will be reluctant to continue with further treatment, preferring to go home. The confidence of the patient in his treatment and the enthusiasm with which his doctors are able to advocate a continuation will determine his willingness.

The most important stage of rehabilitation is the first. The patient should be frankly told what sort of an injury he has had and what we expect the course of it will be. A great deal of our difficulties in the past have arisen because we have not been able to retain our head injury cases for long enough. Much can be done by giving the patient's doctor not only the history of the case, but also warning him against the possibility of the patient becoming a passive resister to cure. The mental resources of many of the industrial population are so few that the wonder is how they fill in the weeks and months and sometimes years that they spend in recovering. We can do much by establishing contact with the general practitioner and his counterpart in the Army, the Regimental Medical Officer. Further, by speech with the wife or relatives of the patient we can make them aware of the most important facts about head injuries and their course and can divert them from a degree of over-solicitude.

Professor Hugh Cairns: In any discussion on rehabilitation of head injury patients it is important to consider the main factors which influence the patients' disability.

(1) *The time factor.*—The time factor varies greatly from case to case. After a head injury the patient goes through a cycle, beginning with unconsciousness, thence through a stage of confusion and a period in which he is liable to headaches, to a final stage in which he is restored to normal or near-normal. This is a spontaneous process. The time taken for its completion may be in one case only a few weeks, in another as long as eighteen months, depending to a large extent upon the severity of the initial injury.

This time factor must always be taken into account in planning the rehabilitation of head injury patients, the more so because we do not yet possess adequate tests by which to measure the recovery of the higher levels of intellectual function. A man may appear on testing to have recovered his faculties completely, and yet he will fail on the intellectual level when he returns to his work. In deciding when a patient should be fit to return to work it is therefore necessary to bear in mind the severity of his injury, and the best yardstick at present available is the duration of the post-traumatic amnesia (P.T.A.). As a working rule I would suggest that the shortest time in which ability to carry out full work may be expected to return is as follows:

P.T.A. 5 minutes—1 hour	...	...	...	...	4—6 weeks
P.T.A. 1—24 hours	...	...	...	...	6—8 weeks
P.T.A. 1—7 days	...	...	...	...	2—4 months
P.T.A. over 7 days	...	...	...	...	4—8 months

I put this forward tentatively as a rough measure to be used in planning rehabilitation. It can be no more than a rough working guide because the duration of post-traumatic amnesia is influenced by other events besides the severity of the brain injury, e.g. the amount of bodily fatigue present at the time of injury, large doses of morphia or a general anæsthetic shortly after the injury, epileptic seizures in the first days after injury, and various psychoneurotic factors. Furthermore, we know that in certain cases where

there is a fracture of the base of the skull and the amnesia is shortlived, damage to the cranial nerves may interfere with return to work long after the higher cerebral functions have recovered. The type of work must also be taken into account; a simple task may be resumed earlier than one which involves the higher levels of intellectual function.

(2) *Disturbance of mental capacity.*—The central disturbance, the main organic cause of disability after head injury, is disturbance of mental capacity. It may occur at various levels of mental activity. At the lower levels there may be disturbance of speech, reading, calculating, or orientation. Initiative, memory and concentration may be affected. At higher levels there may be impairment of judgment, or of the capacity for abstract reasoning. The patient cannot be satisfactorily guided through the stages of rehabilitation without an attempt on the part of the doctor—however halting it may still be—to assess his mind in terms of these functions. After severe head injury the question will arise whether the patient is likely to be fit for his previous work, and this will often largely depend upon his retention of the capacity to learn. While the patient continues to show improvement an adverse decision should usually be withheld.

(3) *Emotional disturbance.*—Emotional factors are inextricably bound up with the process of recovery. The unstable type of man will have additional difficulties in adjusting himself to the task of returning to work, and it is therefore incumbent on those responsible for rehabilitation to assess the man as well as the severity of his injury. This is best done not only by observing the patient's behaviour while under observation, but also by a systematic inquiry into his family history, and into his earlier life and illnesses. The doctor may learn, especially in the cases of soldiers in war time, that before his accident the man was not employed, or felt that he was not employed, in the type of work for which he was best fitted.

Emotional disturbance may interfere with all aspects of intellectual activity and may be itself precipitated by these defects. The patient who becomes confused at a task tends to have a feeling of inadequacy which may lead not only to headache and outbursts of irritability but also to complete suppression for the time being of his powers of thinking: the phenomenon described by Goldstein as the catastrophic reaction.

(4) *Post-traumatic headaches.*—Anyone who is responsible for the rehabilitation of patients with head injury must formulate his ideas about the post-traumatic syndrome—the attacks of headache, dizziness, irritability and confusion which occur so commonly *after* the initial recovery from head injury. There are large gaps in our knowledge of this syndrome, and no little disagreement as to its nature. It is necessary, nevertheless, to have some working hypothesis, otherwise what shall one say to the man who complains of headaches during convalescence? I believe that almost every patient who makes a full recovery from concussion suffers at a certain stage of his recovery from headaches. In the mild head injuries the headaches may occur sporadically for some weeks and then disappear. In the severe cases the headaches may not come on until long after the patient has left hospital, and may not come on at all if there is any serious degree of residual organic defect. The patient must have recovered a certain amount of mental clarity before he appreciates headaches.

Now it is one thing to have a headache; it is another thing to complain about it. Although attacks of headache occur fairly constantly the reaction of the patient to them varies considerably, depending on a variety of factors, such as the emotional make-up of the patient, his anxieties and fears, his ability and desire to cope with his work once more. Emotionally stable, well-adjusted, and reliable witnesses—for example, most doctors—will describe their difficulties in concentrating when first they return to work; they will ascribe their headaches to attempts to concentrate, their headaches or dizziness to exertion or change of posture. Identical symptoms are complained of by other patients who are unstable and badly-adjusted, but nevertheless reliable witnesses. The difference is that the first type will manage to carry on with their rehabilitation with the minimum of interruption, while the second type are likely to break down on return to work unless they are given special treatment, treatment that inevitably comes within the purview of rehabilitation.

If this view as to the incidence of post-traumatic symptoms is correct then we must regard the syndrome as organic, just as syncope is; but, like syncope, it is influenced by emotional and psychoneurotic factors.

The early stages of recovery.—Rehabilitation begins when the patient begins to talk and respond properly. How does he discover that he has had a head injury? As his con-

fusion clears he slowly puzzles it out for himself, with the aid of explanations which come better from the doctor, with reassurance, than from the relations. The explanations and reassurance may need to be repeated more than once, for although the patient may be able to conduct a conversation in a manner that gives a superficial appearance of normality, yet he is at this stage confused, disorientated, and forgetful, for a period varying between minutes and weeks, according as the brain injury is mild or severe.

This is the stage at which assessment of the brain damage and of the type of the patient can first be undertaken. Without such investigations the rehabilitation cannot be adequately planned.

Getting up.—Notwithstanding the recommendations of Symonds these patients are often kept in bed too long, on the assumption that the liability to post-traumatic headaches is thus diminished. There is no evidence in favour of this view, and the practice becomes a bad one when, as so often happens, the next stage of rehabilitation is hurried.

There is rarely reason why the patient should not be allowed to get up a few days after he has recovered consciousness. Thus, a man whose total amnesia is six hours or less can be got up gradually towards the end of a week. If he gets a headache, he can be put to bed with some aspirin, and can get up again next day. Recourse to bed is, however, rarely necessary, for headache is not a conspicuous feature of this stage of recovery. The fact that the patient is got up early does not mean that he is to go back to work early. In cases of prolonged confusion and irritability, after unconsciousness of a week or more, the effect of sitting the patient out of bed and of giving him baths is often most soothing.

Graduated physical activities.—From the stage of getting up graduated physical (and mental) exercise may begin. It is necessary to grade the exercises, and the speed with which the patient passes from one stage to the next depends, not only on his progress with the exercises, but also on the estimated severity of his injury. For the mildly concussed the physical exercise can take first the form of walking and light physical training, thence by stages to more strenuous physical training, games, and heavy physical work. For the severely injured who, when they first get up, are still confused and even disorientated, light exercises to music, gentle indoor ball games, and deep breathing exercises are useful. These patients need much individual attention, and plenty of rest between exercises. Patience is necessary, also, for they often forget a game and need to have it explained to them all over again. No exercise should be pushed to the point of provoking a catastrophic reaction.

What is the value of physical exercise? It hardens the patient physically, thus preparing him to adjust himself the more easily to the physical demands of his normal life. It provides also a sense of achievement which is valuable in a man who is mildly confused and incapable of concentrated mental effort. It helps him to escape boredom. And it is perhaps also beneficial in modifying intracranial pressure.

At what stage should the patient be called upon to do violent physical training, Swedish exercises, and the like? Opinions differ on this question. There are some who would start it within a few weeks of quite severe injuries; others would introduce it more gradually and at a later stage. Before doing severe exercises the patient should, in my opinion, pass successfully through a stage of light competitive games.

Occupational treatment.—While physical re-education is going on handicraft can provide simple tasks within the powers of most patients, tasks which occupy their time at a stage when they are incapable of reading or talking consecutively for any length of time and which give them a sense of achievement: leather-work, basket-work, poker-work, weaving at a hand-loom, and book-binding. Heavier crafts such as carpentry, metalwork, weaving on large looms, and outdoor occupations, such as gardening and house-decorating, come later.

In craft work the teacher must constantly bear in mind that what really matters is not the initial standard of performance, but the degree of improvement shown from day to day. So often the star pupil of the class proves to be a psychoneurotic with headache after a trivial head injury.

Mental exercise.—The simplest mental exercises are those connected with movement, where the alternations of movement require concentration. For the confused patient simple games of a childish kind without competition are useful, for example, sorting cards according to colours, shapes, or what is written on them. It is an index of their degree of confusion that grown men will play these games with considerable pleasure.

In the later stages mental exercises should be directed towards the specific defect. Testing of the mental processes comes first and is in itself treatment. Special exercises can be introduced for lower level defects, such as those of reading and calculating. Sometimes it is possible to supplement the damaged functions, as, for example, by encouraging the patient with a defect of reading to trace or copy the words he is trying to read, or by teaching lip-reading to a patient whose difficulty is in understanding the spoken word. The prognosis depends on the residual learning capacity.

It is doubtful whether special, graded mental exercises can seriously compete with the patient's own attempts to re-educate himself, once he has, by testing, been shown the way; but the value of encouragement by means of continued supervision cannot be over-estimated.

Visual treatment.—No patient can relearn intellectual tasks unless his sight is good, and as many of these patients have visual symptoms, diplopia, phorias, or errors of refraction, it is important that ophthalmological treatment should be given whenever necessary.

Psychological factors.—The importance of psychological factors has already been indicated, and no attempts at rehabilitation are likely to be successful unless the patient's anxieties and fear are assuaged and unless he is helped through the phases of depression and the other disturbances of feeling that so often beset him during recovery from head injury.

The final test.—It is very difficult in hospital or convalescent institution to provide a test of full recovery, and the final test is the patient's return to work. It is the duty of those in charge of rehabilitation to see that the man is adequately supervised during this period, and that any special points concerning graduation of his work in the initial stages should be made known to his family doctor, his works doctor, or his Unit medical officer.

Dr. W. Russell Brain: For a long time it has seemed to me that the high incidence of neurosis after injury, particularly after industrial injuries, and our continued neglect to deal with it as a substantial medical and social problem is a considerable reproach to us as doctors. The first step must necessarily be an attempt to ascertain why traumatic neurosis occurs. This question can be approached in two ways, either by a psychological investigation of patients suffering from neurosis after injury, or by a statistical inquiry into the characteristics shown by a group of such patients. The two methods are supplementary. Psychological investigation of injured individuals is difficult for many reasons. My method this afternoon is the second one and I shall concern myself only with such psychological facts as seem to emerge from a study of the group as a whole.

I have long had an impression that traumatic neurosis occurs much more frequently in patients suffering from the effects of industrial injuries than in those injured in road accidents, and this supposed difference suggested itself as a promising basis for an inquiry. I have therefore taken as my material 100 consecutive cases of male patients suffering from the effects of a head injury acquired in a road accident, and 100 consecutive cases of male patients suffering from the effects of an industrial head injury. All patients were seen some time after their injury, the average interval before they came under observation being ten months. I have divided the patients in each group into three sub-groups according to whether their head injuries were mild, moderate or severe. I have called mild those injuries in which either consciousness was not lost or the patient was merely dazed for a short time. I have called moderate those injuries in which consciousness was lost, but the patient had recovered normal mentality in twenty-four hours and I have classified as severe all cases in which loss of consciousness or mental confusion lasted for more than twenty-four hours. The state of consciousness, however, though important, is not the sole criterion of the severity of a head injury and I have taken into account severe focal cerebral contusion when this occurred with only brief loss of consciousness. I have also divided each group into three sub-groups according to whether I consider the patient's symptoms to be purely organic, purely neurotic or mixed. It is clear that this classification depends to a considerable extent upon personal judgment. There is no difficulty in deciding about most hysterical symptoms. In assessing the nature of other symptoms I have depended upon such criteria as the characteristics of the headache, especially its constancy or otherwise and its relationship to precipitating factors, the effect of the passage of time upon symptoms and the attitude of the patient to them. No doubt others would have classified individual cases differently, but perhaps this is not of great importance since the same methods have been applied to all the cases by the same observer.

INCIDENCE OF NEUROSIS AFTER ROAD ACCIDENTS AND INDUSTRIAL INJURIES

Table I shows the frequency with which neurosis follows head injuries (1) after road accidents and (2) after industrial accidents.

TABLE I.

Road accidents—100 cases	...	Neurotic	Mixed	Organic
		8	15	
		} 23		77
Industrial accidents—100 cases	...	23	32	
		} 55		45

The next step is to inquire whether there is any correlation between the incidence of neurosis and the severity of the injury. This is shown in Table II.

TABLE II.

Road accidents—Severe	...	Neurotic	Mixed	Organic	Total
Moderate	...	1	11	48	60
Slight	...	3	2	18	23
		4	2	11	17
Total		8	15		
		} 23		77	100
Industrial accidents—Severe	...	4	8	22	34
Moderate	...	8	12	10	30
Slight	...	11	12	13	36
Total		23	32		
		} 55		45	100

Table II shows, first, that the injury is severe in a much higher proportion of patients who have had road accidents 60% compared with 34% of those who have had industrial accidents; and secondly that the industrial group shows a high incidence of neurosis associated with the less severe injuries, which is not present in the road accident group. This is better shown in Table III.

TABLE III.

Road accidents—Severe	...	Neurotic and Mixed	Total	Percentage
Moderate and slight	...	12	60	20
		11	40	27
Industrial accidents—Severe	...	12	34	35
Moderate and slight	...	43	66	65

It is quite clear that a severe head injury as such is not an important cause of traumatic neurosis, but we have still to explain the apparently paradoxical correlation between neurosis and the slighter injuries.

It must be remembered that we are here dealing not with totals of injured persons, but with persons selected from the total number injured because the severity of their symptoms (1) in the road accident group calls for compensation (2) in the industrial accident group incapacitates them for work. It will generally be agreed that the incidence of severe head injuries is much higher in those who have been involved in road accidents than in a group exposed to the varied hazards of a large number of industries. Allowing for the fact that in some industries the risk of head injuries is much greater than in others it is still true that a mixed group of industrial workers is exposed to somewhat rare severe injuries, and fairly frequent moderate or slight injuries. If now the incidence of neurosis is independent of the severity of the injury, if, in other words, there exists

in the exposed community a proportion of individuals who react to even a slight injury by developing a neurosis, the high proportion of less severe injuries will lead to a selection of these susceptible persons, since those with slight organic symptoms will soon return to work and therefore will never reach the neurologist. Hence there will be an apparently high incidence of neurosis complicating the slighter injuries, in the industrial group.

But in the industrial group the 35% incidence of neurosis complicating severe injuries is significantly higher than the 20% in the road accident group which may perhaps be regarded as a sample of the general population at these ages; and the generally raised liability to neurosis in the group calls for explanation.

AGE AND OCCUPATION

There is no significant difference in the average age of patients in the two groups, nor between the average ages of those with and those without neurosis in either group, so that there is no evidence that age plays any part in the aetiology of traumatic neurosis.

There are significant differences in the incidence of neurosis in different occupations in both groups. This is shown in Table IV.

TABLE IV.

	Occupation	Total	Neurotic	Percentage
Road accidents	Professional and clerical ...	38	4	11
	Skilled artisans ...	27	5	19
	Light unskilled ...	14	6	43
	Heavy unskilled ...	19	7	37
	Unclassified ...	2	1	—
Industrial	Professional and clerical ...	2	—	—
	Skilled artisans ...	20	7	35
	Slight unskilled ...	19	10	53
	Heavy unskilled ...	59	38	64

This table shows first that in both groups the incidence of neurosis is highest in the unskilled labourers; in fact out of 23 patients in the industrial group who developed neurosis after slight injuries 17 were heavy unskilled labourers. Secondly, men of any occupation are substantially more likely to develop traumatic neurosis if they are injured in an industrial accident, even though their organic injury is likely to be less severe. I would briefly suggest two reasons why a slighter industrial injury is more likely to produce neurosis than a more severe road accident.

First, an industrial injury is an occupational injury, as a road injury usually is not. It therefore suggests to the workman that his occupation is a dangerous one, and it is likely to cause a sense both of physical danger and of economic insecurity. Second the legal procedure is widely different in the two groups. In a road accident the insurance system is a guarantee of compensation in most cases: in the machinery of the Workmen's Compensation Acts it operates in the opposite sense, since the workman's right to compensation is repeatedly under review and frequently contested. Hence although the workman injured at work receives immediate compensation which his fellow knocked down by a car does not, his economic security is really far more seriously threatened. There are other defects, of a similar kind, in the Workmen's Compensation Acts which contribute to the development of neurosis but which I cannot now discuss.

SUGGESTED REMEDIES

(1) Rehabilitation in all cases of slight injury begins with the general practitioner or casualty officer who first sees the patient. These front-line workers need to learn the right psychological handling of the injured man; to avoid suggesting serious injury when none exists and equally "a narrow escape". They should learn also to avoid the hospitalization of really slight cases.

(2) All big centres need units of doctors trained to deal with head injuries, both slight and severe. In this way only is it possible to avoid the ill-effects of scattering these patients in general wards under the care of surgeons who have neither the knowledge nor the interest needful.

(3) Occupational therapy should merge into therapeutic occupation, i.e. organized light work, adjusted to each man's capacity.

(4) The social responsibility for the injured should be more widely recognized and the emphasis changed from compensation to rehabilitation. The need for compensation is to a large extent a measure of the failure of rehabilitation.

(5) The Workmen's Compensation Acts should be revised so that an industrial injury should not immediately involve a potential dispute about the ownership of a sum of money. Medical issues should be decided by medical boards closely linked with rehabilitation units; and an adequate maintenance allowance should be guaranteed to the injured man as long as the medical board regarded him as disabled and as long as he co-operated in his treatment and rehabilitation.

(6) At the same time it is important to avoid an exaggerated paternalism. Here we have to face an aspect of the largely unsolved problem of modern society, how to provide social services without robbing the individual citizen of his sense of responsibility for his own welfare. There would be no traumatic neurosis if all the injured were like an Irish hunting woman who consulted me because after the last of many falls she thought her double vision was worse than it used to be. Such toughness is doubtless partly innate, partly cultural. Society can do a good deal to foster it if it is conscious of the need. As doctors we have the double task of educating both individuals and society.

Dr. Ludwig Guttmann: Rehabilitation after peripheral nerve lesions means restoration of the working capacity of the injured person. It includes, apart from the actual surgical treatment, all methods which accelerate functional recovery:

(1) Therapeutic arrangements of a more passive or preventive nature, such as precautions for keeping the paralysed limb in the right position with and without splintage and physiotherapy.

(2) All arrangements which accelerate functional recovery with the patient's active co-operation until he is enabled to resume his former occupation, or failing that to do useful alternative work in the same industry. Arrangements of this group are (a) remedial exercise; (b) occupational therapy; (c) some physiotherapy; (d) reconditioning.

(3) Vocational training, i.e. training of those crippled by peripheral nerve injuries for special occupations adapted to their permanent disability.

As there are some transitions between the individual groups this distinction may not be considered as absolutely strict. According to this definition it is obvious that rehabilitation after peripheral nerve lesions has to start immediately following injury. Dr. E. A. Nicoll's opinion expressed on this subject in a recent paper on fractures "Rehabilitation starts on the first day of treatment" can be accepted in the full meaning of the words also for peripheral nerve lesions.

General organization.—The installation in this country of several centres for the treatment of peripheral nerve injuries is a great step forward. The congregation of cases in a single department under the same specialized staff, with continuous treatment under the same supervision, is certainly the best guarantee for a systematic study of the whole question, and for better results. The success of a centralized treatment and care of peripheral nerve injuries in other countries was shown by the "Peripheral Nerve Centres" in the U.S.A. during the last war and particularly by Foerster's work in Germany during and after the last war. His material included about 4,000 cases. Although he worked under conditions by no means ideal compared with those of a modern centre in this country, his results were remarkably good and better than those of many other authors of that time. Foerster has emphasized again and again the secret of his better results. It was only in some respects a specialized surgical technique; the main reason was a better and systematic after-treatment and after-care, in other words, a good understanding of rehabilitation.

The installation of centres for peripheral nerve injuries, however, does not cover the whole problem of organization in the rehabilitation work. In practice it is not possible to bring all cases into these centres, particularly in the early days after injury. Therefore precautions should be taken in all General and Military hospitals, *particularly in Military Base-Hospitals*, that the injured can be seen immediately by a Nerve Specialist versed in the after-treatment of peripheral nerve lesions. Neglect of this vital principle of rehabilitation in the first period, even in the first days after injury, accounts for much of the prolonged disability of the injured person, with all its economic consequences. The

importance of this point can hardly be exaggerated. An integral part of the organization of what might be called "Primary rehabilitation service" is a thorough record of all treatment given in the first period after nerve injury. Undoubtedly such a service would greatly facilitate the work of the centres for peripheral nerve injuries and would play a big part in improving the end-results.

Of the same importance as the primary supervision immediately after injury is the late supervision of these cases after their discharge from hospital, from the centres and from the Army. This late supervision also includes the post-war supervision of peripheral nerve injuries. Experiences in all countries after the last war have clearly shown that any successful late supervision of these cases can only be achieved by a loyal co-operation of the medical authorities with the public health services and—as Cairns and Young pointed out (1940)—with the Ministry of Pensions and, last but not least, with the employers. Such an organized co-operation of the various authorities concerned with the rehabilitation work is of particular importance in the reconditioning period of the injured. One of the main tasks of the "after-care service" is (1) to provide the injured man with light and graduated work in his former occupation until he is fit for heavy work; (2) to supervise this light and graduated work. In my own experience the best results in supervising the injured persons during the reconditioning period were obtained with the help of industrial medical officers and general practitioners. Experiences in all countries have shown that many patients, left alone in the reconditioning period, will never make sufficient effort to reach their full working capacity.

In discussing some methods of particular importance for a speedy and, if possible, complete rehabilitation only a few points can be considered. Cases with peripheral nerve lesions can be grouped into those in which restoration of nerve conduction is possible and those in which there is no chance of nerve regeneration. In regard to treatment, however, this distinction is not an absolutely strict one as similar principles have to be considered in both cases up to a certain point.

POSITION OF PARALYSED LIMBS

The position of paralysed limbs follows the principle of close approximation of the points of attachment of the paralysed muscles. The principle underlying treatment is to maintain and increase elasticity of the affected muscles. All experts on the subject agree that overstretching of a paralysed muscle even in the very first period after injury means a severe and often irreparable additional damage of the paralysed muscle. In 1916 Sir Robert Jones expressed it very clearly: "The most skilful operation performed on the most suitable case will prove a fiasco unless the affected muscles are continually kept relaxed until recovery takes place." Unfortunately, this well-known and most essential point is in practice not always duly considered and may even be completely neglected. It is for instance amazing how often this principle is neglected in cases of ulnar and median nerve palsy in spite of the fact that special splints have been described for the approximation of the intrinsic muscles of the hand.

In preventing the claw position of the fingers in cases of ulnar nerve palsy two types of splints are recommended. The one is designed to maintain the proximal phalanges in a position of medium flexion, at the same time preventing flexion of the middle and terminal phalanges. The other, recommended particularly for isolated paralysis of the interossei, maintains the greatest possible extension of the long flexors of the fingers by means of narrow elastic splints which are applied to the dorsal side of the fingers, thus extending all phalanges as far as possible. The advantage of these splints, according to Foerster, lies in the fact that the middle and terminal phalanges remain sufficiently stretched during all the finer activities of the fingers in which small objects are grasped and moved between the tips of thumb and index or middle finger.

In median nerve palsy, in which relaxation of the thenar muscles is so important, splints have also been designed to bring the thumb into a position of abduction and opposition while its terminal phalanx is extended. Among other authors Foerster (1929) has recommended such a splint, which, however, tends to be too inflexible. On the other hand splints, such as recommended by Sumner L. Koch and Michael L. Mason (1939), which are more flexible have the disadvantage that the thumb is held in adduction and in too strong flexion at its metacarpo-phalangeal joint, and they do not give the necessary abduction and opposition of the thumb. The problem of suitable splints for isolated median palsy and also for combined median and ulnar or radial palsies is therefore still

unsolved. Whatever splintage may be used it is of vital importance that any direct pressure of the splint on the paralysed muscle must be avoided, and "splint-free" intervals should be given.

STRENGTHENING OF SYNERGISTS

The taking over of the function of a paralysed muscle by one or several of its normal synergists can be of great practical value in rehabilitation. Besides the well-known compensatory function of the brachioradialis in a biceps palsy and other instances the following example illustrates this principle: In a case of complete paralysis of the axillary nerve abduction of the arm may be carried out astonishingly well by the supraspinatus muscle. It is possible in such cases to dispense with splints altogether and to restore function and working capacity by strengthening such synergistic muscles.

ELECTROTHERAPY

It is one hundred years since John Reid in Edinburgh (1841) first described the beneficial effect of galvanic current on denervated muscles. Since then opinions about the value of electrotherapy in the treatment of peripheral nerve lesions have oscillated a great deal. Experiments on the subject do not allow satisfactory conclusions, and even the great clinical experience of the last war has not settled this problem. Yet experts are agreed that electrotherapy is useful in accelerating rehabilitation after peripheral nerve lesions. My own experience has endorsed the value of electrotherapy carried out by galvanic exercise of the paralysed muscles. If carried out regularly and properly by a reliable person having the necessary knowledge of the anatomy and physiology of movement and under permanent medical supervision it is a valuable auxiliary method in the treatment of atrophy and in maintaining or improving the elasticity of paralysed muscles. This has been proved recently by an experimental study on galvanic treatment of denervated muscles in rabbits carried out in Dr. J. Z. Young's Department of Comparative Anatomy in the University of Oxford by Dr. Ernest Gutmann and myself (1942). Although in these experiments the daily galvanic exercise of the paralysed muscles did not entirely prevent the onset and progress of atrophy immediately after denervation, it had, however, a definite delaying and diminishing effect on the atrophy in later stages. Moreover it accelerated the recovery from atrophy, once the muscles had become reinnervated and recovery of function had commenced. The histological findings in our cases eliminate the suspicion that the greater volume of the treated muscles might be the effect of a hypertrophy of the connective tissue. Exactly the reverse was found, for the treated muscles showed far less fibrosis.

It may be noted that in cases of complete paralysis galvanotherapy is the only method (in contrast to massage) which enables the paralysed muscles to exercise their original function—or to put it in Foerster's own words: "Electrotherapy reminds the paralysed muscle of its normal task." Furthermore electrotherapy is most useful in augmenting active exercise in those cases in which regeneration is taking place but the patient co-operates poorly. On the other hand, it would be overrating the value of the method to imagine that atrophy of muscles can be prevented or considerably diminished in all cases of denervated muscles. In my own cases in which great vascular damage had occurred in addition to the nerve injury or in which the muscles themselves had been very considerably damaged the beneficial effect of galvanic treatment was not so convincing.

REMEDIAL EXERCISE

Active exercise is of *cardinal* importance in achieving the most complete and quickest rehabilitation. In recovering lesions three different stages require special consideration:

(1) As long as voluntary movements are still weak the exercises should only be directed towards overcoming the inertia of movement, and should not work against gravity. The simplest way to achieve this is by placing the limb in such a position that movements are carried out in the horizontal plane. Exercises in a bath are in some cases helpful.

(2) Having overcome the inertia of the limb without any other help, exercise should be attempted against gravity.

(3) If the muscle is able to move the limb against gravity, graduated weights are added against which the muscle has to work.

The principle of the exercises is to effect quick movements over the widest possible range. The movements are followed by fairly long rests, after which they are again repeated. This kind of exercise has always to be supervised since the patient when left alone is usually inclined to exhaust himself in multiple partial performances as opposed to a few maximal responses which are of greater benefit. Since many patients never make progress without assistance a *daily* supervision of active exercise by the doctor has undoubtedly the best effect in obtaining the patient's energetic co-operation and unremitting effort which are so necessary for successful rehabilitation.

OCCUPATIONAL THERAPY

Occupational therapy at the centres for peripheral nerve injuries might be a valuable addition to active exercise treatment. In cases where restoration of nerve conduction is possible it will accelerate rehabilitation. In cases of permanent paralysis it will help to develop and to improve subsidiary and trick movements. It should, however, be emphasized that in order to build up occupational therapy as a really useful and reliable method for accelerating rehabilitation, a carefully elaborated organization and a plan of indication, time of onset and duration, have to be established. These, as far as I know, have not yet been developed in regard to peripheral nerve lesions. Although N. A. Haworth and E. M. Macdonald (1940) published a very suitable list of suggested occupations in peripheral nerve lesions and some authors let their patients work with suitably altered tools, a special technique of occupational training is not yet fully formulated, and the various crafts used in occupational training have not yet been analysed and suitably modified from the physiological and psychological point of view. In a median or ulnar nerve paralysis, for instance, all the arrangements for occupational training must be conditioned by the anæsthetic and atrophic state of the skin and subcutaneous tissues. Exercises which can macerate the skin such as with moist clay, must be avoided, also tools producing a permanent and too strong pressure. Therefore in every case clear direction should be given to the occupational therapist about the details of motor, sensory and trophic disturbances and supervision of this therapy by the doctor is of great importance. A close co-operation between doctor and occupational therapist is also of immense value for the mental state of the patients, particularly in overcoming the various mental disabilities due to injury and hospitalization. The latter particularly, should not be underestimated in war time. In every case the occupational therapist should record all his arrangements and observations, for these can be of great help to the doctor, giving information about the patient's behaviour with regard to the restoration of working capacity.

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