In recent years, with the increase of bone grafting, particularly as the result of the pioneer work of Albee, grafts and other methods of bony fixation have been employed for the fixation and prevention of deformity of the spine in these cases. Unquestionably this is a justifiable procedure in selected cases, but many cases are not severe enough, while others are so severe and intractable, or are so hopelessly crippled generally, that the operation is unjustifiable. A case with obliquity of the pelvis and lumbar curve due to paralysis of the psoas or abdominal and lumbar muscles on one side, seems to me one in which operative fixation of the spine is worthy of serious consideration in the absence of any contraindications. Again, some severe "C" curves which are seen before fixation of the deformity to any great extent has occurred should also be treated by gradual correction as far as possible, with a view to eventual fixation by a bone graft. More is being done along these lines in America than in this country, by Albee¹⁶ and Mackenzie Forbes¹⁷ among others.

REFERENCES.

- ¹ *Acute Poliomyelitis*, Lumsdalen Lectures, 1916, Bale, Sons and Danielsson, London. ² *Lancet*, May 3rd, 1913. ³ *Amer. Journ. of Diseases of Children*, December, 1911. ⁴ *BRITISH MEDICAL JOURNAL*, 1914, i, 1165. ⁵ *Ibid.*, 1918, i, 141. ⁶ *The Action of Muscles*, Lewis, London, 1918; *BRITISH MEDICAL JOURNAL*, 1917, i, 249; *Ibid.*, 1915, i, 60; *Aust. Med. Journ.*, June, 1911, and January, 1913. ⁷ *BRITISH MEDICAL JOURNAL*, 1920, ii, 513. ⁸ *Loc. cit.* ⁹ *Op. cit.*, p. 96. ¹⁰ *Lancet*, 1912, ii, 80, and 1914, ii, 216. ¹¹ *Loc. cit.* ¹² *Loc. cit.* ¹³ *Annals of Surgery*, 1908, ii, 64. ¹⁴ *The Treatment of Infantile Paralysis*, Heinemann, 1917, p. 37. ¹⁵ *Proc. Roy. Soc. Med., Clinical Section*, April 10th, 1908. ¹⁶ *Pennsylvania Med. Journ.*, 1915, xviii, 335. ¹⁷ *Journ. Orthop. Surg.*, June, 1920, ii, 6.

MITRAL STENOSIS, AURICULAR FIBRILLATION, AND THE ACTION OF DIGITALIS.*

BY

C. H. CATTLE, M.D., F.R.C.P. LOND.,

HONORARY CONSULTING PHYSICIAN, NOTTINGHAM GENERAL HOSPITAL.

A WRITER in this JOURNAL† recently made the statement: "A clear conception of auricular fibrillation is essential to the management of heart disease." The commonest antecedents of this disorder are mitral stenosis and myocardial degeneration; it also occurs in connexion with arteriosclerosis, aortic and mitral incompetence, and certain acute diseases, as rheumatic fever, pneumonia, diphtheria, and infective endocarditis.

Whatever the cause of the fibrillation it can be most profitably studied in relation with mitral stenosis. If we wish to understand mitral stenosis, as we commonly see it in young adults, we must go back to the rheumatic heart affections of childhood. Our conceptions of rheumatism are apt to be dominated by the occurrence of arthritis. In adults arthritis is the prominent symptom; the heart affection is incidental. In children, on the other hand, the joint signs are often transient, insignificant, or absent, while carditis is very common. I use the word "carditis" advisedly, because pericarditis and endocarditis never occur without myocarditis. It is in children especially that this liability to pan-carditis exists. Murmurs and friction are well known and common signs, but the most striking sign of all, to my mind, indicating involvement of the myocardium, is the accelerated cardiac action which may continue for weeks or months following an attack of rheumatic fever or chorea. These cases need prolonged rest if the cardiac condition is to have time to quiet down. Valvular and muscular lesions are incurable, and the only chance of averting or mitigating their effects is to encourage resolution of the infective process by means of rest.

The structure of the rheumatic nodules on the valves and in the wall of the heart is similar to that of the subcutaneous fibrous nodules occasionally met with. The effect of the nodules on the valves may be rapidly destructive, causing, in the case of the mitral, more or less regurgitation; these cases may end in mitral stenosis from subsequent contraction of the fibrous ring to which the valve segments are attached. But a more common origin of stenosis is the presence in the valve of islets of infection, which lead to a chronic process of sclerosis extending over

years. Rheumatism is proverbially relapsing, and knowing its nature we can have no doubt that from time to time extensions of the infection in the heart take place, not necessarily accompanied by arthritis, but gradually leading to a tighter and tighter narrowing of the mitral orifice. Mitral stenosis is commoner in women than in men; chorea is commoner in girls than in boys. Acute observers like Barlow have suggested that the partiality of chorea for the female sex may to some extent explain the frequency of mitral stenosis in women. Chorea, like rheumatism, is notoriously apt to relapse; sometimes a murmur can be heard during an attack, sometimes not. I believe that most, if not all, cases of mitral stenosis are due to sclerosing valvulitis, whether choreic, rheumatic, or merely latent; its destructive effects are slow and insidious; the mitral curtains become thickened, indurated, and adherent at their margins, and it is not realized till years have elapsed that an irremediable narrowing has occurred. This sclerosing process may cause no alteration of the heart sounds till it has been at work a considerable time.

The symptoms and signs of mitral stenosis may be divided into (1) the incipient stage; (2) the stage of full development; (3) the stage of auricular fibrillation. In the first two stages the pulse is regular; in the last it is grossly irregular.

Mitral Stenosis: Early Signs.

The first stage causes no symptoms, hence it will not be recognized unless looked for. Children of known rheumatic history ought to have their hearts examined from time to time, especially at the time of choosing a career. Every patient ought to be examined both in the standing and the recumbent position; a presystolic murmur, not heard in the standing position, will sometimes be brought out if the patient does a little exercise and then lies down. An important early sign is an apparent reduplication of the second sound at the apex. It is not a true reduplication, as the second part of the sound is produced at the mitral and not at the semilunar valves. A real reduplication, heard at the base, is due to asynchronous closure of the sigmoid valves, but is of no importance as an early sign. An apparent doubling of the first sound at the apex may be due to a short and ill-developed presystolic murmur. An instructive case of this kind lately came before our special neurological board for army pensioners:

He was a man, aged 25, who complained of muscular pains and occasional swelling of the ankle-joints. I noticed slight, irregular, jerky movements of the right arm and leg, but as tremors and spasms are very common in this class of case, the significance of the symptom did not at first occur to me. In both standing and lying positions the heart's impulse was slightly forcible, though there was no obvious enlargement; the first sound was rather loud and accompanied by a systolic murmur; the second sound at the apex was reduplicated. At this moment one of my colleagues happened to come into the room and I asked him to confirm the signs. While he was listening he exclaimed: "Why, the man's got chorea!" and so he had plainly enough.

Here we had the three parts of the rheumatic picture pieced together—namely, the muscular and arthritic pains, the heart lesion, and the chorea. These early signs indicate heart disease of at least three years' standing, and the fully developed signs of mitral stenosis indicate disease of five or more years' standing. This man was working as a coal-miner, and illustrates the point of unsuitability of occupation. He was advised first to have treatment from his insurance doctor, and then to change his occupation if possible.

Intermediate and Later Signs.

The fully developed signs of mitral stenosis are so well known that I need only refer briefly to them. A presystolic thrill felt at the apex and terminating with the impulse is almost pathognomonic. The rough presystolic murmur of crescendo character, terminating in a short snapping first sound, and the accentuated pulmonary sound are well known and typical signs. It must be remembered that the murmur is heard over a very limited area—that is, the immediate neighbourhood of the apex; neglect of this fact has sometimes led to failure in diagnosis. The short first sound resembles the second sound in quality, and as the second sound often cannot be heard at the apex care must be taken not to mistake the presystolic murmur for a systolic one, and the first sound for the second. This mistake can be avoided by timing the

* A paper read before the Nottingham Medico-Chirurgical Society, February 16th, 1921.

† Review of *The Mechanism and Graphic Registration of the Heart-beat*. By Dr. T. Lewis. Vol. ii, 1920, p. 166.

murmur with the finger on the carotid pulse. The peculiar sharp first sound can often be heard several inches, even a foot or more, from the patient without the intervention of a stethoscope. The presystolic murmur may totally disappear, but the snap sound will probably remain. I went into the country lately to see a woman, aged 38, whom I had known for years as having a well-marked presystolic murmur. On this occasion the heart was regular and slightly rapid; there was neither murmur nor thrill, but the snap sound was definite and audible without contact with the patient at a distance of two inches. As the left auricle becomes dilated and hypertrophied and the stenosis narrower, the murmur often occupies the whole of the diastole, commencing with an accent shortly after the second sound, then diminishing, and again intensifying in the presystolic period. After auricular fibrillation has set in the diastolic portion of the murmur remains and the presystolic disappears.

This stage may last a varying number of years, the condition may appear to be stationary, and some people would say the valvular lesion was compensated. If the stenosis remain moderate life may be prolonged many years, but the tendency is for the narrowing to increase and for breakdown of one kind or another to occur. A large proportion of persons with mitral stenosis seldom feel well: they are soon fatigued and out of breath; there is generally slight cyanosis; they complain of cold extremities because the warming blood cannot reach these parts in sufficient quantity; they suffer from occasional epistaxis, from bronchitis, dyspepsia, and passive congestion of the viscera. My object is to follow out the effect of mitral stenosis on the heart, and only passing mention can be made of such accidental complications as haemoptysis, infarction of the lungs, embolism of cerebral or other arteries.

Auricular Fibrillation.

In a case of mitral stenosis the auricles may assume a condition of fibrillation in consequence of the natural progress of the disease, or of some sudden violent effort. The auricles have now lost the function of contraction by which they normally drive the blood into the ventricles. By fibrillation is meant an inco-ordinated, tremulous and flickering movement of the muscular wall of the auricles, which is in a state of continual agitation. If I may use an illustration of my own, I should compare the fibrillating auricles to the weak fibrillary twitchings which occur in the muscles of the body when they are undergoing paralysis and atrophy. In both cases weak and isolated contractions are taking place, and in neither case is there any resulting, purposive movement. The ventricles normally receive their contractile impulse from the auricles by means of the auriculo-ventricular bundle of fibres; the weak, rapid and irregular impulses arising in the auricles are reflected in the weak, rapid and irregular pulse—the well-known mitral pulse. This has been called “the perpetually irregular pulse,” since it remains irregular as long as the auricles continue to fibrillate. Most other forms of irregularity (for example, that due to premature beats) are either temporary or alternate with periods in which the pulse is regular. The fibrillations of the auricles may amount to as many as 500 a minute; the ventricular rate may be 120, 140, or even 200 in rare cases, so that it is obvious that many of the impulses fail to excite any ventricular contraction. It would not be correct to describe this condition as one of paralysis of the auricles. Indeed, if the auricles were paralysed and merely passive the heart would be better able to carry on its work. The ventricles are worried by the ceaseless stream of weak, rapid and irregular impulses proceeding from the auricles; their contractions are consequently irregular and inefficient, and their period of repose is shortened. This irregular action, combined with structural changes in the muscular wall, is a common cause of heart failure, as we see it manifested by dilatation of the heart, venous engorgement, passive congestion, and oedema. Many of the weak heart-beats cannot be felt by the finger on the pulse, and the only method of correctly ascertaining the real ventricular rate is by auscultation. This rule of auscultation applies to all forms of pulse irregularity, which by this means can often be differentiated from one another. The perpetually irregular pulse is in itself an important sign of auricular fibrillation, but these are also other signs in mitral stenosis

cases. The murmur loses its rasping character, becoming softer; it is often purely diastolic, not running up to the first sound when the pauses between the beats are long, but occupying the whole interval when the pauses are short. This diastolic murmur has been mistaken by competent observers for the murmur of aortic incompetence; Mackenzie, to whom we owe the foundation of our modern knowledge of heart disease, was the first to explain the true meaning of the murmur. The first sound often loses its sharp snap and becomes more of a tapping character. The onset of auricular fibrillation may in some cases cause but little discomfort; in others it may give rise to increasing cardiac failure from the first. Sir James Mackenzie states that he has seen many individuals with auricular fibrillation who have led strenuous lives, engaged in hard manual labour, and infers that in them the muscle of the ventricles had not been seriously damaged.

I have stated that in auricular fibrillation the ventricles beat rapidly and irregularly. This is true for the great majority of cases. Occasionally the contractions are slow and regular; this occurs when myocardial disease involves the auriculo-ventricular bundle, causing heart-block, and thus interrupting the passage of impulses from auricle to ventricle.

Proof of the Occurrence of Auricular Fibrillation.

Mackenzie has said that “the discovery of this disorder is the most important yet made in the functional pathology of the heart.” Of the many hypotheses put forward to explain the perpetually irregular mitral pulse this is the only clear and unassailable interpretation. After Mackenzie had been engaged for some years in studying tracings from the venous pulse in the neck he noticed fine fibrillary waves in the tracing in certain cases where the wave caused by normal auricular contraction was absent. It is now known that these fine waves are caused by the fibrillating auricles. Dr. Thomas Lewis was the first to demonstrate the occurrence of fibrillation by pointing out the similarity between clinical electro-cardiograms, and similar records taken from animals in which fibrillation had been experimentally induced. Spontaneous fibrillation sometimes occurs in horses, and it was from observation on a horse that Dr. Lewis obtained final proof of the occurrence of this disorder. The animal was rendered unconscious, and in the exposed heart the fibrillating movements were clearly seen. It is thus obvious that the conception of fibrillation is no mere theory devised to explain the irregularity; but that the actual occurrence of this disorder has been definitely proved both by observation and experiment.

The Action of Digitalis.

It has long been known that digitalis slows the heart by prolonging diastole—that is, increasing the resting period. It is the discovery of fibrillation that gives the clue to the reason why digitalis acts so remarkably in some cases, and in others appears to fail. It has a twofold action, slowing the whole heart by stimulating the vagus nerve, and, by a specific influence on the auriculo-ventricular bundle, blocking some of the impulses proceeding from auricles to ventricles. It is thus clear why in many cases where the rhythm is normal and regular but little good results from digitalis, and that a great deal of the benefit derived in auricular fibrillation is due to the blocking of many of the disorderly impulses proceeding from the auricles. In this affection the heart is more susceptible to its influence, and there are times when it acts like a specific. It is more successful in rheumatic than in degenerative cases. Many cases of mitral stenosis, when the pulse is regular, do not require digitalis and are better without it. It should, however, be used whenever there is dilatation, except in acute febrile conditions. After irregularity has set in, whether in the early stages, or in the later ones characterized by oedema and other signs of heart failure, the results are often brilliant.

There are many ways of giving digitalis, but for ordinary purposes the B.P. tincture is reliable. It is said to lose its potency when dispensed with water, but I have not found this to be a common occurrence. In auricular fibrillation one drachm of the tincture—that is, $\text{m}\times$ every four hours, or $\text{m}\times\text{v}$ every six hours—should be given daily, carefully watching the effect by counting the pulse twice a day by auscultation. After four or five days the heart's rate will begin to fall; in another day or two it will be

between 70 and 80, and then the drug must be left off for a few days. When the heart's beats occur in couples, as is sometimes the case, the drug should be immediately omitted for a few days. Other signs of sufficiency are severe headache, nausea, vomiting, and diarrhoea. Any of these call for suspension of the drug. After a physiological reaction of this description has been obtained, an attempt should be made to find the daily quantity of digitalis which will keep the heart about the normal rate. Patients can take small tonic doses for months without bad effect if they are instructed to omit the medicine for a few days occasionally. The patient's sensations are a good guide as to whether more or less of the drug is required, and some feel best when the heart's rate is kept as low as 50.

In heart failure from purely degenerative changes, in which the pulse frequently remains quite regular, the effects of digitalis are not so good. In these conditions digitalis should be given in the same doses with the same precautions as I have already advised. Mackenzie states* that he has many times attempted to reduce the increased rate of the heart when the rhythm was normal, and invariably failed. This observation certainly applies to all febrile and toxic states. Here the heart muscle is poisoned by the bacillary or other toxin, and digitalis can have no good effect while this condition remains. It may be useful for the resulting heart weakness after elimination of the toxin. Sutherland† obtained reduction of the pulse rate after the temperature had subsided in rheumatic fever. Speaking generally, more good may be anticipated when digitalis slows the heart's action; a longer period of repose is followed by a stronger beat. Cases have been reported in which good resulted although no reduction in rate was obtained.

For pulse irregularities due to premature beats, which commonly cause intermission of the pulse, digitalis should not be given. The drug itself will occasion premature beats, and would certainly aggravate the condition where the tendency already exists. It is not a safe conclusion that because a heart intermits occasionally it is necessarily a weak heart. Digitalis is often wrongly given for supposed "weak heart." Our ideas are certainly clearer than they were ten years ago as to the cases digitalis is likely to relieve and those which it is not.

The paper was illustrated by lantern slides. For some of the subjects I am indebted to Sir James Mackenzie, Dr. Lewis, Dr. Price, and Messrs. Shaw and Sons.

BIBLIOGRAPHY.

- Albutt's *System of Medicine*, vol. vi, 1909.
 Brachman: Auricular Fibrillation, *Lancet*, February 19th, 1921.
 Broadbent: *Heart Disease*, 1900.
 Lewis: *Clinical Disorders of the Heart Beat*, 1912. *Mechanism of the Heart Beat*, 1920. *The Soldier's Heart*, 1918.
 Mackenzie: *Diseases of the Heart*, 1913. On Digitalis, *Heart*, 1910-11; and other papers.
 Poynton: The Nature and Symptoms of Cardiac Infection in Childhood, *BRITISH MEDICAL JOURNAL*, 1918. On the Study of Heart Disease, *Ibid.*, vol. ii, 1920. Acute Rheumatism in Children, *Lancet*, vol. ii, 1920.
 Price: *Diseases of the Heart*.

THE TREATMENT OF SCIATICA BY GALVANIC ACUPUNCTURE.

BY

E. A. GOULDEN, M.D.,
 LLANDRINDOD WELLS.

THE treatment of sciatica may be comparatively simple or very troublesome. Some mild cases, with rest in bed and sedatives, recover, but in others the whole Pharmacopoeia has no effect, for no known drug has any effect on neuritis or on the absorption of the exudation. Neuritis is usually divided into two types—the parenchymatous and interstitial—no local treatment can have any effect on the former; it is with the interstitial type associated with inflammatory changes in the sheath and connective tissue, and accompanied by exudation of cells, that we are concerned. There is reason for believing that this exudation is distributed not continuously along a nerve but in patches revealed by tender areas or by use of the faradic current. Treatment by acupuncture is particularly serviceable in these cases of nodular fibrositis.

* *BRITISH MEDICAL JOURNAL*, January 29th, 1921, p. 152.
 † *Ibid.*, vol. ii, 1919, p. 50.

Dr. Davis, formerly of Llandrindod Wells, first introduced and described this method in the *Bristol Medico-Chirurgical Journal* in June 1915, but it has been in use for twenty years in hundreds of cases of sciatica and other forms of neuritis.

It is not my intention here to enumerate the different causes of sciatica. I exclude all cases due to pelvic growth, bone disease, spinal cord disease (as locomotor ataxia), diabetes, venereal disease, etc. These have their own special form of treatment, and must be managed on constitutional lines. A definite diagnosis is as important in the treatment of sciatica as in any other ailment, for local treatment of sciatica when there is grave constitutional disturbance is bound to end in failure.

The aim of all the various forms of treatment devised for sciatica is to induce hyperaemia of the nerve. In the Scotch douche and radiant heat an endeavour is made to secure this by the varying stimuli of hot and cold water, or by exposing the whole limb to high temperature. A general hyperaemia of the skin and underlying tissues of the whole of the lower extremity may be obtained, but there is no guarantee that the nerve shares in this hyperaemia—often it does not; at any rate the method is empirical.

By acupuncture the hyperaemia occurs just where it is required, and it can be given in definite doses varying according to the response of the nerve. Again, when an electric current is passed through the tissues sodium hydrate is formed at the negative electrode, which in this case is the needle passed down to the tender spot on the nerve. This sodium hydrate has a caustic action on the tissues. In acupuncture only a small amount of current is used (3 to 6 milliampères) whereas in destruction of a naevus 20 milliampères or more are used. In the case of the naevus a large area has to be destroyed, but in the case of exudation in the nerve sheath the area is very small and the effect should be limited to the exudation. The effect of ionic movement in the tissues is involved also.

From one or all of the above effects it is maintained that by this treatment there is complete relief of pain, but the wasting of muscles with weakness of limb and lameness requires appropriate treatment.

Electrical acupuncture, if carried out according to instructions, is harmless. It must not, of course, be used recklessly with any strength of current, nor must the needle be plunged into any part of the body without consideration of the underlying parts.

Method of Application.

The equipment necessary is:

1. Pantostat or other universal apparatus.
2. Insulated needles of various lengths with platinized points.
3. Holder for needles.
4. Button electrode.
5. Hypodermic syringe and 2 per cent. solution of novocain.
6. Sterilizer.

The sensitive spots along the course of the nerve must be found by means of the faradic current and each one separately treated. An indifferent electrode attached to the positive pole of the faradic current is placed below the knee or on the back. The negative pole is attached to a moistened wash-leather button electrode mounted on a handle.

The buttock is first tested; after turning on the current until the patient just feels it, the button is moved over the surface of the skin until a sensitive spot is touched; this is marked. Two or more of these spots may be found, and the most sensitive is first treated. The easiest way to find the most painful spot is to reduce the current until one or other of the spots is not felt. In neurotic cases it is a good plan to approach the spots from different areas to be quite sure it is properly localized.

The galvanic current is now used. An insulated needle, about 4 in. long, sterilized and attached to a holder, is connected up to the negative pole. The same indifferent electrode is used, now transferred to galvanic current instead of faradic. The skin over the area is painted with iodine and anaesthetized with novocain (2 per cent.). The needle is applied to the chosen spot and the current quietly turned on. I usually begin with about 2 milliampères. The needle is now passed through the skin and deeper tissues and more current applied. It is necessary for the patient to feel something, but it is unnecessary to produce pain. Good results can be obtained in some cases by using 2 milliampères; in other cases 5 or 6 milliampères may be required. If the patient complains of pain, then the strength