jam, sweet foods, chocolate, and drinks containing much sugar, such as herb beer, sweet wines, and combinations of sugar and alcohol. They would thereby be helping the Food Controller, as well as doing something to diminish their own risk of diabetes.

Alcohol, and especially combinations of alcohol and sugar, if they can still be obtained, should be very limited in the case of those who have much mental strain, anxiety, or worry. The regulations now in force will check any excess for most people.

Through the war, we are now all suffering, more or less, from mental overstrain, worry, anxiety, or sudden mental shocks, which will tend to increase the risk of diabetes. We cannot avoid them, but we can do something (and this is especially desirable in those who are suffering severely) to diminish their effects by directing our attention, whenever possible, to subjects not directly associated with the particular anxiety or worry, and especially by close occupation. Most people have now to work very hard, and occupation and close attention to work are useful in diminishing the effect of mental shock and anxiety; but when the overwork is excessive something may be done to diminish the injurious effects by putting aside any work not absolutely necessary, if this is possible.

Sleep is very important. When insomnia is associated with the great mental strains already named prompt treatment is desirable, and, if it cannot be checked, drugs such as chloralamide, trional, adalin, etc., taken under the direction of a physician for a short time, may be of much service.

Summary.

It is desirable for all to cut down sweet foods and drinks, chocolate, jam, sugar, and alcohol to a minimum during the war, and especially for those who have a family history of diabetes, and are suffering from great mental strain or shock; they will thereby help the Food Controller and also diminish the risk of diabetes. Occupation and close attention to work are useful in diminishing the effects of mental worry and shock, and thereby the risk of diabetes, but in certain cases of excessive overwork it is desirable to cut off work not absolutely necessary, if this is possible; sleep is very important.

The recent food restrictions, as already mentioned, will check for most people any excess of sugar and alcohol, and will thus tend to diminish the risk of diabetes. Those who have been obliged through these restrictions to discontinue excess of alcohol or sugar should, however, not replace these by excess of non-alcoholic drinks containing much sugar, and excess of jam, chocolate, and other sweet foods which may be still obtainable.

REFERENCES.

- ¹ The details were published in the *Medical Chronicle*, July, 1908.
- ² *Diabetes Mellitus and its Treatment*, London, 1898.

THE EFFECT OF INTERMITTENT STRETCHING ON MUSCLES AND NERVES AFTER NERVE SEVERANCE.

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ONE of the problems of the treatment of cases of nerve severance is the time during which movement of the paralysed muscles can be allowed and the extent to which it can be carried on with safety. In the period before suture the practice is to allow some degree of movement, and Sir Berkeley Moynihan,¹ in a recent paper, says that in order to keep the joints supple the paralysed parts must be freely moved every day, and many times a day. On the other hand, for a certain time after suture, no movement at all is allowed. The necessity of this has been specially insisted on by Sir Robert Jones,² who has had a wide experience of nerve suture cases.

The statement that movement is not permissible for some time after nerve suture is usually given in the form that the muscle during this time must be kept completely relaxed, or that the muscle must not be stretched. Thus Sir Robert Jones² says that "the slightest stretching of a muscle on the point of recovery disables it again," and Sir Berkeley Moynihan¹ that "not for a moment at any time must paralysed muscle be stretched." These are no doubt merely practical directions to avoid delay in recovery,

but the natural inference from them is that any degree of stretching is injurious to the muscle, and that it is this injury which delays the recovery. The inference is strengthened when it is at the same time pointed out that prolonged stretching of a muscle causes permanent elongation. So far as this inference is made it must tend to restrict movement before nerve suture, for if stretching is injurious to a muscle after suture it will be injurious to it for more or less time before suture. In any case it is necessary for satisfactory treatment to know what degree of stretching not only paralysed muscle but also degenerating and regenerating nerves will stand. I venture, then, to offer some remarks on these points, although my experiments are incomplete. Unless otherwise mentioned, I only consider the stretching produced by intermittent ordinary joint movement, and not the protracted stretching caused by the unrestricted action of antagonistic muscles. We may consider separately the effect on muscles and the effect on nerves.

I. STRETCHING OF MUSCLES.

The effect of intermittent stretching on muscles might *a priori* be either advantageous or the reverse, according to the weight which is laid on particular events. On the one hand, it forces lymph from the muscles, and so presumably metabolic products, and this we should expect to be advantageous. Further, it seems not unlikely that it is of advantage in relation to connective tissue formation. In denervated muscles the connective tissue increases—it is said to be visibly increased in microscopic preparations three weeks after nerve section—and part of the late contracture is attributed to the shrinking of the newly formed tissue. The connective tissue when first formed is soft and extensible. Intermittent extension will elongate the developing fibres, so that when they shrink there may be less tendency to contracture. On the other hand, muscles after denervation rapidly lose weight—in cats and rabbits the gastrocnemius loses about 50 per cent. of its weight in about four weeks—and it is practically certain that in this state it cannot stand as great a strain as normal. Whilst a great reduction in its power of withstanding strain might take place without making it liable to be injured by the degree of strain put on it by free joint movement, we cannot offhand say that free movement does not injure it. Observations on man can hardly settle the point, since the effect has to be judged by the rapidity of regeneration, and this is greatly influenced by the events after nerve suture. In animals a more definite result can be obtained by noting the effect of intermittent tension on the appearance of the muscles and on the degree of atrophy.

A short time ago I published an experiment³ on these points. The popliteal nerves in a rabbit were cut on both sides, and the leg and foot on one side rhythmically extended and flexed for an hour morning and evening.

At the end of three weeks the animal was killed and the muscles of each leg weighed. The muscles had no obvious difference to the eye, and no sign of ruptured fibres. On the side on which the paralysed muscles had been rhythmically extended, four of the muscles were rather heavier than on the other side, one was of the same weight, two were somewhat lighter. The differences were not decidedly outside the normal difference of weight on the two sides in normal animals.

The experiment showed that stretching the paralysed muscle a great number of times to about the full normal extent did not in its total effect appreciably affect the atrophy. It must be noticed that, on account of the experimental error, a slight effect would not be appreciable unless a number of experiments of the kind given were made, and that irritability might be altered without an alteration in the loss of weight. Further, the total effect may have been the algebraical sum of + and - effects, but, from the practical point of view, this is unimportant. I have made incidental observations on muscles in later stages of atrophy up to about three months, and have seen no sign that they are injured by moderate intermittent tension, or by the degree of strain exercised by antagonistic muscles provided this is not prolonged.

II. STRETCHING OF NERVES.

Movements of joints and stretching of muscles exerts more or less pull on the nerves. The conditions affecting these are essentially different before and after nerve suture.

Stretching Nerves by Movement before Nerve Suture.

Nerve fibres pass through the two well-known stages of forming, first, a granular protoplasmic band, and then a hyaline band—the “band fibre.” The former lasts two or more weeks—its duration varying in different fibres—and its appearance suggests that it is very little extensible. Fibres in this stage sometimes show great inequalities in the granular band, which might be due either to tension or to inequalities in protoplasmic formation. It is unlikely that they are due to tension since the nerve in the early period after severance is free to move. In two to three weeks after nerve severance the cut peripheral end becomes more or less fixed to the surrounding connective tissue, and a given movement causes a somewhat greater pull on the nerve. I have tested the extent of this on the sciatic nerve and its branches in rabbits and cats. By complete extension or flexion of the limb the nerve may be straightened, but its tension so far as I have seen is too slight to cause injury, and I have not found that it causes any rupture of the degenerating fibres. It may, I think, be concluded that, in the pre-suture period, fairly free extension and flexion movements are not likely to injure either muscle or nerve. Naturally, forcible movements are always to be avoided.

In the pre-suture period there are some definite advantages in a flexible splint, allowing a certain amount of movement. Passive movement can be carried on at frequent intervals by the patient, and, when flexors or extensors are not paralysed, limited voluntary movements can be made, sufficient to prevent the wasting in the non-paralysed muscles which accompanies disuse.

Stretching Nerve by Movement after Nerve Suture.

We may consider first the simplest case—namely, that in which the nerve is not shortened. In this case movement will tend to strain the sutures and rupture the nerves growing from the central into the peripheral end. But connective tissue soon joins the ends, and binds them—at first loosely—to the surrounding tissue. Restricted movements can be made without injury, since these put extremely little tension on an unshortened nerve. When the connective tissue has become firm, tension on the nerves will not injure the nerves at the suture as readily as it injures the newly formed fibres and the “band fibres” in the peripheral part of the nerves, consequently whether full movement can be made or not depends on whether the tension caused by it is sufficient to injure the peripheral part of the nerve.

The following experiments, a further account of which has been given elsewhere,⁴ bear on this question. In cats the peroneal nerve (Experiments 1, 2, 3) or the tibial nerve (Experiment 4) was compressed on one side sufficiently to break through the axis cylinders without breaking through the nerve sheath; the limb was left without a splint, so that the muscles would be extended by their antagonists for a greater or less time, according to the posture of the animal. The animals with cut peroneal nerve were allowed to walk about as they pleased; that with the cut tibial nerve was kept in a cage for a week and then allowed gradually increasing exercise. The recovery of nervous control was rapid. In Experiments 1 to 3 reflex abduction of the fifth toe was obtained after nineteen days; stimulation of the peroneal nerve caused fairly good contraction of all the extensor muscles of the leg in twenty-one days (Experiment 1), and strong contraction after thirty-six and thirty-eight days (Experiments 2 and 3). In Experiment 4, in which the tibial nerve was cut, the animal, after forty-eight days, could keep the heel well off the ground in walking; stimulation of the tibial nerve caused contraction of the flexors of the leg, and stimulation of the posterior tibial nerve—though with currents considerably stronger than normal—caused contraction of the muscles of the foot. On microscopic examination, all the nerve fibres were found to have undergone Wallerian degeneration.

These experiments show that in animals a considerable degree of movement does not prevent rapid regeneration in an unshortened nerve. The definitely ascertained facts with regard to the effects of nerve severance are so similar in man and animals that the results given above are, I think, applicable to man. I conclude that in cases of suture in man, when the nerve is not shortened, slight movements can be begun in a few weeks and rather rapidly increased in extent. Early movement probably has the advantage of elongating the connective tissue binding the nerve to the surrounding structures. The connective tissue in its later stages tends to fix the nerve and thus to cause the peripheral part of the nerve to be subjected to a greater strain during movement. In consequence, in cases

of nerve compression in which there has been considerable connective tissue formation, it is necessary in the later stages to be more cautious about movement than in cases of immediate nerve suture.

In the great majority of cases in man the nerve has to be shortened, and until the ends become firmly joined a very slight movement may be sufficient to rupture the fibres at the junction, and thus to cause a more or less serious delay in regeneration. Obviously the greater the shortening of the nerve the greater the risk. But even when the junction is firm there is still the risk of injuring the new fibres and “band fibres” in the peripheral part of the nerve, especially in the smaller branches, by even slight movement. There are unfortunately no comparative observations on the degree of strain degenerating and regenerating and normal nerve fibres will stand. If new fibres and “band fibres” throughout the peripheral end of the nerve can stand as much strain as the normal nerve, there seems no reason why movement should not be begun as soon as the union of the nerves is firm. If, on the other hand, new fibres and “band fibres” stand much less strain than normal nerves, it may be necessary to wait until the nerve fibres have become fully developed up to their terminations, and this in some cases would take many months. In any case, it is important to shorten the nerve as little as possible. It would, indeed, probably be better to insert a piece of fresh nerve, not more than half an inch, when much nerve has to be excised, but this can only be settled by experiment.

There is one other point I would mention. It is generally recognized that if a nerve has been severed the sooner it is sutured the better. The main reasons for this are that the longer a muscle is left to atrophy the longer time it takes in recovering its normal weight. At best it is a slow process. It is probable also that nerve regeneration is quicker if it is sutured before the central end has formed a large neuroma and before the “band fibres” have decreased in diameter. The practical difficulty is in distinguishing between complete nerve compression which will recover without operation and nerve severance which requires operation. Tinel⁵ considers that this often takes two to three months. In simple compression new fibres are formed in the part of the nerve just below the point of injury long before there is any sign of recovery on stimulating muscles and motor points. If, then, this region could be stimulated without the stimulation spreading to the normal nerve it would give rise to sensation, and compression diagnosed. In certain cases it would, I think, be possible to do this by passing a needle covered, except at its point, with shellac through the tissues on to the nerve and stimulating with faradic shocks of gradually increasing intensity. If there were no sensory reaction a month after the injury a diagnosis of nerve severance would be much strengthened.

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NOTE UPON A HELPFUL DIAGNOSTIC SIGN
IN RUPTURED DIGESTIVE ULCERS.

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SEVERAL years ago I saw a patient, a hawker, upon his admission to the Royal Victoria Infirmary, Newcastle-on-Tyne, under Professor Rutherford Morison. He was suffering from acute general abdominal pain of a few hours' duration, and so acute was it that he maintained a constant screaming such as incommoded the other patients in the ward. His doctor, a very careful practitioner, stated that the patient had many times consulted him for alleged sudden attacks of acute abdominal pain, which had just as suddenly passed off. Despite repeated careful examinations nothing abnormal had been discovered, and he came to be regarded as a probable malingerer.

Upon admission his overwhelming pain and a board-like rigidity of the anterior abdominal wall were evidence that