only a subsidiary part in bone formation, but a graft consisting of compact bone and periosteum alone will in the large majority of cases not unite, thus proving the great importance of marrow.

One case of non-union of the radius which I had under my care illustrated this point. A graft of bone had been taken from the subcutaneous border of the tibia consisting of compact bone and periosteum alone without marrow. This graft remained in position in the arm for three months without any sign of union, and was then quietly discharged through the skin.

4. *Size of Graft.*

The graft should be at least two inches longer than the space between the fractured ends which it is going to fill. The older method of bone transplanting or grafting as used by Macewen aimed at freshening up the fractured ununited ends of the bone and filling up the space between them with the chopped up pieces of bone which naturally consisted chiefly of compact bone, and which lay in contact with each other and with the freshened bone ends. But the chief power of union in a bone graft comes from the presence of the bone marrow and the adjacent more porous bone which is completely absent from the fractured ends for a distance of half an inch to an inch, owing to the obliteration of the medullary cavity; therefore the transplanted bone fragments came into contact only with the sclerosed ends of the bone in which the blood supply is markedly diminished; and the osteogenetic power almost absent. Any bone graft which is taken should be long enough to extend beyond this sclerosed area on both fragments.

5. *Preparation of Graft.*

The graft may be obtained from the tibia or from the fractured bone itself at a higher level in two ways.

(a) By means of a circular saw, with either one or two parallel blades, driven either by a small motor or by hand by means of a large wheel turned by an assistant at some distance from the table. With this the bone is sawn down to the medulla for the required distance, and then transferred to the site of the operation.

(b) The other method is by means of chisels and a bone drill. If an attempt is made to remove a bone graft by means of a chisel alone it will be found that the bone becomes splintered and almost useless for the purpose in view. If, however, the bone is first drilled down to the medulla along the line of the proposed bone graft, then the subsequent use of the chisel is without danger, as the bone breaks between the drill holes.

When the graft of sufficient length has been obtained a bed should be made for its reception in the two fragments at the site of fracture by removing from these broken ends a wedge of bone equal in breadth to the graft and so placed that the graft lies on either fragment for a distance of at least $1\frac{1}{2}$ in. When the graft has been placed in the bed prepared for it, it should be anchored there by means of catgut or small bone pegs. No metal, such as plates or wires, should ever be used in its fixation, owing to the fact that metal of any description placed in a bone acts as a foreign body and leads to atrophy of the bone round the site of the metal, thus hindering bone formation which would otherwise occur between the fragments.

It has been shown that in a plated fracture bone is thrown out on all sides except at the site of the plate or screws. There is atrophy of bone which can frequently be seen in the *x*-ray photograph as a light area round each of the screws.

The osteogenetic action of the bone graft should not be opposed by the inhibitory action of the screws. As regards the after-treatment the newly implanted bone graft should be kept in position without any stress or strain for a period of at least two months.

Many forms of splints may be used for this purpose, but the most efficient method of fixation is to apply a plaster-of-Paris case to the whole limb, so that all the joints which by their movements could in any way act on the transplant are completely fixed. This case should be put on immediately after the operation. It is not at all necessary to leave its application over until the stitches are taken out, as they can be easily removed through an opening made in the plaster directly over them. This is a marked advantage, as the surgeon has in his mind at the

time the exact position of the limb in which the graft lies most snugly in its bed.

When the plaster has been removed after two or three months the transplant will probably be found to be firmly united, but in case the union is not firm the limb should be immediately replaced in plaster or splints and treated by fixation and venous congestion, with the administration of thyroid extract, which undoubtedly tends to promote the deposit of callus and so to hasten the union.

The failures of bone-grafting operations which I have seen have been due to (1) want of proper interval since the cessation of discharge, (2) insufficient length of the graft, (3) inefficient fixation, (4) the use of the sliding graft.

A POSSIBLE ELECTRO-CARDIOGRAPHIC SIGN OF MYOCARDIAL CHANGE.

BY

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DURING the last few years the attention of those interested in diseases of the heart has been increasingly directed towards the signs and symptoms by which impairment of the myocardium can be diagnosed. The importance of the heart muscle in the prognosis of cardiac disease is no new discovery; the pioneers of cardiology fully realized that grave valvular lesions could be compensated for by efficient heart muscle, but while their methods of examination permitted surprisingly accurate diagnosis of valvular defects, there was by no means the same precision in their means for determining the state of the heart muscle.

Though modern methods of investigation have somewhat increased our knowledge in this direction, it is not possible, as yet, to say that we can as accurately visualize in any individual case the condition of the myocardium as we can, for instance, that of the aortic valves. Any method of investigation, therefore, which tends to throw light on this problem is worthy of serious consideration.

Numerous attempts have been made to arrive at a just estimate of the condition of the myocardium in regularly acting hearts, such as the careful consideration of the subjective symptoms, the response of the heart to exercise, the relative intensity of the first apical and the aortic second sounds, the length of the A.V. or P.R. interval, and the inversion of the second ventricular or T wave of the electro-cardiogram in at least two of the usually employed leads. No doubt all of these methods have their uses.

We have had during the last few years the opportunity of examining several thousand cardiac cases and of comparing the clinical findings, and in a large proportion the subsequent histories as well, with the electro-cardiograms. As a result of these observations we have become increasingly convinced that the height of the second ventricular or T wave affords some indication of the efficiency with which the ventricles are functioning.

The second ventricular wave marks the end of systole, and it is generally agreed that it is produced by some portion of the base remaining in a state of contraction after the contraction of the apex has ceased. There is not, however, the same agreement as to the exact site of this residual contraction. Sherrington considers it to be the aortic base; other observers are not disposed to localize it so definitely. From the point of view under discussion this is immaterial; the essential question is whether very low or absent T waves in an electro-cardiogram indicate myocardial impairment or not.

With a view to bringing our opinion in some measure to the proof, it seemed to us that if we could get cases in which there was clinical evidence of myocardial change, and in which the electro-cardiogram showed small or absent second ventricular waves, and if on treatment these waves increased or reappeared in electro-cardiograms concurrently with an improvement in the clinical condition, it would, to a certain extent, support our contention.

Unfortunately, marked myocardial degeneration is not a condition which, as a rule, easily or rapidly yields to treatment, so that suitable cases for such an observation are by no means common. It seemed to us, however, that cases of syphilitic myocarditis might afford the required material, and we now think two such cases may be worthy of being put on record.

CASE I.

Mr. W. X., aged 45, was seen in consultation with Mr. Allport by one of the writers (J. S. G.) in June, 1915. He contracted syphilis in 1901; the symptoms were severe, ulceration of the tongue being practically continuous until 1905, when he

FIG. 1.

went to Aix and had mercurial inunctions; the tongue healed. In 1912 he complained of pain in the chest, flatulence, and occasional vomiting; his Wassermann reaction was strongly positive. Salvarsan and mercurial injections were given; his condition, however, got worse, and he suffered from pain radiating down the right arm and a systolic murmur was audible at the apex. A series of neo-salvarsan injections was given, which was followed by a long course of mercury and iodides; the murmur disappeared after the first injection. In 1914 he had a very bad attack of typhoid fever, being laid up from January to April; the tongue again became ulcerated, but cleared up under iodides. He nearly died of heart failure.

In June he underwent another course of inunctions at Aix. An x-ray examination of the heart showed slight enlargement,

FIG. 2.

both to the right and to the left, no aneurysm, but enlarged glands in the mediastinum; the finger nails were corrugated.

When seen in consultation in June, 1915, he complained of pain in the left side, only being able to sleep when lying on the right side, pain over the sternum, slight dyspnoea, and a sensation of sickness over his heart on exertion, which was increased by exercise and after meals; there was no cough nor oedema. The area of cardiac dullness was lightly enlarged, the apex beat being in the fifth space near the nipple line; the first sounds were weak but no murmur was audible; the pulse-rate 100, blood pressure 140, he did 10,107 foot-pounds of work in two minutes, there was a poor reaction to work and he showed signs of collapse.

The electro-cardiogram (Fig. 1) showed an absence of second ventricular or T waves in leads 1 and 2 with inversion in lead 3.

He was treated by mercurial inunctions and steadily improved. When examined again in 1916 his pains had disappeared, the cardiac dullness was still slightly increased, but the apex beat was well within the nipple line, the first sound at the apex was flapping and short, the second reduplicated, the aortic and pulmonary second sounds were audible, the blood pressure was 118, the electro-cardiogram (Fig. 2) showed well marked second ventricular waves in leads 1 and 2 with inversion in lead 3. It will be observed that figures 1 and 2 show the sign attributed to left-sided preponderance.

CASE II.

Mr. Y. Z., aged 30, was seen July, 1916, in consultation with Dr. Green, of Finchley, by one of the writers (S.R.W.); he had had scarlet fever when 13 and contracted syphilis in 1908; he was treated for two years. Beyond occasional sore throats he had

FIG. 3.

suffered from no other illness. He complained of dyspnoea and palpitation on exertion and a constant feeling of lassitude, and said that he fainted on excitement or any over-exertion. He was markedly anaemic, the pulse-rate was 60, volume very small, the apex beat was diffuse and almost impalpable, the area of cardiac dullness was greatly enlarged, extending from 2 in. to the right of the mid-sternal line to over 5 in. to the left; x-ray examination revealed a very large heart, the shadow agreeing with the limit as defined by percussion; it was obviously soft and atonic as it was horizontally placed and seemed to be lying on the diaphragm. The first sound at the apex was very faint and flapping in character, the second sounds were audible at base and apex, no murmurs could be heard; he was not exercised nor was his blood pressure taken as he fainted twice during examination; the urine had a specific gravity of 1024 and contained no albumin. On account of the patient's nervous condition and the ease with which severe

FIG. 4.

fainting attacks were provoked the blood was not taken for the Wassermann reaction. His electro-cardiogram (Fig. 3) showed very poorly marked second ventricular waves in lead 1, almost absent in lead 2 and completely so in lead 3.

He was treated by Dr. Green with mercurial inunctions, and examined again in consultation in September, 1916, when his general condition was distinctly improved; the cardiac area now measured 1½ in. to the right of the mid-sternal line and 4½ in. to the left; this was confirmed by x-ray examination. The electro-cardiogram (Fig. 4) showed definite T waves in the first and second leads, and indications of them in the third. Antisyphilitic treatment was continued, mercury and iodides being given. He was seen again in March, 1917, when there was a marked improvement. The cardiac dullness was now 1½ in. to the right of the sternal line and 3½ in. to the left;

this was confirmed by x-ray examination. The shadow of the heart, besides being smaller, was of much more normal outline. The electro-cardiogram (Fig. 5) showed well-marked T waves

FIG. 5.

in leads 1 and 2 and distinct T waves in lead 3. Unfortunately he moved somewhat when lead 2 was being taken, so the record was not as neat as could be wished.

While it is not contended that these two cases in themselves are conclusive proof that absence of the second ventricular waves in the electro-cardiogram indicate myocardial change, they are certainly suggestive, and tend to confirm many other curves in our possession. It is to be hoped that other observers will put on record their experiences, not only in syphilitic cases but also in other forms of myocardial involvement, since it is only by numerous observations, and above all by electro-cardiographic observations, carefully correlated with the clinical findings at various stages in the history of the same patient over prolonged periods, that anything like certitude can be reached.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

TONSILLECTOMY.

As I pointed out in a paper read at the International Congress in 1913, surgeons are prone to debate the merits of this or that technique for tonsillectomy simply from the standpoint of the removal of the tonsil. Some of the remote after-results, elicited by examining a large number of patients from one to eight years later, are of the greatest practical relevance. As regards technique, each man should, of course, use the method and instruments with which he gets the best results. Considered broadly and without detail, operators range themselves into three groups: (1) Those who use nothing but some form of guillotine, claiming that by this method every tonsil is removable in its entirety, capsulated; (2) those who dissect the tonsil out, claiming that with any form of guillotine no one can be certain of entirely removing any tonsil; (3) those who combine partial dissection with the use of a guillotine.

To my mind the existence of this third group is evidence that groups (1) and (2) are both in error, in that they go to unjustifiable extremes. The truth lies between, and I venture to submit that the following view is hardly assailable.

A certain proportion (which I will not here attempt to specify) of tonsils are removable, complete in capsules, by certain guillotine methods. The remainder are not, and have to be removed by some form of dissection, which requires more practice and dexterity than the former. No one, therefore, should claim to be prepared to deal with any and every tonsil with which he is confronted, unless he is practised in enucleation by dissection.

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POISONING DUE TO BELLADONNA PLASTER.

T. C., aged 37, a strongly-built, muscular labourer, was first seen at 11 a.m. complaining of pain in the back. Nothing abnormal was discovered, and as the pulse and temperature were normal and he was anxious to continue his work, a belladonna plaster about 6 in. by 4½ in. was applied, and he went back to his employment.

At 2 p.m. he was carried in on a stretcher, struggling and being held by two men. The skin was harsh, dry and reddened, pupils dilated, pulse 130, and respirations 40; he was delirious and semi-conscious; the temperature was unobtainable on account of his movements. The plaster was immediately removed and he was admitted to hospital, where he remained more or less in the same condition until 9 p.m., when he became quieter and sank into an uneasy sleep, the pulse then being 115 and respirations 30. The temperature was 97.5°. The following morning he was much better, though the tongue and lips were dry and furred, and he was still slightly incoherent in speech. He had no recollection of what had occurred, and though he declared that he felt quite well he refused solid food, and was with difficulty persuaded to take any nourishment. The bowels responded to an aperient, and the urine passed naturally contained no albumin, blood, or casts.

Two days later the only sign remaining was slightly enlarged pupils responding slowly to accommodation; the patient left feeling perfectly well—pulse, respiration, and skin condition being normal. There was no history of any previous fits or similar illness, and I have no doubt that the symptoms were directly due to an overdose of atropine absorbed through the skin from the plaster. The case is of interest in showing the danger which may arise from this cause in susceptible persons.

Chester.

B. G. R. CRAWFORD, M.B.

HALAZONE FOR WATER STERILIZATION.

(Report to the Medical Research Committee.)

IN the BRITISH MEDICAL JOURNAL, May 26th, Dakin and Dunham describe a new chlorine compound, *p*-sulphondichloraminobenzoic acid, suitable for sterilizing small individual quantities of drinking water. For convenience they call the new substance halazone. The chief advantage claimed is that it can be put up in tablets, which, when kept in amber glass bottles, lose strength only very slowly. The dose for ordinary water is given as one tablet to an imperial quart, and for heavily polluted water two tablets to a quart, the time of exposure in both instances to be thirty minutes. Samples of halazone tablets supplied by the Medical Research Committee were subjected to various tests.

Weight of Tablets.—From Dakin and Dunham's article it appears that the tablets are intended to weigh approximately 0.1 gram each. The weight of tablets from three lots was found to vary: the weight of tablets from lot K was 0.075 gram each, from lot M 0.098 gram, and from lot N 0.104 gram. The variation in the weight of the tablets is an error which should be corrected.

Solubility.—One or two tablets in 38 oz. of water contained in an aluminium water bottle, carried by a marching soldier, were always found completely dissolved within ten minutes; with an enamelled water bottle holding 40 oz. of water complete solution required twelve minutes.

Taste.—Taste experiments were conducted with tap water only. One tablet to a quart was not detected by any one of three observers. Two tablets to a quart were detected as taste by two observers, and as taste and smell by the third. In respect to taste halazone seems to be identical with chlorine from other sources, and with certain waters would no doubt form chlorine compounds, having an objectionable taste.

Keeping Qualities.—Tablets kept in a bottle under ordinary laboratory conditions were tested at the end of six weeks, and were found quite as effective as usual in sterilizing various types of water, the ordinary doses being used.

Mode of Action.—Water treated with this compound gives the ordinary starch iodide test for free chlorine, and the efficiency of the sterilization may be forecasted from the amount of free chlorine remaining after thirty minutes' exposure, as judged by the depth of blue colour with starch and iodide. Ordinary tap water treated with a double dose smells and tastes of chlorine. Hydrogen sulphide and organic matter interfere with sterilization by halazone as by chlorine from bleaching powder.

From these considerations it seems probable that halazone, when added to water, liberates free chlorine, which