and the other denying, that the muscle can be seen to beat when separated from nerve cells. The contention that every cardiac muscle fibre is capable of supplying its own stimulus and beating independently may be taken as disproved. All the later evidence goes to show that the ganglion free apex of the frog's heart is incapable of beating unless stimulated. Experiments on mammalian hearts also tend to prove that only certain parts of the heart are capable of starting an independent rhythm, though observers do not exactly agree with one another. For instance, Hering,²⁵ by making extensive cuts through the hearts of dogs and other mammals, found that a section cutting off the great veins stopped the heart for a time, and that later the heart started beating again; further cuts removing other parts of the heart showed that certain regions—such as the left auricle, the right auricular appendage, and the ventricular apex—never started a rhythm of their own. All the parts capable of starting a rhythm, such as the great veins, the greater part of the right auricle, and the upper parts of the ventricles, contain numerous nerve cells, while the auricular appendages and the ventricular apex contain no nerve cells. Langendorff and Lehmann²⁶ had previously come to the conclusion that the auricular appendages were incapable of starting an independent rhythm, but Erlanger and Blackman,²⁷ while generally confirming Hering's results, state that the whole of the right auricle, including the appendage, exhibits the property of rhythmicity. Assuming, however, that Hering is correct in his view, that only those parts of the heart exhibit rhythmicity which contain numerous nerve cells, this does not absolutely prove that the nerves supply the stimulus, though, of course, it affords strong testimony in favour of that view. If only certain of the muscle fibres possess the power of rhythmically contracting, we should expect these important fibres to be specially well provided with blood vessels and nerves.

A difference of structure would be expected in association with a difference of function. In respect of this point there is some evidence in favour of the myogenic theory; Gaskell had already²⁸ remarked that the muscle in the sinus venosus of the frog, which exhibits the greatest rhythmicity, was of a more embryonic type than the rest of the cardiac muscle, and recently Keith and Flack²⁹ have shown that a similar difference of muscle exists in mammals and man. They point out that the remnants of the sinus venosus are found chiefly in the right auricle in the muscle round the vena cava superior, coronary sinus, and remnants of the venous valves, although it is possible that some remnants may also exist in the left auricle round the openings of the pulmonary veins. The muscle in these situations belongs to the pale variety of striped muscle, as does also the muscle in the A-V bundle, whereas the rest of the cardiac muscle is red. The A-V bundle may be regarded as the remnant of the auricular canal, the appendage forming the auricle proper. Thus a special muscle tissue is found in those situations where a rhythmical beat may start, and is found nowhere else, with the possible exception of the muscle round the opening of the pulmonary veins in the left auricle. At two points or "knots" the muscle differs still more markedly from the general cardiac muscle. One knot forms the commencement of the auricular ventricular bundle just above the septal cusp of the tricuspid valve, and the other is at the root of the superior cava. The second of these receives a specially large blood supply, and has numerous nerve cells, and is possibly the spot from which the normal cardiac contraction starts.

There is also direct evidence in favour of the stimulus being of muscular origin. The first and most important is afforded by Engelmann's experiments on the great veins of frogs,³⁰ in which he found that these veins were capable not only of rhythmically contracting as a whole but that even very small pieces of them, hardly a cubic millimetre in size, rhythmically contracted also. In many of these tiny pieces Engelmann was quite unable to find any nerve cells although the muscle was very thin and the cells should have been easy to find. It is true that modern methods of staining show nerve cells to be numerous over the great veins, and it would be well if Engelmann's observations were repeated; but until they are disproved it seems to me that they must be accepted, and the possibility of the muscle beating rhythmically without the intervention of nerve cells acknowledged.

Support is lent to this conclusion by the fact that the embryonic heart in birds and fishes starts beating before there are any nerves or nerve cells in it.³¹ It is true that it also starts beating before the muscle fibres have developed, but the cells which start this rhythmic pulsation are mesoblastic cells from which muscle fibres are subsequently developed, while the epiblast, from which, so far as we know, all nerve cells are derived, has no part in the causation of the beat.

In conclusion, it may be emphasized that the myogenic theory is not incompatible with any of the known phenomena of the heart beat, while it affords the best explanation of many of them. It is certain that the muscle fibres possess the properties of contractility, excitability, conductivity, and tonicity, and it is probable that these are exercised during the normal beat of the heart without the intervention of the nervous tissue. It is also certain that all the muscle fibres are not capable of building up a stimulus for themselves, but there is evidence to show that certain fibres of peculiar structure possess this property. While certain facts seem to find their readiest explanation in the neurogenic theory, especially the response of the quiescent heart to the stimulation of the accelerator nerve, there are others pointing as strongly to the hypothesis that the heart beat is purely muscular; and in the face of Engelmann's direct observations on the great veins in frogs and the occurrence of pulsation in the embryo heart before development of nervous elements, it seems to me that the complete myogenic theory has the more weighty evidence in its favour, and should be accepted until stronger arguments are brought against it. The conception that the rhythmic beat is purely muscular in its origin does not preclude the possibility of the beat being influenced by outside nervous impulses; this would give a sufficient explanation of the large nerve supply to the heart.

Attributing the rhythmic power of contraction to the muscle is, of course, only a very partial explanation of the cardiac beat, the cause of which lies deeper in physico-chemical changes in the cells. Much suggestive work has been done on these lines by Loeb,³² Howell,³³ and others, but a discussion of this is outside the province of the present article.

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LOCOMOTOR ATAXIA: ITS EARLY RECOGNITION AND GENERAL MANAGEMENT.

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IN considering the nature of the lesion, a sclerotic change in the posterior columns of the cord, in the posterior nerve roots, and in the peripheral nerves, we must bear in mind that although acute and subacute attacks do occasionally occur, the disease is essentially chronic and progressive, and that from a strictly curative point of view little can be expected. The course of the disease is usually very long, and may extend through a period of twenty or thirty years. Our aim, therefore, in treating the malady should be chiefly to relieve the symptoms, and as far as possible to arrest or retard the degenerative process. The cause of this degeneration is by most authorities considered to be syphilis. Erb, in his investigations on this subject, found that there was a history of syphilis in 90 per cent. of cases of tabes; Moebius

concluded that the disease "never originated without syphilis"; and, although the statistics of other observers show a somewhat lower percentage, there can be no doubt that syphilis is responsible for a very large number of cases of the disease.

How the result comes about is uncertain. Fatigue, excesses, cold, trauma, overstrain, intoxications, etc., are considered to be exciting causes; there may also be hereditary predisposition.

It has been shown that if syphilis be treated early and thoroughly the probability of the appearance of tabes is lessened, but not removed.

1. The Preataxic Stage.

Perhaps one of the greatest difficulties in regard to this stage is its recognition, yet it is at this early stage that treatment may be of most service.

It often happens that the patient complains of gastric or intestinal disturbances (the so-called crises), and as they simulate ordinary dyspepsias the underlying cause may be overlooked.

The neuralgic pains, too, are misleading and may be looked upon as rheumatic. I saw a number of cases while resident medical officer at the hospital at Buxton some years ago, and noted the tendency there was for patients suffering from locomotor ataxia to be sent as cases of rheumatism. A diagnosis is often missed by omitting to test the knee response.

Cases of so-called sciatica may be really tabes, and this disease should always be suspected when the "sciatica" is bilateral. An early intimation of the onset of the disease, and often that first noticed by the patient, is difficulty of micturition; he may ask advice simply on account of this.

A young man came to me about three years ago complaining of being unable to control his water, especially during the night, when he frequently used to "wet the bed"; he had no other symptoms which would lead to a suspicion of a spinal lesion. This patient has now marked ataxia with other evidences of the disease well pronounced; the trouble in regard to micturition, is, however at present in abeyance.

A patient in whom there is no ataxia and who walks briskly may complain of a burning feeling and numbness in the hands and feet, symptoms suggestive of peripheral neuritis. If the calf muscles are not soft and flabby, and pain does not result from pinching them, locomotor ataxia should be suspected.

It is always advisable when any of these early symptoms are observed to at once seek for confirmatory signs; probably the most important of these is loss of knee-jerk—often a very early manifestation, and with one or more accompanying symptoms it is practically diagnostic.

Eye indications (the Argyll-Robertson pupil, ptosis and optic atrophy) should be looked for; indeed, blindness may be the first symptom of tabes. Laryngeal dyspnoea, with cough and stridor, is occasionally a very early symptom, and the spasm may be so great as almost to cause asphyxia, though this is very rare. Lightning pains often occur early.

I have a patient now—a female, aged 52—who for several years has suffered from intense darting pains in both forearms, and although during the early days of my attendance on her I looked for signs of tabes, until the last year or so I was unable to satisfy myself that the disease was really present. In this patient the knee-jerks are now absent; she has very small pupils; says she feels giddy when washing herself; she sways when standing with the eyes closed; and has also other signs and symptoms of the development of the disease.

The pulse is in a number of cases accelerated.

Dr. Purves Stewart states that in the examination of the cerebro-spinal fluid we have a valuable and apparently constant means of recognizing tabes in its early stages, and that if there is no excess of lymphocytes present this disease (and also general paralysis) can confidently be excluded.

2. The Ataxic Stage.

This develops gradually. The patient sways in standing with his feet together and his eyes closed, and he finds difficulty in getting about in the dark; he is apt to fall if he suddenly turns round; the ataxic gait comes on slowly, and is quite characteristic; also inco-ordination of movements. There is no difficulty in recognizing this phase of the disease; it may continue for an indefinite term of years, and gradually merge into a condition of paralysis, when the patient becomes unable to walk and is obliged to take to his bed.

3. The Paralytic Stage.

In this intercurrent affections are apt to ensue, one of which is likely to be pyelonephritis or pneumonia.

General Management.

The preliminary or preataxic stage is often long, and characterized by few symptoms, and the case may never advance beyond this stage. The patient should be encouraged to follow his usual employment in a quiet way as long as he is able to keep about; he should be careful to avoid excesses of all kinds; systematic movements, regulated gymnastics, and general exercise are good, but must be indulged in short of fatigue. Cycling, as a rule, is not to be recommended, for fear of over-exertion.

Diet must be carefully regulated, and, in severe crises, peptonized milk and rectal feeding are indicated. It may be necessary during exacerbations, whether from crises of different forms or from severe pains, for the patient to be at complete rest in bed, with counter-irritation to the spine by heat, blisters, or the free use of the actual cautery. By these means great relief is obtained.

Suitable medicines must be given for the gastric and intestinal attacks; and constipation, which is common, relieved by an occasional purge and the usual tonics. Diarrhoea is sometimes troublesome, and requires checking in the ordinary way. Occasionally a hot or Turkish bath is very comforting and otherwise beneficial.

Drugs are often very disappointing, and the importance of devoting attention to the mental aspect of the case must never be lost sight of. Tabetics are apt to drift into a depressed condition, and no effort should be spared in endeavouring to brace up the muscular and other tissues which are not directly implicated, and to keep the general tone of the patient at its best. Massage is of use in many cases, and is a help to this end.

When the disease is advanced and paralysis has developed the patient should lie on a water bed, and all precautionary measures must be taken for the prevention of bedsores and other intercurrent troubles.

Special Indications.

(a) *Bladder.*—Retention and incontinence of urine are common symptoms, and cystitis, pyelitis, and suppurative nephritis may be set up. If cystitis occurs it should be treated with salol and quinine; the salol is broken up into carbolic and salicylic acid, and being excreted by the kidneys, disinfects the urinary passages. Urotropine is most excellent when the urine is alkaline and offensive; it may also be necessary to wash out the bladder for this condition. It is well to use a large India-rubber catheter, and strict antiseptic precautions must be observed. Catheterization, with the same precautions, must be resorted to whenever the bladder is imperfectly emptied.

(b) *Dyspnoea or laryngeal crises* as a rule are not serious, although at times they may be very severe and persistent; they may be relieved by the application of cocaine, inhalation of amyl nitrite, or a few whiffs of chloroform.

(c) *Perforating ulcers* form on the foot, generally over the metatarso-phalangeal articulation of the great or small toe, but other parts may also be affected, and sometimes both feet. There may be a sinus leading down to diseased bone, and gangrene occasionally sets in. In early stages ulcers must be treated by prolonged rest in bed and antiseptics; scraping becomes necessary in some cases. The ulcers may heal but recurrence is to be expected.

(d) *Fractures of bones* are caused very easily. They unite very quickly with a great amount of callus, so much sometimes that at the end of ten days or a fortnight there is a large mass around the part, due not only to callus, but also due to ossification in the soft tissues about the injured bone. These and even the muscles occasionally become so compact that there is the appearance of one solid mass of bone. The condition is akin to the arthropathic changes in Charcot's joints which occur in some persons suffering from locomotor ataxia, and which chiefly affect the knees. The effusion may be rapid. The joints must be kept protected from injury and abnormal movements by apparatus or position. Excision has not proved satisfactory. Fractures must be kept absolutely still, and fixed for a longer period than would be necessary in a healthy person, because the union tends to become soft, and directly the

patient bears weight on the limb after the splints have been removed the bone will very probably bend.

(e) *Ataxia*.—Probably the best form of treatment is by Frenkel's exercises, and even in very bad cases improvement is marked. When the ataxia is extreme and the patient unable to stand and walk, simple movements must be made while in bed. The first of these movements is that of raising one leg slowly and steadily to a fixed point, then bringing the heel down on a fixed point. A board can be used with notches, in which the heels are placed. The patient is then made to raise the foot and bring the heel down into another of the notches. These movements are persevered with several times each day, until the patient can perform them accurately. The next advance is to train him to stand steadily, and then to walk. At first this can be greatly aided by the use of an apparatus so constructed with adjustable crutches on wheels, that part of the patient's weight is transferred from the lower limbs to the axillae and arms; afterwards he should exercise with the aid of sticks, then without any support. He should next be made to walk bringing his foot down accurately on lines ruled on the floor. It is essential that the patient be impressed with the importance of making each step and movement in the precise way indicated. After some improvement has taken place and the patient has gained confidence, he may practise the movements himself. The best results are obtained in patients who take interest themselves in the exercises, and who are persevering in their attempts to carry out suggestions. It is important to give the patient every encouragement, and to try to help him to gain confidence in his own efforts. Movements for the arms suitable for each individual case can be devised. Every exercise must be made with great care. At first the movement should be practised for about a quarter of an hour two or three times a day, less or more according to the severity of the case; they should be stopped directly there is any sign of fatigue, and over-exertion must always be rigidly avoided. The exercises ought to be carried out under the eye of the medical attendant. They should be persevered with for not less than a month, except when contraindicated by fatigue, or other untoward symptoms.

X Rays.—In certain cases the *x* rays should be tried. Dr. Byrom Bramwell, in speaking of the effects of the treatment and its possibilities, states, in a case in which the most careful dieting, rectal feeding, and medicinal treatment had practically failed to arrest the gastric crises, which were very severe and of 2½ years' duration, the result was most remarkable. The *x* rays were applied for five minutes every day to the dorsal region of the spinal column. Immediate and extraordinary improvement resulted from the treatment, and the patient was able to digest potatoes, meat, etc., without pain or discomfort, and gained 10½ lb. in weight during the first week. There was a return of the symptoms in this case; they, however, were again relieved by the *x* rays. Nothing is known as to the mode of action of the *x* rays in cases of visceral and internal disease; it is probable that the improvement gained in locomotor ataxia is the result of a mental or psychical impression.

Thermal treatment may be obtained at Cheltenham, Buxton, Strathpeffer, and other places in this country; abroad, at Nauheim, Aix-la-Chapelle, St. Moritz, etc. Cheltenham, the garden town of England, has many advantages; the mild climate, the level aspect, and the general attractive appearance make it eminently suitable for the tabetic. A new central spa at the Town Hall was inaugurated by Dr. Goodhart on June 20th, 1906. The surrounding hills can be reached by electric car, where at a height of nearly 1,000 ft. above sea level the air is most invigorating. The most suitable temperature, as a rule, for baths is about 80° F. Sulphur baths are used, and are spoken highly of by some. Baths in general aid the circulation and are refreshing and comforting. The change of scene, regulation of diet, and general management to be obtained at a spa have a stimulating and helpful effect on the mental and general condition all-important to an ataxic patient, and there is no doubt that considerable benefit sometimes results from such treatment.

Suspension.—Benefit has been noted from this, it was probably due to suggestion and to psychical effects. It is not a form of treatment to be recommended and is now very rarely practised.

Electricity.—Both faradic and galvanic currents have been used, the former applied to the skin with a wire brush chiefly for the relief of pain, and with the hope of restoring sensation. The latter is best applied by means of two very large electrodes, one over the sacrum, the other higher up; the upper electrode is moved slowly up and down the spine, so as to vary the density without rapid makes or breaks, the current being gradually raised to the maximum which can be borne. The object of this is to modify the nutrition of the cord. Electricity may be tried for the paralysis which occurs, and should be applied to the nerves and muscles which are affected.

Marriage.—Tabetic patients ought not to marry.

Climate.—Cold and damp aggravate the pains; an equable warm and dry climate is one most suitable.

Drugs.—Potassium iodide and mercury have been largely given, but most authorities agree that they have not much influence over the lesions of the disease. If the case is seen in an early stage these remedies should be used, and if a history of syphilis can be elicited, and especially if the primary infection occurred within, say, two years of the onset of tabetic symptoms, or if there has not been early and thorough treatment of the syphilis, they should be administered perseveringly. Potassium iodide may be combined with colchicum and alkalies when the pains are severe. Silver nitrate given in 4-grain doses for a long time often relieves and lessens the frequency of the pains, and may do some permanent good. Aluminium chloride may be given two or three times a day, and certainly with benefit, especially for the pains. Zincophosphate is beneficial in some cases. Gold chloride has been used with good effects. Arsenic should be pushed and its general tonic effect is undoubtedly of service; its combination with iron is sometimes advisable. Strychnine is a remedy constantly employed for the tonic effect and is often of service. Ergot may be used in acute and subacute attacks, and it is recommended by Charcot for urinary troubles. Cannabis indica is serviceable in some cases for the relief of the pains. Calabar bean has some influence in improving muscular power and in retarding wasting in paralysis. Phenacetin and lactophenin are very useful for the relief of the pains, and also for control of crises and may be repeated. Antipyrin is used by many, but it is not without danger in large doses. An attack of pain will often yield after three or four doses of ten grains given at intervals of an hour. Sodium salicylate is worthy of trial when the pains are much in evidence. Nitroglycerine is very useful if there is increased arterial tension, then it may be given for a long time in increasing doses, with much benefit in relieving the crises and lessening the pain. Morphine is a remedy the use of which it is advisable to postpone as long as possible, but it may be a necessity if the distressing pain resists all other treatment; the smallest dose which will afford relief should be administered in the form of hypodermic injection. Sometimes it is also required for the gastralgia.

Animal Extracts.—Testicular juice, spinal cord, brain substance, spermin, have been tried but with very unsatisfactory results.

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AN OPEN METHOD OF ETHER ADMINISTRATION.*

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THERE are, of course, many known ways and means of administering ether, and I do not claim any originality for the method I am about to describe; but I think it would be worth bringing to notice, although I do not commend it as the only way ether should be administered, but rather look upon it as an addition to the

* Read before a joint meeting of the Lancashire and Cheshire and North Wales Branches at Chester.