TENDONS.

When Hunter was appointed surgeon to St. George's Hospital in 1768, and thus obtained the first real opportunity of applying his peculiar store of biological knowledge, he was already 40 years of age. In the previous year there happened two notable events in his life: he was elected to the Royal Society and had his tendo Achillis ruptured. It is the latter event which interests us here. He had been suffering from cramp in the calf of his leg (he was subject to muscular spasms and cramp), and he had been dancing; he was not married then. He noted that the rupture was unattended by pain; it was only when repair set in that the tendon became sensitive. He noted further that he had lost all voluntary control of muscles yoked to the tendon, by no effort of will could he make the muscles of his calf contract. But he also recognized that in sleep the muscle obtained a power of involuntary contraction. He clearly did not understand why the muscles should pass out of action during consciousness, and assume a power to act during sleep. He knew nothing of the structure and functions of the spinal cord, nor the significance of that kind of action we call reflex—that knowledge came with Marshall Hall. He based his treatment on those two simple observations. He encircled the calf of the leg with a bandage to prevent "involuntary movements," and applied an apparatus during the night "to steady the muscles." After the first day or two following the accident the patient was allowed to walk about, with the heel of the boot somewhat raised on the injured side, and was instructed to step off the inner side of the heel, as is the manner with those who suffer from flat-foot.

At the time Hunter suffered from this accident he had already acquired two acres of land at Earl's Court, where he established what would be described nowadays as an experimental station. Healing of tendons became a matter of interest to him. Ottery states that he cut the tendons of dogs by a subcutaneous method—the earliest record we have of such operations. We know from Everard Home that one of the deer then kept at Earl's Court had a tendo Achillis cut for a double purpose—to keep it from jumping the enclosing fence at Earl's Court, and at the same time to provide information as to the mode of healing. I can show you fine specimens of tendon repair which Hunter obtained by experimental means. He found that a gap between the separated ends was no bar to union; coagulated lymph could eventually provide a strong bridge across a wide gap. After his own death it was found that the cicatricial bond in his tendo Achillis had become calcified.

THE MINIMAL MUSCLE LOAD AND THE WILL.

We come now to another side of Hunter's teaching regarding the nature and action of muscles, which has an important application to present-day conditions. We may call this part of his teaching, in order to distinguish it, the principle of the "minimal load." Let me explain by use of an example what is meant by that expression. Let us take the case of a labourer who has just recovered from typhoid fever. We want to test his strength. We ask him to lift and carry a sack containing 2 cwt. of coal. We should be very foolish if, when we find he cannot move it, we concluded that he has no strength. Yet that is how the strength of weakened and disabled muscles are being tested now in many instances. Let us take the case of the deltoid muscle. If we start it into action as the arm hangs by the side it has to move its maximum load at the very start; it has then to lift the weight of the arm when its purchase is at a minimum. The deltoid may, when so tested, appear absolutely paralysed, yet if the disabled man lies on his back with his arm half abducted and its weight supported on a board, and we then apply the principle of the "minimal load," it may be found that the muscle, far from being paralysed, has a very considerable power of action.

It is characteristic of Hunter that he never did halt or bend to point out the immediate practical application of his observations and "principles." He gives us, as it were, the stick or the knife, but expects that we ourselves will do the whittling. That is why Hunter is a prince to the thinking surgeon and only a babbler to the merely practical one. He tells you the position of a joint which gives

a muscle its greatest power; he points out that the weight of a limb is a heavy burden; he recognizes that muscles may be weakened from many causes; he insists on the mastery which the will can obtain over them, but nowhere does he formulate these observations into a system to be applied to the treatment of disabled muscles. Indeed, I must own that without the aid of my friend Dr. W. Colin Mackenzie I should never have realized the practical bearing of many of Hunter's facts. Dr. Mackenzie makes no claim to be the discoverer of the "minimal load" treatment of disabled muscles, but I am certain that no one has realized its practical importance more than he, and no one has realized and applied the right methods to the restoration of disabled muscles with an equal skill. When you have discovered that a muscle loaded to a minimal degree can exhibit a spark of movement, then you have to bring the will to bear upon that spark. As it increases you will be able gradually to increase the load and thus nurse what is often regarded as a useless structure back to a fair or full degree of vigour. Dr. Mackenzie's methods, as revealed by his published results, bespeak infinite patience on the part of both surgeon and patient, and these are qualities which are hard to obtain in either surgeon or patient. In this we here come back to the bed-rock of Hunterian teaching: the only certain means of treatment are those which employ the natural recuperative powers of the body.

One other aspect of Hunter's teaching has a bearing on the treatment of muscular defects. He was not the first to realize that it is impossible for a muscle or a set of muscles to contract without their antagonists being called into action at the same time. He learnt that doctrine as a student from Winslow's still excellent textbook of anatomy; but he did realize more than any one who went before him that the relaxation of the extensor or antagonist muscle was just as important, as real, and as vital an act as the contraction of the flexor or prime-moving muscle. He never could determine whether the relaxation of the antagonist was due to a voluntary or an involuntary stimulus. That doubt, we shall see, has been resolved in recent times. The surgeon must always think in terms not of single, but of antagonist muscle groups.

Remarks

ON

THE TREATMENT OF NEURASTHENIA
AND PSYCHASTHENIA FOLLOWING
SHELL SHOCK.

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A VERY large number of cases of persistent neurasthenia, psychasthenia, and allied conditions, following shell shock are now under treatment in England. Similar affections are also caused by the shock or continued anxiety of Zeppelin raids and the continued anxiety from other risks of injury. The symptoms may commence suddenly after one severe shock, or gradually after repeated shocks. In many of the severer cases the patient is unable to carry out his duties, military or civil, for a long period, and we have the expense of his continued pension. It is important both for the patient and the country that he should recover as early as possible. The treatment is, however, often very unsatisfactory, and to many medical men very uninteresting. It should be psychological as well as medical. Very slight cases may improve rapidly after a short rest, but in many of the severer cases the symptoms are very persistent. The patients are sent into hospital; they often rest most of the day, take little exercise, and are not occupied definitely in any way. They have time for thinking and brooding all day over their experiences and symptoms, and for thinking of the time when they will be expected to return to the front, or will be exposed to the same risks. Very many of the severer cases do not improve much, and after weeks or months leave the hospital with the symptoms well marked.

The following is a line of treatment which, from a study of these severer cases, I consider useful and would

emphasize, and I think these suggestions will be found useful also by others.

Importance of Diagnosis.

The patient should be examined carefully, the symptoms noted, and signs of organic disease searched for. It is very important to exclude early general paralysis of the insane, organic diseases of the nervous system, commencing insanity, and organic diseases of the various systems. When this has been done, malingering or "shirking" should be carefully considered and excluded before the treatment is commenced. Excluding cases of functional paralysis, loss of speech and deafness following shell shock, etc., which are not considered in this article, and considering only neurasthenic and psychasthenic symptoms following shell shock, the differential diagnosis from malingering or "shirking" is sometimes very difficult. Though very many cases of malingering and shirking are seen, in a large number of cases the symptoms are undoubtedly pathological, and the medical man who regards the cases as all "shirkers" is unsuitable for treating such patients, and should leave the treatment to someone who understands their condition better. Some of the men who have distinguished themselves by the greatest bravery and daring in this war, and received the V.C., D.C.M., and other medals, and some of the men who have been able for months to view the shell fire with the greatest possible calmness, have suffered eventually from shell shock. Such cases should be carefully considered and examined before being diagnosed as malingerers or shirkers. The symptoms may continue long after the patient is discharged from the army and when he has no fear of further risk, though it is important that he should be relieved from anxiety on this account. Further, after suffering from neurasthenia, the patient may recover and return to the front and behave with the greatest bravery.

In this article the symptoms of the neurasthenia and psychasthenia resulting from shell shock will not be described, but the following may be mentioned as they are often especially well marked: mental irritability, sensation of fatigue, headache, difficulty in fixing the attention on any subject, obsessions and sleeplessness; the patient is very nervous and is easily and greatly startled by slight noises; often he is constantly thinking of his past experience of the shell fire, and he has great difficulty in fixing his attention on any other subjects. He often sleeps very badly, it may be only one or two hours at night, and when awake at night is constantly thinking of the war. It is interesting to note that many symptoms are often observed which are frequent in Graves's disease. A fine tremor of the hands like that of Graves's disease is very common, also sweating and palpitation are common, and a von Graefe's symptom in slight degree often noted—less marked but similar to that of Graves's disease. Exophthalmos and thyroid enlargement are not observed.

Anxiety with Respect to Further Shell Shock.

When the diagnosis is quite clear and malingering and organic diseases can be excluded, and the symptoms well marked and persistent, it is desirable, in the first place, that the patient should have no further anxiety from shell explosion and similar risks. He should be sent to a hospital or home in England, or far from the front, and treatment carried out. If the symptoms are very severe or have been very persistent, it is desirable that the patient should be informed that he will be transferred to some department of the army at home, permanently or temporarily, where no further risk from shell shock will occur, or to munition work or to other occupation. This is a point of much importance. If the patient is placed in a hospital and allowed time to think and brood over his experiences he often becomes very anxious and dreads the time when he will be sufficiently well to be sent back to the front and exposed to further risks. This great anxiety and dread of a repetition of the shock from shell explosion or similar risks is a great hindrance to recovery and the patient should be freed from it as early as possible. But this anxiety is only one cause of the persistency of the symptoms, and when the patient is relieved from all anxiety of further risk the symptoms often continue, especially if he sleeps badly. Also anxiety respecting his family or those depending upon him may hinder recovery; he should be relieved from this if possible.

Treatment.

He should be told that he is not suffering from any disease which is dangerous to life, that he will undoubtedly recover, and that perseverance in the line of treatment advised is most important. He should be kept as cheerful as possible. As will be mentioned subsequently, all war news should be cut off at once and conversation about the war should be avoided.

At first a short period of complete rest is desirable, and this is well combined with the "sleep treatment" described in the next section. He should be well fed and any gastric or intestinal troubles treated. The bowels should be kept regular, and any affection of the abdominal or thoracic organs or any other ailments (malaria or dysentery) or their results should be carefully treated. In suitable weather the bed or sofa should be drawn into the open air and sunshine when a garden is attached to the hospital or house where he is treated.

Sleep Treatment.

In a large number of the cases the patient sleeps very badly indeed, for weeks or months, and may be able to sleep only for two or three hours or less every night. Often when awake at night he is thinking of his experiences at the front. It is most important to try and check the insomnia as promptly as possible. Trional is one of the most useful drugs I have tried; in a few cases 30 grains of potassium bromide at night may be of service. A mixture of potassium bromide, with small doses of chloral hydrate, and tincture of opium, or syrup of codeia is sometimes very useful. Other drugs will also be of service. If adalin or chloralamide can be obtained they are very suitable.

When the patient is able to sleep better he often improves rapidly, but in some cases after he is able to sleep well the symptoms continue, especially if he is fearing a return to the front or if he is constantly thinking over his experiences. On the other hand, as already mentioned, if the patient sleeps unsatisfactorily the symptoms often continue even when all dread of further war risk ceases. During the day very often the patient is constantly thinking about his experience of the shell explosions, and the war, or of his symptoms, except when he is occupied by reading, conversation, or in some other way. A very important point is to check thinking on these subjects.

For this a sleep treatment for a few days is often useful. The patient is kept asleep part of the day as well as the night by drugs; potassium bromide may be given three times during the day in addition to the trional or bromide at night, or trional is given at night, and after dinner at midday. Or a mixture containing potassium bromide, with small doses of chloral hydrate, and tincture of opium may be given two or three times during the day (in place of the bromide or the trional). But the dose of the drugs should be carefully regulated, and only just sufficient should be given to keep the patient asleep part of the day. The drugs should be continued for a few days only, and discontinued at once if bad symptoms are noted. He should be closely occupied when awake by something interesting to him—games, draughts, dominoes, patience, billiards, handwork, netting, zigsaw puzzles, reading, etc. In summer, when the weather is suitable, the bed may be drawn into the open air if a garden is adjacent to the hospital or bedroom. This sleep treatment may be carried out for four or six days, but it should be very carefully observed.

If the patient can sleep well during the night and half of the day he often improves decidedly. After a dose of 15 grains of trional at night one of my patients would constantly sleep all night and all morning until midday or 1 p.m. But often another dose of trional after midday dinner is useful. Some require very large doses of drugs before they sleep; in these cases we may be content with sleep during the night alone, and the drugs should not be pushed and should be discontinued during the daytime.

This sleep treatment is often of very great service for a week at first, but for some time trional or other drug may be required at night.

Mental Treatment: Occupation.

After the sleep treatment it is desirable that the patient should try to cease thinking about the war and his past experience and of his symptoms.

(a) He should avoid reading war news in the papers, journals, and books. In conversation the war should be avoided. Cutting off all war news in this way is of distinct service. Also he should not discuss his symptoms with others and the symptoms of other patients should not be related to him.

(b) He should direct his thoughts to a new subject, or to a subject not associated with war, and best of all to some new occupation.

(c) The occupation should be one requiring some thought, and he should apply himself very closely to this occupation.

(d) The occupation should be one which is very interesting to him, and which is likely to become more interesting as it is continued.

(e) If the occupation is one which can, after a time, be carried out mechanically without thinking, then the patient is liable to wander back to his old thoughts about the war, whilst he is doing work. It is then often useful to vary the occupation, so that closer application will be needed. Thus, if after spending much time in netting, he finds that he no longer requires to think about the work, he may change to fretwork, or some other work, so that closer application will be necessary.

Suitable Occupations.

The occupation most suitable will vary with different cases. The following may be mentioned:

Games, such as draughts, dominoes, cards (especially patience, which the patient can play alone), billiards, zigsaw puzzles, etc.

Hand occupations, netting, fretwork, wood-carving, "poker work," sewing, knitting and needlework, rush work, raffia work, basket work. Netting mats is often very suitable. Handwork in the ward, bandage rolling, knife cleaning, etc., may be useful.

The study of French or foreign languages in some cases may be tried if he is interested in the language, and finds that he is not wearied by it. Drawing, painting, pen painting, photography, music, typewriting, may be of service.

Later, when he is stronger, gardening and outdoor games, field work, grass cutting, motor wagon driving, etc., are suitable. Driving a motor wagon or transport is very suitable if the patient is interested in it, and some patients will find it of much service. The driving of a motor wagon requires close application; it may be interesting to the man, and the calls for attention are so varied that his thoughts are fixed more or less on the work in hand. He is also out in the open air, and great physical fatigue is avoided.

The occupations must be interesting to the patient, and his attention must be kept to them very closely; hence the most suitable kind of occupation will vary much in different cases; one patient will be interested in netting mats, the next will find it irksome. He should therefore be allowed to take up one or two of the most interesting. He should sell his work if possible, so that he may have the pleasure of earning money; if wealthy, the money may be given to some charitable institution.

Games are useful at first, but very soon most of the time should be devoted to occupations. Later work in the Army Service or Motor Transport Corps or munition work may be suitable. The patient may improve rapidly if he is transferred to some occupation in England in which he becomes deeply interested and has no further risk of shell shock—such as the training of cadets, training in the machine gun section, etc.

SUMMARY.

To recapitulate, the important points which I desire to emphasize in the treatment suggested in this article are:

1. All *anxiety* and fear of further exposure to similar risks to life, and anxiety from other causes, should be removed if possible, and the patient should be definitely told that he will certainly recover.

2. The *sleep treatment* is very useful. At first hypnotic drugs may be given both at night and during the day for a short time; so that the patient may sleep all night and, for a few days, also during part of the daytime.

3. He should *cease thinking* of the war and his experiences. This may be brought about (a) at first by the sleep during part of the daytime as well as during the night as just described, and by occupation whenever he is awake; (b) afterwards he should be kept asleep all night (by drugs); but during the day the drugs should be discontinued and he should be kept fully *occupied* in a suitable way.

4. As regards the kind of occupation:

(a) A new subject or one not associated with his war experience is desirable.

(b) *Very close application* to the work in hand is important.

(c) The occupation should be one requiring thought, and if the patient finds, after continuing it for some time, that it can be done mechanically, the occupation should be changed or altered so that thought is required.

(d) It should be one *very interesting* to the patient, and one which will become more interesting.

Many other methods of treatment have been tried and recommended, but I have not attempted any review of the literature of the subject, and have only considered the treatment which, from my own observations, has appeared suitable. In many of the severe cases recovery is very slow, but I think the line of treatment suggested will be found of much service.

THE RED BLOOD CELL COUNT AND HAEMOGLOBIN CONTENT OF THE BLOOD IN DISORDERED ACTION OF THE HEART.

BY

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(Under the direction of the Medical Research Committee.)

THE accompanying table of estimations sets out the results of the examination of fifteen patients at Hampstead Military Hospital. These were unselected cases of D.A.H. (disordered action of the heart) of all degrees of severity; that is to say, they exhibited the group of symptoms associated with this nomenclature, in varying degree. None of the patients had been "gassed," and none exhibited unusual symptoms, such as nocturnal dyspnoea.

The haemoglobin was estimated by Haldane's haemoglobinometer. The percentage was taken as the mean of two observations, one at a dilution which caused the tints to match, and the other at a further dilution which caused the specimen to be slightly paler than the standard tint. This tends rather to overestimate than to underestimate the percentage. The red cell count was made in a Zeiss-Thoma counting chamber, which was estimated by micrometer measurement to err (if at all) on the shallow side; it would not, therefore, tend to yield excessive estimations.

Two specimens of blood were taken from a puncture in the ear of a patient in separate pipettes at the same sitting; 160 squares of the counting chamber were counted from each specimen, and the average of these two estimations was taken as the true blood count.

The observations were made between the hours of 10 and 12 in the morning on the patients who had taken no exercise and who had remained indoors. This series of observations was made in March and early April during an exceptionally cold and severe spell of weather.

The average number of red cells is commonly given as about 5,000,000 per c.cm. in males, but there does not appear to be any complete agreement on this point. A rise normally takes place after exercise and at certain stages of digestion. The count also varies with age, and, according to von Limbeck,¹ this variation is considerable; thus he gives the average count between 19½ and 22 years as 5,600,000, 25 to 30 years as 5,340,000. A very high average count was found by P. W. Hawk² in a number of healthy young athletes in training—that is, 5,600,000 immediately before exercise.