

woman and child, beloved—as few men have ever been loved—by his associates and friends, a man who made friends wherever he went and enemies never, lived to see his dream of conquest of malaria and yellow fever come true, lived to receive honours from every country in the world, such as few men have ever lived to receive. But I am sure his greatest pride and joy always were the confidence and loyalty of his associates and subordinates, and the knowledge that he did make the world "a bit easier to live in," in the phrase he himself used.

I have tried to tell you of a few men who have not only mightily helped in the forward march of knowledge, and conferred great benefits upon humanity, but a contemplation of whose lives and deeds must assuredly be a delight for us, an inspiration when our courage fails, a source of pride that we are—be it ever such humble—members of the same noble profession.

I hope that hearing a little of the few men I have told you about, these men who

". . . bulk big on the old trail, our own trail, the out trail,  
They're God's own guides on the long trail, the trail that is  
always new."

will give you a stimulus to read some day the biographies of the heroes of our craft, for the inspiration and comfort these will give you, and the faith that will be strengthened within you that ours is a fascinating trail, a wonderfully worth-while trail, in spite of its many patches of hard going, for it is "a trail that is always new."

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### ON CARDIAC IRREGULARITIES.

By H. L. HEIMANN.

We are confronted in our daily practice by irregularities of the heart beat which are reported either subjectively or objectively. The differentiation of such phenomena was at first wrapped in obscurity inasmuch as the physiology of the cardiac contraction was misunderstood.

The following is a quotation from McKee's translation of Colnheim's *heim's Pathology* (1882) (i.):—"Dr. Heidenhain was able to show that in perfectly strong and healthy dogs a considerable rise of arterial pressure makes the heart beats arrhythmical because the cardiac and inhibitory nervous symptoms are disproportionately excited, and that after chloral poisoning even a moderate rise of pressure has the same effect, we can certainly experience no surprise at such an occurrence in persons suffering from heart disease where the excitability of nervous centres is subjected to disturbing influences of the most varied kind." This passage indicates that irregularities of the heart beat were thought to be of nervous origin purely. In that year (1882) however, Gaskell (ii.) first showed that all the phenomena of the heart beat in the frog and tortoise were successfully explained on the myogenic theory. In 1893 Kent and His showed the existence of a specialised form of muscle fibres (called the bundle of Kent and His (iii.)), which conduct the impulse from auricles to ventricles. In 1910 Thomas Lewis (iv.) showed conclusively by electro-cardiographic experiments that the sino auricular node (node of Keith and Flack) was the origin of the normal heart beat. The whole conception of a heart cycle has been brought into being by a mass of physiological, patho

logical and clinical evidence furnished by a number of workers. Of these we may mention Gaskell (v.), Starling and Bayliss (vi.), J. Mackenzie (vii.), Wenckebach (viii.), and Lewis (ix.) All our ideas of heart irregularity are based on this conception. The analysis of a heart cycle means an enquiry into the origin of the state of excitation and the spread of excitation with the resultant contraction of muscle. At the junction of superior vena cava with the right auricle is the sino auricular node, consisting of peculiar muscle cells, nerve cells and nerve fibres. These cells and fibres are in connection with the vagus and sympathetic chain on both sides of the body. The node is the normal pace-maker of the heart, and the vagus and sympathetic can act on this node to slow or quicken the heart respectively. The state of excitation spreads outwards from the pace-maker along both auricles and arrives in turn at another piece of neuro-muscular tissue, the auriculo-ventricular node placed at the right and posterior border of the auricular septum. Any response in the ventricles to excitation of this node is known as "supraventricular." Hence the state of excitation spreads to the ventricles along a special conducting system, the bundle of Kent and His, which soon divides into two main bundles, one to each ventricle. These branches subdivide and become continuous with the Purkinje fibres distributed to the ventricle. The propagation of the excitation wave along this system leads to the synchronous systole of the ventricles.

Cardiac irregularities can be caused by changes in sympathetic or vagal tone or by conditions of the auricular musculature the conducting system or the ventricular musculature. Of conditions affecting the heart muscle itself, it may be said that they can be divided into intrinsic, where there is actual damage to the muscle itself, and extrinsic where chemical or mechanical conditions are impressed on the organ from outside. Eventually the chemical condition often gives rise to intrinsic and organic damage and intrinsic irregularities.

The Vagal Arrhythmias are generally physiological. The commonest condition is that of Sinus Arrhythmia so often found in children and athletes of great stamina. This irregularity consists in a rhythmical increase of pulse rate during inspiration and decrease during expiration. A less common form of vagal irregularity is a waxing and waning of the pulse rate spread over a space of 10 to 15 seconds.

A third condition of this type occurs more rarely, that of sino-auricular block. Here, whole cycles (auricular and ventricular) disappear at irregular intervals. This irregularity vanishes during exercise. Sometimes this irregularity gives rise to feeling of giddiness and palpitation and thus becomes pathological. According to Strickland Goodall the condition is not dangerous unless it is associated with aortic regurgitation. Lewis in "The Mechanism and Graphic Registration of the Heart Beat" (x.) points out that it commonly occurs in association with auriculo-ventricular (tone) block. In these cases the prognosis is that of the latter lesion and in the uncomplicated cases the outlook is excellent.

The diagnosis of this last form of vagal tonus is only clear from an instrumental tracing, showing an absence of both auricular and ventricular beats. Otherwise it cannot be distinguished clinically from "dropped beats" due to "true" heart block, as in both conditions there is a pause in the pulse beats accompanied by an absence of heart sounds. Occasionally, however, in auriculo-ventricular block the blocked auricular beat can be heard to the left side of the sternum, as a muffled sound.

Vagotonic conditions of the heart are often accompanied by vagotonic effects in other viscera—for instance a quickly emptying stomach with spasm of the musculature producing pain in the epigastrum some two hours after meals. The cases of excess of vagal tone which need treatment generally respond quite readily to a moderate dose of Tincture of Belladonna (M. V tds.).

**THE EXTRASYSTOLE OR PREMATURE CONTRACTION.**—Mackenzie (ix.) states: "The fact that the occurrence of an extrasystole is due to some part of the heart's structure being temporarily more excitable than the normal starting place, has led to the idea that it may be an evidence of some disease process." He goes on to show that this is by no means the truth.

Premature contractions may be auricular, nodal or ventricular in origin whence they derive their names. The commonest type are those that arise in one or other of the ventricles. The patient may or may not be conscious of the irregularity. He may complain of the heart bumping, of unpleasant sensations in the breast, of consciousness of irregularity when lying down at night, or, when the condition recurs frequently, he may say that he has irregular palpitation. The irregularity is heard as a premature beat of the heart followed by a pause. The premature beat may not be sufficiently strong to lift the aortic valves, when there will be a corresponding gap in the pulse, and at the heart only the first sound will be heard (thus distinguishing it from heart block). If the aortic valves are lifted there will be a premature pulse wave with a succeeding pause. The pause is said to be fully compensatory when the pulse wave following occurs at such a time as it would have done provided there had been no extrasystole. It occurs in ventricular and nodal origins of the premature beat and signifies that the pace maker of the heart has not been disturbed by the phenomenon. In auricular extrasystoles, however, the pause is not fully compensatory; the auricle contracts prematurely in response to an extrinsic point, the pacemaker at the sinus recovers before the compensatory pause is complete, and the auricle beats in response to this, its normal leader.

Generally, these irregularities disappear with exercise when the pulse rises above 120/minute in rate. Sometimes, as Mackenzie points out, they are brought on by excitement, sometimes they are found at rest.

Extrasystoles, particularly of the ventricular type, are often brought on by extrinsic causes; for instance, mechanically by a stomach dilated with wind; chemically by bacterial poisons as are generated in such foci as diseased tonsils, tooth sepsis or intestinal infection, or by over-smoking.

Under these conditions the treatment is directed towards the agent, the prognosis depending entirely on the primary condition. In other cases the premature contraction accompanies evidences of true cardiac disease which always makes the prognosis the more serious. For instance, in mitral stenosis auricular extrasystoles are often the harbinger of auricular fibrillation. In aortic regurgitation extrasystoles, ventricular in character, betoken a break down of the vaso motor control and forewarn a decompensation. In true heart block premature ventricular contractions often precede a fatal issue.

In the three latter types of cases, bed is the rule and with the mitral stenosis cases digitalis will often postpone the advent of fibrillation.

Auricular or nodal extrasystoles may be repeated at an explosive rate in the neighbourhood of 160-220 per minute—they then constitute a Simple Paroxysmal Tachycardia which is not strictly an irregularity except that as a rule the end of the paroxysm shows a pause of a compensatory nature. A quick and regular succession of ventricular extrasystoles from a single focus in the same way constitutes a paroxysmal ventricular tachycardia upon which we shall not expand; it is a rare condition.

**AURICULO-VENTRICULAR HEART BLOCK.**—This is a condition of impairment of conduction between the auricles and ventricles due to affection of the Bundle of His.

The earliest form of the condition, and one that is impossible to diagnose by clinical means, is a prolongation of the auriculo-ventricular

interval to more than one-fifth of a second. I have seen this condition occur in a dysentery of the type acute in onset. The clinical picture was in a dysentery of the Flexner type acute in onset. I have also seen it occur coloured by premature ventricular contractions. I have also seen it occur in an acute tonsillitis and in gall bladder condition. One would regard the aetiological factors in these circumstances as extrinsic but causing if progressive, an intrinsic condition when the myocarditic lesion passed from a toxic condition to a degenerative state.

In the next state of block occasional auricular beats are blocked and a "dropped beat" occurs—that is, the corresponding ventricular beat does not occur and there is a gap in the rhythm of the pulse equal to the space between alternate pulse beats. This condition may be diagnosed clinically from extrasystoles as in the latter there is always one (and generally two) heart sound accompanying the irregularity. In heart block there are no sounds corresponding to the gap in the pulse rhythm (save a muffled auricular sound heard in a minority of cases quite different from the ordinary first or second). Dropped beats often disappear with exercise and hence are indistinguishable from premature contractions on that score.

As more auricular beats are dropped so the irregularity becomes more marked until each alternate auricular beat has no response. This is a two to one block and is quite regular at a pulse rate of about 48/minute as a rule. This rhythm is stable in rare instances over a period of some years but in other cases exercise may suddenly double the rate by causing the ventricle to respond to each auricular contraction. Three to one block and four to one block do occur, but they are rare and are transitory phases towards the last stage of complete heart block.

In all these forms of block an instrumental tracing is necessary; in the earliest stages it may be the only way of distinguishing any pathological state, in the later stages it may be necessary, as stated earlier in this article, to distinguish it from sino-auricular block.

As a rule, the last stage of block where auriculo ventricular dissociation is complete presents a characteristic clinical picture. The pulse rate is 35 or under, is regular, and is unaffected by exercise to any extent. The heart is enlarged to the left and downwards and the blood pressure is increased, thus the output per stroke is increased. The more healthy the bulk of heart muscle, the more it will be enabled to hypertrophy. It must be remembered that heart block is due to some interference with a specialised portion of the heart muscle, and that the pathological process generally produces affection of other portions of the myocardium as well. The interference may be transient when produced by extrinsic causes, as in the case already quoted of an intestinal infection, or it may be permanent and progressive when it is due to effects of acute rheumatism, or degeneration or syphilitic disease. There is also a very rare intermittent or paroxysmal form which may be due to a calcareous mass in relationship to the bundle as described by Wiltshire and Russell-Wells, or to a Hydatid cyst (xii.) is a similar position, as described by myself in a case of Dr. A. Watt (xii.) (Autopsy by Dr. A. S. Strachan of the S.A.M.I.R.).

It is important to remember that block is one of the ways that myocardial degeneration is shown, before other evidences appear; it is thus especially important in cases where the myocardial lesion exists without valvular defects and where other symptoms and signs are vague.

To give a prognosis in a case of block one must first of all consider the rate of progress of the condition, and whether it is transient or permanent; then follows the aetiological factor and whether it can be treated specifically.

Harris (xiii.) reports a case of a man aged 51 with complete heart block, who has carried on his work in a sphere of great activity for some

20 years; he looks well and has been able to run sprint races. In this case the bulk of the myocardium was obviously healthy. I have a case in which there is a two to one block; the heart is greatly enlarged to the left and the systolic blood pressure is 280 mms of mercury; about which it has remained to my knowledge for four years. In my opinion this high blood pressure would have been incompatible with life for a single year if the patient had not had heart block.

The occurrence of Stokes-Adams attacks in heart block must be mentioned. The syndrome occurs in sudden changes in the rate of block, during which complete asystole often occurs. Fits, epileptiform in character, ensue, these being localised or generalised as the case may be, varying with the length of asystole or, in other words, with the state of cerebral anaemia. (xiv.)

In treatment of these conditions, we must remember that local infections have an influence, and probably are the cause of the condition in some cases. Intestinal infections have already been mentioned; other instances met with in practice have been teeth, tonsillar, gall bladder and urinary infections. These are examples of extrinsic factors eventually becoming intrinsic factors.

For the more severe and progressive types of lesion we find that about 20 per cent. are caused by syphilis (Strickland Goodall) the remainder are associated with cardiovascular degeneration of the middle-aged and senile type, or with the results of acute rheumatism. These conditions are treated as respects the cause, always remembering that the arsenicals given intravenously in syphilitis often cause a focal reaction at the seat of lesion and are therefore dangerous in this condition until it has been treated vigorously by iodides, mercury and bismuth injections.

If the condition follows on acute specific fevers it is rarely necessary to order anything but rest for a period extending for some to two three weeks after the lesion has disappeared, so as to give the more "silent" parts of the myocardium a chance to heal as well. If the condition is causing giddiness, or syncope or fits, a lessening of the block and improvement of the symptoms may be obtained by the administration of liquor adrendine M. V (1 in 1,000) subcutaneously twice or more a day (Phear, Parkinson.). A similar effect may be obtained by the administration of Ephedrine Hydrochloride Gr.  $\frac{1}{2}$  by mouth as required. Both these drugs stimulate the sympathetic. Atropine by mouth or injection has a similar physiological effect by paresis of the vagus, the opponent of the sympathetic. Barium chloride in gr. 1/5ths has also been used by mouth. Rest should be enjoined and foci of infection should be treated by gradual means of eradication.

Drugs of the digitalis family often bring out latent heart block and so are generally contra-indicated except where failure of compensation exists, when their direct effect on the ventricular muscle is utilised.

**AURICULAR FLUTTER AND FIBRILLATION.**—Myocardial lesions, where the auricular muscle is greatly affected, result in auricular fibrillation or more rarely in auricular flutter. The latter condition only causes an irregularity under certain circumstances and is often a stage in the ushering in of fibrillation. This latter lesion gives rise to the perpetually irregular pulse. In both flutter and fibrillation the fundamental rhythm of the heart is upset by a state of the muscle that Lewis calls (xiv.) circus movement. We enlarge upon this later. In flutter, the auricles beat at a rate of 220 to 370 per minute. Three to one or four to one block generally exists with a pulse rate ranging in the neighbourhood of the seventies. Occasionally the amount of block varies from instant to instant, and the pulse consequently registers as totally irregular and simulates that of auricular fibrillation; it differs in this wise, however, that a moderate amount of exercise causes two to one heart block, hence

a regular pulse ranging over the hundreds results. The auricular rate is practically unaffected by exercise—or excitement. Just occasionally heart block disappears and a most rapid pulse appears. In my experience a patient's pulse has jumped from 78/ minute to 234/ minute by simply turning him round in bed.

Flutter may be paroxysmal but is often constant. The treatment may be divided into that of the abnormal rhythm and that of the underlying etiological condition. It is a rhythm which causes a great deal of distress when there are high ventricular rates.

The treatment of this rhythm consists in giving large doses of digitalis to the patient in bed. Fibrillation of the auricles often ensues and on stopping the digitalis regular rhythm sets in. If this fails, digitalis is again given and when fibrillation appears, quinidine sulphate is exhibited in doses beginning with grs. v. and increasing to grs. xxx. a day. John Parkinson and Evan Bedford state: "Digitalis has an enormous advantage over quinidine in virtue of its beneficial effect on cardiac efficiency from the first, irrespective of change in rhythm." (xvi.).

By these means normal sinus rhythm is often produced. The quinidine treatment is not to be recommended, however, in cases where embolism has occurred or in very old-standing cases, as the restoration of normal rhythm may be accompanied by further emboli. It is also to be emphasised that this treatment requires following with the electrocardiograph to trace the change of rhythm. In paroxysmal flutter small doses of quinidine grs. v. to x. given in two or three doses daily, will often prevent the occurrence of the condition.

The way in which quinidine acts has to be considered later.

The aetiological factors producing flutter or fibrillation of the auricles may be divided into degenerations, the infections, and chemical poisons. In addition, the onset of fibrillation has been attributed in a very small number of cases to the physical agency of a shock by an electric current.

The degeneration include those due to old age, those due to high blood pressure—interstitial nephritis group of middle age; the infections include those of acute rheumatism and of syphilis; and the chemical poisons those of the toxic thyroid state (true Graves, or toxic adenoma) and the poisons of typhoid and pneumonia. The chemical group are extrinsic in character but the thyroid poison often causes permanent degenerative changes in the muscle, becoming intrinsic therefore. The heart recovers to some extent, at any rate, when the state of thyrotoxicosis is ended, then very often normal rhythm again ensues. The effects of the acute fevers are generally temporary, though some degree of myocardial weakness sometimes persists.

The condition of auricular fibrillation may be recognised by the presence of the extreme irregularity of the heart and pulse; this irregularity persists with exercise. Fibrillation was originally supposed by Mackenzie to be due to nodal rhythm (xvii.). Later on the electrocardiograph showed this conception was erroneous. The auricle does not beat as a whole but isolated portions of the auricular muscle contract independently, at a rate of some 400/ minute. The motor function of the auricle disappears and it becomes merely a reservoir. Luckily for the patient, even in untreated conditions, these twitchings cannot all be passed down the Bundle of His owing to the existence of the refractory period. The ventricular rate in untreated cases varies considerably, but is often round 120/ minute and may be considerably higher. This state of affairs in a normal ventricular muscle would lead to flagging, but in these cases the ventricular muscle is also affected by the myocarditis lesion; hence the high pulse rate causes an even greater strain on this part of the heart, which it is the object of treatment to relieve.

Since the auricular muscle is not acting as a whole, the presystolic murmur disappears in mitral stenotics with the advent of this irregularity.

Its place is taken by a rough murmur as variable in its position in diastole, as is the length of this phase of the cycle in this condition.

The common valvular conditions accompanying the irregularity are mitral stenosis and regurgitation (and sometimes aortic regurgitation) with the rheumatic group; aortic regurgitation with the syphilitic group occasionally with the high blood pressure group. Sometimes pericardial adhesions accompany the rheumatic group. In the syphilitic conditions, there are often co-existing signs of early tabes dorsalis. The type of enlargement of the heart varies with the accompanying lesions and hence with the aetiology. The right side of the heart is affected mostly in mitral stenosis and the left side in cases where high blood pressure or aortic regurgitation is present.

Although fibrillation exhibits a clinical picture varying somewhat with the aetiology, the irregularity itself has a typical polygraphic and electrographic appearance. In both the rhythm is totally irregular and in both the only evidences of auricular aetiology are some irregular twitchings on the venous pulse tracing and on the diastolic period of the cardiograph. The irregularity may follow on flutter, may alternate with flutter, may be induced from flutter by therapy; it may also be paroxysmal in type, later becoming constant. Its clinical characteristic has already been insisted on, that of a total irregularity at all rates.

The treatment of this condition depends in part on its etiology. The management of the irregularity, as a rule, devolves on drugs of the digitalis group. This family causes an increase of the block at the auriculo-ventricular junction, thus only a small proportion of the auricular twitchings are conducted and the ventricular beats are slowed from say 120/minute to 70 or even 60, as the case may be. On this account the ventricle has a much better chance of being filled adequately and the aortic valves are lifted by practically every heart beat. This makes the heart a more efficient pump than before, when a large proportion of the beats were not successful in lifting the valves and were therefore useless. In addition these therapeutic agents cause an increase of the diastolic pause, and give rest to the overworked and diseased ventricles. Digitalis in liquid form deteriorates very quickly in this climate and so it is preferable to give it as one of the dry preparations. Of these I have found Nativelle's Granules (grs. 1/500 or grs. 1/230 of digitalis) or Tabloid Digitalis folia grs. 1 the most useful. The latter product has been on the market only a short time but is reliable in its standardisation.

Digitalis may be given in large doses at the beginning of the treatment when decompensation is extreme and a quick action is desired (up to the equivalent of 4 drachms of the tincture) (Eggleston). The drug has a cumulative effect in the body and in ordinary therapeutic doses (M to MXV of the tincture) does not begin to act for 48 hours. Digitalis can also be given hypodermically in grs. 1/100 doses. Strophanthin is given intravenously in doses grs. 1/200 but not without some risk.

In the successful administration of digitalis in this condition the apex rate progressively diminishes; at first the pulse rate may increase as the heart becomes more efficient in lifting the aortic valves, but when the apex rate and the pulse rate have approximated to one another, they both diminish together and compensation begins to be re-established. The further treatment consists in the administration of digitalis in just sufficient quantities to keep the pulse rate and the apex rate at the normal figure. When this is accomplished the patient is generally capable of doing his daily work if it does not entail heavy physical exertion. Excess of digitalis is shown by nausea, vomiting and diarrhoea, or by a "coupling" of the heart beats, that is, each heart beat is followed by a premature contraction of the ventricle.

In cases of hyperthyroidism, high blood pressure or syphilis, the aetiological factor must be dealt with specifically.

The use of quinidine to restore normal rhythm in case of fibrillation, is very restricted. The theory of its use in flutter and fibrillation may be shortly stated.

It depends on the circus movement we have already mentioned; this is in progress around the mouths of the great vessels entering the right auricle. A state of excitation exists in this circular path and continues to progress indefinitely unless a portion of its path is in a refractory state when the state of excitation is disposed of and the normal pacemaker at the sinus again assumes control. To obtain this object either the rate of conduction of the muscles must be increased or the refractory period must be increased. Quinidine compounds increase the refractory period but slow the conduction time, so that to be efficient in any case the former action must predominate.

This can be brought to pass in about 60 per cent. of cases, but in few of these is the effect lasting. According to the work of Parkinson and Maurice Campbell (xviii.) the drug can only be used with lasting effects in cases where fibrillation has started within the preceding six months. It is the drug of choice in paroxysmal fibrillation. It is never used until congestive failure has been efficiently treated.

Pulsus Alternans is not an irregularity of rhythm. The pulse is regular to clinical observation but the amplitude of the pulse wave is alternately large and small, the blood pressure showing the same phenomenon. The irregularity can often be picked out by the sphygmomanometer using the auscultatory method, but is most accurately shown by a pulse tracing. It is often a transitory phenomenon occurring after a premature contraction. It is always a sign of severe myocardial disturbances, and is often accompanied by a triple rhythm at the apex (gallop rhythm) or by disturbances of conduction. The electrocardiographic tracing may show alternation of the QRS complexes even when there is none of the pulse, or may show no change from normal, when the pulse is alternating.

The condition occurs in digitalis poisoning but on the other hand is often benefitted by the administration of foxglove. Its true significance is not known. It also occurs in the pulses of the fastest rhythm of a paroxysmal tachycardia and of auricular flutter, and here has not got a sinister significance.

This paper has dealt with irregularities of rhythm but not with the paroxysmal tachycardias of regular origin. In it, the various clinical findings have been discussed so as to allow a differentiation of the phenomena. The mechanisms of the occurrences have been described and the treatment has been argued from mechanical and aetiological points of view. Extrinsic and intrinsic factors producing irregularities have been described but cannot be rigidly differentiated from one another.

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### NOTE ON THE INJECTION TREATMENT OF VARICOSE VEINS OF THE LEG.

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Varicose veins is a common and very disabling condition. It interferes with work and with pleasure; its sequelae are numerous and some of them, e.g., thrombosis and haemorrhage, are not without danger. It is a distressing complication of pregnancy. It debars people from entering the Public Services and last, but not least, its unsightliness makes it a matter of great concern to women who adopt that excellent and hygienic fashion—the short skirt. The treatment of this condition has, until recent years, been the tedious and unsatisfactory operation of partial or total saphenectomy but this has been entirely replaced by a method which is much simpler and more lasting in its results, viz., the injection method. It is free from danger, inexpensive and ambulatory, and, therefore, in every way preferable to operation.

An extensive and rather confusing literature in which various methods are advocated has grown up in connection with the injection treatment, and the novice will be well advised to adhere to one recognised method such as the quinine method and to continue with it until he has attained proficiency. It is a very simple procedure and no special knowledge is required in carrying it out.

It may be of interest, before describing the technique of injection, to make a few remarks on the venous circulation in the leg. Normally, a considerable quantity of blood circulates through the superficial veins of the leg. In addition to the two saphenous veins and their numerous tributaries there are a large number of independent skin vessels. The general direction of the blood in the saphenous veins is upwards but there is a complicated circulation between the superficial and the deep vessels. Broadly speaking, the flow below the knee is from superficial to deep veins and, above the knee, in the reverse direction. This is borne out by the arrangement of the valves in the communicating vessels and also by the radiographic experiments of Sicard and others who injected lipiodol into the superficial veins and observed the passage of the opaque fluid into the deep veins. The saphenous veins are subject to a considerable amount of variation in their arrangement and it is possible that these variations have a bearing on the etiology of varicose veins.

The small saphenous vein begins behind the lateral malleolus, passes up to the popliteal space, lying outside the deep fascia, and pierces the latter to end in the popliteal vein. It is supplied with, on an average, eight bicuspid valves situated just below the entrance of the main tributaries. Communications with the deep veins are scanty but there are from two to four large and constant vessels which pass to the great saphenous vein, carrying a considerable quantity of blood to the latter.