a Thesis

on

The Main Factors Concerned in the Production of Varicose Veins of the Lower Extremities, with some Considerations as to Surgical Treatment.

by

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Mr. Manz

Bemidj

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Ilute Egy

Dear Sir,

I beg to acknowledge your letter of the 22nd inst. informing me that the £10 stamps duty for W. has been repealed. As I already a member of the Medical Council I presume that it is no longer payment for fee with respect the M. D. degree.

Yours truly,

T. Miller Wilson
The subject of varicose veins of the lower extremities has always seemed to me one of extreme interest. The apparent simplicity of the condition, and the too often unsatisfactory result of treatment seem to be sufficient reasons for the more careful study of this common ailment. The views held by various authorities, both as to causation and treatment, are so diversified, and apparently contradictory, that the every-day observer of the condition is too apt to pass over the fundamental factors of causation, and simply to look at the condition as a troublesome complaint, of which the elastic bandage is the unavoidable accompaniment; and he accordingly does not bestow as much attention on these cases as their gravity demands. Although the condition is such that, in account of its insidious onset and slow growth, definite conclusions can seldom be drawn as to its actual mode of origin, at the same time there is at our
disposal a considerable amount of statistical and other information, from which I think we may draw certain definite conclusions as to causation and mode of origin. In this thesis I propose to consider in detail the circumstances affecting the return flow of blood from the lower extremities, with the view to obtain more definite information as to the exact mode of origin of varicosity, and also the bearing which these considerations will have on the recognised theories of causation and methods of surgical treatment.

Varicose veins are generally defined as permanently dilated veins with thickened walls and are distinguished from simply dilated veins by the fact that there are definite degenerative changes in the walls of the affected vessels. As a rule the veins are elongated and tortuous, and the walls are thickened so that the vessel may stand open like an
artery when it is cut. The valves in the affected region are always insufficient and either disappear altogether or are represented by ridges or bands on the wall of the vein. On microscopic examination the thickening of the walls is found to be due to a development of fibrous tissue in the middle coat. The outer coat may also be thickened, but the inner is usually unaltered. In those cases where dilated pouches occur the wall is found to be much thinned and the muscular fibres atrophied.

Before proceeding to the main considerations it will also be well to briefly recall the general anatomy of the veins of the lower extremity. The veins of the leg are divided into two systems—superficial and deep. The superficial system consists of a network of veins running in the superficial fascia directly underneath the skin, which unite to
form two main branches, the internal or long, and external or short saphenae veins, running up respectively on the inner and outer aspects of the limb, and terminating by opening into the main venous stream, the former into the femoral and the latter into the popliteal vein. These veins are always guarded at their orifices by one or more pairs of valves, and throughout the system we find valves at various points. The deep vessels consist of a system of venae comites running alongside of the main arteries of the leg, and bearing corresponding names. The chief branches opening into the main venous trunk are: the peroneal opening into the posterior tibial, the external saphena into the popliteal and the profunda and internal saphena into the femoral. The deep system is also supplied with numerous valves and is connected with the superficial system by several communicating branches.
These facts have to be constantly borne in mind in considering the subject of varicosity as the pressure relations of the two systems would seem to have an important bearing on the subject.

With regard to the mechanism of production of varicosity the views of different observers are so varied that it is somewhat difficult to arrange the facts in natural sequence. In this paper I propose to discuss

I. The influence of gravity as it affects the main return current in the leg.

II. The anatomical and physiological relations of the deep and superficial systems and the consequent effect of increased pressure in the main venous stream.

III. The relations of abdominal and intravenous pressure as they affect varicosity.

These are the headings around which
I shall endeavour to group the main facts, but it will often be impossible to limit the considerations entirely to any one in particular as the various factors continually interact with each other.

Influence of Gravity.

Varicose disease occurs as a pathological condition in the veins of the lower extremity. In the upper extremity it is practically unknown. Now the veins in the upper extremity are provided with an arrangement of valves similar to that in the lower extremity, and differ only in so far that whenever the venous blood from the arm reaches the sub-clavicular vein and passes over the first rib its flow towards the heart is assisted by the action of gravity; in the lower extremity on the other hand, the venous flow is opposed in its whole course by the action of gravity and only when the recumbent position is assumed is this influence neutralised. Now with surrounding conditions similar in many respects the two systems differ
pathologically, mainly in the liability
to varicosity of that in which the
blood flow is opposed by the action of
gravity.

It is also noteworthy that although
obstruction to the venous return by axillary
thrombus is fairly common, to such an
extent as to produce oedema and to bring
into play the collateral circulation, yet
such obstruction seems to have no tendency
to produce varicosity in the veins of the
arm.

Again in the head and neck the veins
are not provided with valves, the reason
probably being that as the head is seldom
lower than the body the return flow of blood
to the heart is assisted by the action of
gravity and there is consequently no
tendency to rise of pressure in these vessels.
In some cases however one notices that
certain of the superficial veins of the head
and neck, e.g. the temporal, may become
tortuous and dilated. This condition
occurs in certain forms of heart disease
and is also noticed in some athletes.
and public singers where sudden, and excessive strains are put upon the heart and main vessels. This would seem to be an analogous condition to varicosity and had the position been a dependent one, and the same strain experienced, true varicosity would in all probability have been the result.

Dilatation of any vein, whatever its position, may occur to a considerable extent, but if that position be not a dependent one, anastomosis is so free that this dilatation is only temporary and the vein soon regains its normal size.

Turning now to the positions where varicosity is liable to occur, we find that in all of them the situation is below the level of the pelvic brim, and so such that gravity can exert its greatest effect. Thus we find the condition occurring at the lower end of the rectum giving rise to piles, and in the region of the testicle giving rise to varicocele as well as in the lower extremities.
These positions are all dependent and in all of them we must take into account the influence of the inferior vena cava with which the veins of all these regions are directly connected. Thus we have to estimate the influence of a large valveless column of blood in the veins beneath it; and many observers maintain that the actual weight of this column in the upright position is the main factor in bringing about varicosity. Let us look at the grounds on which this assumption is based.

When the upright position is assumed the effect on the general circulation is to increase the pulse rate, and this even though the change is only from the sitting attitude. This acceleration of the heart's action indicates more work done and therefore increased difficulty in circulation. This increase cannot be explained by increased difficulty in propulsion of blood towards the capillaries, as the greater volume of blood is now assisted in its flow
from heart to periphery by the action of gravity. The explanation must therefore lie in the fact that the venous return current is impeded and tends to flow more slowly. The acceleration of the heart's acts counteracts this tendency by diminishing the pressure in the large veins of the chest, so that it may even become negative, and at the same time by increasing the positive pressure in the capillaries and small veins. The effect of gravity must consequently be to increase the blood pressure in the venous system in the lower parts of the body, and the further the vein is from the heart the greater will this effect be. Thus the pressure will be greatest in the veins in the region of the ankle—that is to say at the lowest point in the direct line of the action of gravity—and will diminish as we proceed upwards until we reach the region of the heart where it may become negative. Now it will be observed that though the pulse rate is increased, this increase is neutralised in the capillaries and small veins, and
the rate of flow in the veins generally is relatively diminished. Thus to sum up, the effect of gravity on the column of blood in the iliacs and inferior vena cava is to cause increased pressure in the veins beneath by slowing the return current.

As to the actual weight of the blood in these vessels, it does not seem possible that it can exert any direct backward pressure on the blood in the veins beneath, unless the direction of the current was altered and it flowed backwards; in which case as far the greater volume of blood comes from below the level of the heart, the flow through that organ would be practically stopped and syncope would result. Even if by any hypothesis we should deem it possible that the blood from the head and neck was sufficient to keep the heart in action, we should still be bound to conclude that if gravity caused backward flow in the inferior vena cava, venous circulation would be impossible in the lower
parts of the body would be impossible so long as the upright position was maintained. It must also be remembered that gravity will affect equally all the vessels at any given level, and so if it is sufficient to cause backward flow in one external iliac vein it must have a similar effect on both the internal iliacs as well as the corresponding external iliac on the other side. Therefore I think we may conclude that backward flow in a main venous trunk, due to gravity, is impossible.

These facts all go to prove that gravity is one of the main factors in the production of varicosis. For whenever a vein becomes varicose gravity will tend to counteract any effort at spontaneous cure on the part of the vessel involved, by increasing the pressure in it whenever the erect attitude is assumed, and thus preventing the vein wall from regaining its normal tone. So that whatever be its influence as a factor of causation, gravity must
always tend to the maintenance of the condition. Thus a complete definition of varix ought to include the statement that the position of the dilated vein or veins is such that, owing to the action of gravity in the upright position, its walls are unable to regain their normal tone.

At this point it will be convenient to discuss a class of case in which the action of gravity is supposed to be the main cause of the condition. I refer to those cases in which the varix is limited to the internal saphena and its branches. This class of case is said to occur in tall people (Bennett: "Varicose Vein" p.16. 1871). and is explained by many as being due to the backward pressure of the unsupported column of blood in the vena cava and external iliac, acting upon the valvular orifices of the saphena and causing it to give way.

Trendelenberg (Med. Ann. 1893. p.574) has performed certain very interesting experiments in such cases. He places the patient in the horizontal posture and elevates the limb,
whereupon the varices are found to empty and in place of the swollen vein we have a depressed tract indicating its course. He also shows that by varying the position of the limb, the lateral pressure in the femoral vein is sufficient to support a column of blood in the saphena, the height of which can be seen to vary with the amount of elevation of the limb; so that the dilated saphena vein forms a natural manometer indicating the lateral pressure in the main venous trunk. Further, when the patient is made to cough, the column of blood in the saphena is noticed momentarily to rise, thus showing that there is a very close connection between the abdominal and intra-venous pressure. From this he infers backward pressure in the iliac and actual reflux of blood in that vein. To further prove this he makes the following experiment: Having elevated the limb until the varices are apparently empty, he occludes the saphena with the finger, and then
allows the patient carefully to assume the erect attitude. At first the trunk of the saphena remains apparently empty. Then gradually fills, but never becomes so distended as before. Whenever, however, the finger is removed the veins immediately resume their extreme distension. Hence he argues that there is a direct backward flow of blood from the iliac to the saphena vein.

This reasoning seems to me entirely erroneous. We have already seen that backward flow in the iliac due to gravity is impossible; in this case however a new factor is introduced, for here we have an outlet from the femoral vein into a large dilated vessel without the intervention of a valve, and it may be argued that the blood in the femoral will pass out through this opening and so diminish the pressure in that vessel thus backward flow from the iliac will result. If such should be the case, we must either suppose that the action
of gravity on the blood in the inferior vena cava and external iliac is sufficient to entirely stop the current of blood passing up the thigh, and so to allow the blood to pass directly backwards into the saphena, or else that the orifice is so large and the capacity of the vein so great that it is sufficient to accommodate all the blood passing up through the femoral as well as that passing back from the iliac.

We have already seen that our first hypothesis is incompatible with the laws of circulation, for if the action of gravity is sufficient to stop the blood current below it, then venous return flow is impossible in the upright position. As to the second supposition, if such a state of affairs did come about, the result of the removal of such a large quantity of blood from the general circulation would be to cause immediate syncope. I think it is much more reasonable to suppose that the blood passing up the thigh
in the femoral vein is sufficient to fill up the empty saphenous vein and at the same time to maintain the continuity of flow, at a slower rate no doubt, in the femoral and external iliac veins. For it must not be forgotten that the blood passing up in the superficial veins will assist in dilating the saphena so that the actual quantity of blood passing directly from femoral to saphena may be comparatively small.

The influence of abdominal pressure in causing backward flow must also, I think, be excluded as such pressure must act on all the vessels within the abdominal cavity, and if it cause backward flow in one, it must cause backward flow in all. Therefore I think we must entirely exclude the possibility of backward flow in a main venous trunk so long as there is no actual wound in the vessel through which the blood may escape.

Frendelenbergh's experiments however are of extreme interest and give us
Valuable information as to the influence of incompetency of the valve at the orifice of a large superficial vein, and also as to the relationship of abdominal and intra-venous pressure. I take it that the explanation of the experiment is as follows:—When the limb is elevated, the deep veins, owing to the action of gravity, are able to carry all the blood from the deep structures, and perhaps even some from the superficial tissues as well through the communicating branches, so that the superficial vessels are almost emptied, the smaller quantity of blood in them not being sufficient to distend the enormously dilated vessels to any appreciable extent. Thus the track of the varicose vein now appears depressed. Now as the valve at the orifice of the saphena is incompetent, we have an unsupported vein opening at an angle into a well supported main vein without any valvular protection, and therefore no blood will flow from the saphena to the femoral
until the pressure in the former is at least equal to that in the latter, and therefore as the saphena is unsupported it must be dilated to its full extent before the current can become continuous. This implies that so long as the erect attitude is maintained the saphena must always be in the stretch, and will therefore tend to dilate more and more. When the saphena becomes permanently dilated and its walls rigid, it is then practically a rigid tube connected with the femoral and so in certain positions it acts as a natural manometer to that vessel. Thus when the patient coughs the abdominal pressure is raised, and the effect of this is to increase the pressure in the iliacs and vena cava and thus to prevent the blood returning from the limbs quite so rapidly as it otherwise would, and so to cause increased pressure in the femoral with a corresponding rise in the column of blood in the saphena. On occluding the orifice of the saphena by digital compression and then allowing
The patient to stand up, the superficial veins fill to a considerable extent through the anastomosing branches and capillaries; but whenever the finger is removed we have blood passing directly from the femoral to that vein, until the pressure in the two vessels is equalised.

I think these facts explain the profuse haemorrhage which occurs from the upper end of a wounded or ruptured varicose vein. For if this vein communicates directly with the deep system without the intervention of a valve, then the pressure in the wounded vessel being lowered, and as all the valves in it are necessarily inadequate, the blood will at once flow from the deep to the superficial vessel and escape through the wound, producing syncope very rapidly by lowering the pressure in the iliacs and inferior vena cava.

As Trendelenberg points out we have here also the explanation of the great value of ligature of the saphena in such cases; for by it we at once cut
Of direct communication with the femoral and thus relieves an enormous strain from the dilated vessels.

Further, I think that we have here the key to the mechanism of production of such cases. For given repeated and prolonged increases in abdominal pressure, from whatever cause, the result will be increased lateral pressure in the iliacus and all the veins beneath them. The effect of these irregular increases will be greatest just outside the abdominal cavity, so that the femoral vein will be the first to suffer. This vessel will accordingly tend to dilate and this dilatation may be so great that the valves in this vein become incompetent. At the same time, if the dilatation is excessive the orifice of any vein opening into it (e.g. saphena) will also suffer, so that the valves guarding it become incompetent. Should there be a second strong valve behind the first, which does not give way, the result will be dilatation of the intervening portion giving rise to a subcutaneous tumour in the groin. But if this second valve also gives
way, varicosity of the whole internal saphena and its branches will probably result, as the saphena will now have constantly to support a pressure equal to that in the femoral. Thus it would seem highly probable that these cases primarily arise by failure of the valve at the orifice of the saphena, and in any case the failure of such a valve must have an important influence, as so long as direct communication between the two vessels exists, cure is impossible.

Thus it would appear that in those cases in which the varix is confined to the internal saphena and its branches gravity can only play a subsidiary part, for gravity acts typically on the terminal branches, and it would seem necessary to have some such other cause as abdominal pressure, which acts almost directly on the great veins of the thigh.

We now come to our second main consideration namely, the anatomical and physiological relations of the deep
Scheme.

1. Superior External Iliac
2. Ilio-Femoral
3. Inferior Common Femoral
4. Upper Saphenous
5. Profunda
6. Superficial Superficial Femoral

Perfect Types (Bennett)

Imperfect Types (Bennett)
and superficial systems, and as having a direct bearing on the subject last discussed, I wish, first, to consider the arrangement and probable function of the values in the groin. Mr. Bennett has devoted special attention to this point and has collected valuable statistics as to the variations in the arrangement of the values in this region (op. cit. pp. 35-46). From a series of postmortem examinations he divides his cases into two main groups:

1. Those in which the arrangement may be considered perfect.
2. Those in which there are material deviations from the perfect type.

I have sketched in these types roughly and diagrammatically, indicating the presence of a value by the form (X) and I think their study is of interest; I do not however propose to describe each in detail as the different arrangements are obvious.

Among these types it must be noted that type B is very rare, - q.v. Mr. Bennett says "this arrangement... is seldom met with,"
the profunda valve being apparently the
nearest in the thigh. (p. 39) Type C is a
problematical arrangement which Mr. Bennett
has never been able to find, and type B
is also very rare, Mr. Bennett only having
been able to find one such case.

On comparing these groups one is at
once struck by the fact that in all cases
whether perfect or imperfect, there is always
a valve or the remains of a valve at the
orifice of the internal saphena vein.

If we examine the perfect types we find
that they have two and only two points
in common.

1. A valve at the orifice of the internal
    saphena.

2. A valve in the main trunk immedi-
    ately above the orifice of the same vein

The profunda, on the other hand, rarely
has a valve at its orifice and may or
may not be guarded by a valve in
the main trunk immediately above it.

Looking at the deviation forms in-
dividually we find that they are of much
interest.
Thus, in type A, the orifice of the saphena has no value immediately above, but on the contrary, there is a value immediately beneath it. This arrangement will necessarily expose the orifice of the saphena to greater strain. Of this, Mr. Bennett says "abscence of the ilio-femoral valve (type A) is very commonly associated with absence or inadequacy of the proximal saphenal valve."

Type B differs only from the last in that the valve in the main trunk is below instead of above the orifice of the profunda, and therefore the strain on the saphenal valve in this case is not so severe. Accordingly, inadequacy of the saphenal valve is not found to be a necessary accompaniment of this arrangement.

Type C is problematical and need not be considered further.

Type D is of much interest. Here we have an arrangement in which there is no value in the main venous trunk, neither in the external iliac, common,
Superficial or deep femoral, but in the cases described there is no mention of any special frequency of varicosity. It is also noteworthy that the saphenous valve, in each case were very strong, and that in one case there were as many as seven pairs of valves in the upper part of that vessel.

To sum up, we find that, excluding the occurrence of this saphenous valve, the imperfect types agree only in one point, and in this only do they differ from the perfect types, namely, absence of a protecting valve in the main trunk above the orifice of the saphena. Thus I think we have strong presumptive evidence for concluding that the cause of the imperfection in these types is the absence of a valve or valves to protect the orifice of the saphena. I think we may even go further and say that the chief function of the valves in the deep veins of the groin is to lessen the strain on the valves at the orifice of the saphena.
backward flow in the femoral is impossible, we must proceed to consider the way in which these valves lessen the strain on the portion of vessel beneath them. Whenever the abdominal pressure is increased — say by a cough — the pressure in the deep veins is increased, and the current is correspondingly slowed, so that the pressure in the veins immediately outside the abdominal cavity is considerably raised; but as we pass down the limb the increase in pressure must grow less and less, the more it is distributed. Therefore although we have no actual backward flow, still we have a wave of pressure passing down the limb. Now if there is a valve in the main stream, increased pressure in, and dilatation of the vessel above it will tend to closing of this valve and so a certain amount of energy will be dissipated in its neighborhood. In this way the valve will protect the section of vessel beneath it from any sudden increase of pressure, although the current may never be actually stopped.
Comparing for a moment the internal saphena and profunda veins we find that they differ as to the valvular arrangement at their orifices in two points:

1. The orifice of the saphena is always guarded by at least one pair of valves, whereas the profunda only in exceptional cases possesses such valves.

2. Whereas in all the perfect types there is a valve in the main trunk immediately above the orifice of the saphena, such a valve above the profunda vein is only found in one of the perfect types.

These facts would lead us to suppose that there is some fundamental difference in the relations of these two vessels; for in the case of the profunda we have a large vein opening into the main venous trunk, and subjected at its orifice to all the variations of external pressure on that vessel, the orifice of which is seldom protected by a valve, and only in certain cases...
is there a valve in the main trunk immediately above it. This seems to be a point of great importance, for if the conditions in the two vessels were similar, one would expect the profunda for excellence in the vein of varicosity and not the saphena. Again in such cases as Type D, where there is entire absence of valves in the main trunk, such an arrangement seems to have no special influence on the production of varicosity except in so far as it leaves the orifice of the saphena unprotected, and we accordingly find that here the saphenous valves are specially strong and, it may be, more numerous. This would lead us to suppose that absence or inadequacy of the valves in the iliac and femoral veins, is a factor of comparatively small importance in the production of varicosity. Mr. Bunnell has evidently come to a somewhat similar conclusion (p. 41, p. 43) for he says "Although I have no doubt that under certain circumstances the arrangement and adequacy
Of these valves have an important relation to the production of varicose veins in a fair proportion of cases, it is perfectly certain that a large number of instances of varicosity so-called are seen in which the valves have nothing whatever to do with the occurrence of the disease.

Now as we have seen that there is a decided difference between the internal saphena and profunda veins in their liability to varicosity, and as the former belongs to the superficial and the latter to the deep system, it will be well to consider the relations of these two systems more closely. In this connection it will be convenient to take up firstly the action of gravity, as its effects are simpler, and less liable to be obscured by adventitious circumstances.

At this point it must be noted that the superficial veins in the extremities are freely dilatable within certain limits, to meet the variations in the amount of blood which they carry. This may be seen at any time
by changing the horizontal position for the vertical, when the veins which before were inconspicuous now become prominent and distended. Thus their walls must possess a considerable amount of elasticity, and it would seem that whenever the veins are so overdistended that their walls lose their elasticity, varicosity is the result. Now, although the walls of the deep veins are equally elastic, they cannot be dilatable to the same extent as the superficial vessels, because they are surrounded by supporting structures. Therefore it will require a greater increase of intra-venous pressure to cause dilatation, than would be necessary in the case of the unsupported superficial veins.

We have already seen from the general consideration of the subject, that the effect of assuming the erect attitude is to increase the pressure in the main venous stream, and that this increase is greatest at the periphery and diminishes as we pass towards the heart. Thus the
Increase will be greatest in the vessels of the foot and ankle, and these vessels will tend to dilate. But, seeing that the deep vessels are surrounded by muscular and other structures, and as, in the erect attitude, the greater number of muscles are either in a state of contraction or tension, and most of the fibrous and ligamentous structure are rendered tense by the straightening of the limb, it follows that the deep veins, being closely surrounded by tense and comparatively rigid structures, are unable to dilate. Consequently, the immediate rise of pressure in these vessels is greater, and the flow of blood from the capillaries is correspondingly retarded. On the other hand, as remission in pressure in the superficial vessels is relatively less owing to their free dilatability, there will be a greater tendency for the blood to flow into them from the capillaries, until the pressure in the two systems becomes equalised. Thus indirectly, the superficial veins act as a manometer. The deep branches indicate the degree of pressure in the deep system.
Thus the general effect of gravity in the upright position is to cause dilatation of the superficial vessels. At the same time gravity will exert a certain amount of influence on the outlets of the superficial veins. For if the pressure in the deep system be raised, the flow of blood throughout the whole superficial system will be retarded by the increased pressure on the valves at the orifices of the saphenae veins. Here again, as the superficial vein is unsupported and therefore dilatable, any marked increase in the pressure in the deep vein will tend towards dilatation of the superficial vein to its full physiological extent, until the pressure in it is equal to that in the deep vein and onward flow is once more possible.

These facts would seem to explain the generally accepted dictum that varicocely affects specially the superficial vessels owing to their want of support, and it is evident that free dilatability of the vein is absolutely essential to the occurrence of varicocely.
It may then be asked: "If the deep veins are efficiently supported, why should case occur in which dilated deep vessels are found post-mortem?" My contention, however, is, not that the deep veins are undilatable at all times, but that they are practically so in the erect attitude, when the main supporting structures are tense. Consequently when these structures are relaxed, as in the sitting or recumbent postures, the case is altered. For given flexion of the knee and hip with relaxation of the muscles it is quite possible for the deep vessels to undergo a certain amount of dilatation due to increased pressure in the iliacs or vena cava. In fact in such attitudes the increase in pressure would fall primarily on the deep vessels and only when further dilatation occurred in them was it impossible would the full force of this increase be transmitted to the superficial veins. Whenever however the erect attitude was resumed the veins would require to accommodate themselves to the sur-
rrounding structures, which would now be much more tense and rigid, and therefore their dilatation beyond a certain limit would now be prevented. Any increase in pressure would thus be transmitted almost directly to the superficial vessels. Thus I think it is quite reasonable to suppose that under certain circumstances the deep veins might become dilated as to their calibre and thickened as to their walls. At the same time, too, these vessels are efficiently supported and protected from dilating in the erect attitude, they will not give rise to the same sensations of pain and weakness which occur in varicosity of the superficial veins. In fact, I think we might compare such veins to ordinary varicose veins supported by an elastic bandage. When the support is removed at night, the veins are dilated and dilatable, but during the day they are excess dilatation is foreseen. Thus it would seem that the vessel in order to become varicose must not only be dilatable,
but must be dilatable in the erect attitude, the two fundamental factors for the production of varicosity being gravity and want of support. This implies, I think, the further consideration that dilated veins in the deep system are not truly varicose. In regard to this point Mr. Forchsen says "Varice of the deep veins is less common, as the vessels are better supported. They give rise to no appearance which can be recognised during life."

This opinion is diametrically opposed to a conclusion arrived at by Mr. Bennett who says (p.25): "Thus two distinct classes of the disease exist, one beginning in the deep veins and subsequently involving the superficial... The points on which he depends for diagnosing deep varicose veins is a peculiar cramplike pain which comes on directly after the patient rises in the morning, associated with other signs such as slight general enlargement of the limb, a collection of small varicose veins below and behind the inner ankle, varix at the saphenous opening, and a collection of fine radicating veins over
The inner aspect of the limb and far above the knee. I think most of these accompanying signs can be explained as they are all dilatations of superficial veins. Undoubtedly the two latter signs seem to be secondary to dilatation of the deep veins of the thigh. As to the crampy pain which Mr. Bennett considers to be pathognomonic of commencing varicose and to be due partly to surrounding muscular contractions, but in great part to the natural resiliency of the vein wall, I think this may also be explained in another way. For if the deep vessels are in any way dilated they will tend to become engorged in the recumbent posture when the supporting structures are relaxed. Consequently, when the erect attitude is assumed and the main trunks are suddenly compressed by the tension of the surrounding structures, the muscular branches are unable to return the blood with which they are engorged. They thus set up a certain amount of irritation and induce contraction of the surrounding muscular fibre. In this way the balance of pressure is soon regained and the pain passes off. Thus the conclusion arrived at is practically
The same, namely, "That this crampy pain is pathognomonic of a dilated condition of the deep veins." The only point at issue is as to whether this dilatation is a true form of varicosity. I submit that there is an essential difference between the two conditions. I do not think that the evidence is sufficient however to entirely negative the possibility of varicosity in the deep veins where the muscular and other structures are extremely lax, but in the great majority of cases there seems to be sufficient to prevent the occurrence of symptoms.

It would seem then, that the action of gravity in the erect attitude is to cause dilatation of the superficial veins and that this dilatation is greatest in the leg and ankle. The question then arises, "Can varix be brought about solely by the action of gravity, as for example by long standing?" In the case of a full grown healthy man this would not often seem to be the case, for in a great number of trades and occupations, the workman has to
follow his employment standing in the erect attitude, and we would expect that if long standing alone was sufficient to cause varicosity, the complaint would be well nigh universal. But in the case of a young growing boy, who is taken from school and apprenticed to a trade where he has to stand in a workshop all day, at an age when active development is going on, and whose vascular system is not as yet fully developed, it seems highly probable that such conditions are sufficient to bring about varicosity. On consulting Mr. Bennett's tables (p. 116) we find that out of 259 cases occurring in the male, 94 cases or 36.29% showed themselves before the age of twenty-five, thus showing the tendency of the condition to affect young people. In the female table, out of 315 cases, 85 or 26.98% occurred before the age of twenty-five. Thus amongst the females the proportion is 10% less, even though this total cannot exclude a certain number of cases due to pregnancy. I think this difference may be explained.
by the fact that girls are not as a rule sent out to work at so early an age as boys. The results would have been still more interesting, had Mr. Bennett restricted his first group to cases occurring before the age of twenty, as this would practically have limited the class to individuals who had not attained full maturity. Mr. Bennett would have us believe that the great majority of the cases occurring in youth may be accounted for by some hereditary or congenital defect in the venous system. Whether this be so or not, it is evident that the condition does not occur as a rule in infancy or childhood, but only manifests itself when increased strain is put upon the venous system by continued maintenance of the upright position. Should the valvular apparatus in the femoral be inadequate, there will be a greater tendency to varix of the saphena, but there are many cases arising in young people, where the valves at the orifice of the saphena remain competent, and where the varix commences
at the ankle, so that heredity at best can only give us a partial explanation. It seems more reasonable to conclude that any weakness or inadequacy of the veins or their valves will predispose the individual in whom they occur to varicosity.

In adults, long standing also would seem to have an important bearing on the production of varicosity, as it is very often found in those whose occupation entails much standing; but in such cases there would usually seem to be some contributing cause, such as weakness of the venous system, constipation, pregnancy, etc.

Varicosity arising in this way—by repeated dilatation of the superficial vessels until the natural elasticity of their walls is overcome, caused either by long standing alone, or in conjunction with other causes, would tend to begin where gravity exerted its greatest effect, that is to say in the region of the foot and ankle, and would tend to spread upwards if the long standing was persisted in; for every
time the erect attitude was assumed, the non-resilient portion would at once fill, and the pressure effects would be transmitted to the portion of vein directly above it, and the condition would become worse from day to day. The process would thus be a gradual one and the rapidity with which it progressed would depend on the length of time spent in the standing position each day, as well as on the contributory causes.

The question may then be asked, "Why should increased venous pressure in some cases give rise to varix, in others to oedema, and in still others both?"

The explanation depends, I think, on the dilatability of the superficial veins as well as the mode of incidence of the pressure. Take the example of gravity. When the patient rises, the pressure in the veins of the leg and ankle is increased, but owing to the dilatability of the superficial veins this increase is neutralised, and is prevented from
passing back to the terminal venules and capillaries. For if the veins of the leg were undelatable rigid tubes, any increase of pressure in them would be transmitted directly backwards to the capillaries, and, other circumstances being equal, oedema would result. Thus the superficial veins by their delatability prevent any ordinary increase of pressure from acting directly on the capillaries. But if we imagine the increase in pressure to be so great or so long continued, then the superficial veins can dilate no further, then the pressure is carried directly backwards to the capillaries and oedema results. This in fact actually occurs in advanced cases of general varicosity, where the veins are so distended that they are practically undelatable and when consequently get solid or non-reducible oedema. I think this helps us to understand the influence of tumours pressing on a main venous trunk, or of general obstruction to the venous return, as in
heart disease. If this obstruction is sufficient to constantly raise the venous pressure to any appreciable extent, the superficial veins soon reach their limit of distension and oedema occurs. In the recumbent position, this increase will act equally on the deep and superficial vessels and there will be no special tendency towards dilatation of the superficial vessels. Hence obstruction can only act as a cause of varicosity in so far as it raises the venous pressure, but it cannot of itself give rise to a varicose condition, and therefore it must be looked upon entirely as a contributory or predisposing cause as the case may be.

Thus we conclude that oedema is the result of a constant pressure affecting equally all the veins of the limb whereas varicosity is brought about by intermittent pressure affecting specially those veins which are unsupported. It will also be seen that oedema is not a necessary symptom in commencing cases.
of varicosity, and when it does occur it may usually be traced to some extraneous cause such as anaemia, heart disease, renal disease etc, but that in advanced cases affecting all the superficial veins of the leg, oedema will almost always be present, more especially if the patient stands for any considerable period of time in the erect attitude.

Gathering all these facts together, I think we are justified in concluding that varicosity may arise in two ways,—

I. By the failure of the valvular apparatus at the orifice of a large superficial vein, whereby the lateral pressure in the main vein acts directly on the outflow of blood from the superficial vein, thus causing it to become varicose; that this condition is most liable to occur in the groin, and to affect the orifice of the internal saphena, although it may also affect the external
saphena or any large tributary branch; that its origin is sudden, and that it is usually brought about by irregular increase of abdominal pressure; more especially, if the adjoining valvular apparatus in the deep veins is absent or inadequate.

II. By gradual dilatation of the superficial veins, due to repeated over-strain, brought about by the action of gravity, in the erect attitude, assisted by any cause which increase the pressure in the deep veins; that its origin is insidious and its progress gradual, and that it begins in the region of the ankle and spreads upwards.

Having thus got a general idea of the modes of origin of varicosity, we must now look more particularly at the generally accepted causes of the condition, and consider the way or ways in which they act. These causes may be grouped roughly under our third
Variations in abdominal pressure.

The most commonly accepted causes of varicose veins are constipation and pregnancy. Constipation has been considered by many to cause varicosity by pressure of accumulated feces on the left external iliac vein. Against this so-called "focal tumour" theory, many objections may be urged. For this tumour is a movable one and is surrounded by small intestine which is easily compressible. When the erect attitude is assumed this tumour will be thrown forward into the cavity of the pelvis and in this position can have little or no influence on the iliac vein. So that it is only in the recumbent posture that it can exert any possible influence; and as we have seen that obstructive tumours can only act as contributory causes and that their effect is only appreciable in the erect attitude I think we must dismiss this view of the causation of varicose veins altogether.
On the other hand it is undisputed that constipation is a prominent cause of varix. Mr. Bennett has noted it (p. 44) as occurring in 34.36% of all male cases. Its influence would seem to be explained by the fact that there is a considerable increase in abdominal pressure during the act of defaecation. In constipation this act is greatly prolonged and intensified, and its effect on the venous return is consequently greater. Now even a slight variation in abdominal pressure is sufficient to affect the pressure in the femoral vein. This is shown by Trendelenberg’s experiment, where a cough is sufficient momentarily to raise the column of blood in the saphena, supported by the lateral pressure in the femoral. We have also seen that this increase in pressure is due, not to an actual reflux of blood in the iliac, but to a general slowing of the current. Now if we consider the strain put upon the veins outside the abdominal cavity during a prolonged effort to defaecate, it is evident...
That its effect must be considerable. The pressure in the femoral, and consequently in the saphena, will be greatly increased. This may be seen by watching the saphena during such an effort. It at once becomes prominent and dilated. The vein which is likely to suffer first is that immediately outside the abdominal cavity, as here the backward wave of pressure will be greatest. If these expulsive efforts are continued, the femoral will tend to dilate, and it may do so to such an extent that the valves in it become incompetent. The orifice of the saphena will also suffer, and if the dilatation is great the valves protecting its orifice will become incompetent. If the distal valve is strong and holds out the tendency will be towards the formation of a varicose tumour at the saphenous opening; but should this valve also give way, the result will probably be varix of the whole saphena and its branches.

Even if the increased pressure in the
femoral is insufficient to render the saphenous valves incompetent, it must increase the pressure in the superficial vessels generally; in this way it will intensify any dilatation which has already occurred, and will increase any tendency to varicosity which may already exist. Thus gravity and abdominal pressure may interact with each other in various ways, and so give rise to the different forms of varicosity with which we are familiar. For example, it seems reasonable to suppose that if the veins of the superficial system generally are in a state of extreme distension due to gravity, a slight increase, brought about by abdominal pressure, might be sufficient to render incompetent a valve at the orifice of a large branch of the saphene, whereby this particular branch and its radicle would become over dilated. In this way we might get a localized varicose mass arising.

Pregnancy, we are now in a position to estimate the influence of pregnancy. Mr. Bennett finds (p. 44) that out of a total
of 315 female cases, pregnancy was noted as a cause in 100 cases or rather more than 30%. Thus its influence would seem to be considerable. Now it is certain that pregnancy greatly increases the intra-abdominal pressure, especially during its later months, but this increase is regular and persistent, so that the venous circulation will soon adapt itself thereto. In the erect attitude this increase in abdominal pressure must intensify the action of gravity and tend towards dilatation of the superficial veins. Thus, if the upright position was not persisted in too long, pregnancy, if itself, would not be likely to cause varicosity in this way. But if constipation be super-added, it is evident that this initial increase in pressure, when combined with the intermittent increase during the act of defaecation, will be a powerful factor in bringing about varicosity. In this way slight constipation combined with pregnancy will have quite as much effect in producing varix, as excessive
constipation acting alone. Tho' I think pregnancy must be looked upon
more as an adjuvant to constipation
than as being the actual exciting cause.
In certain cases however pregnancy
may be looked upon as actually setting
up the condition. For during parturition
the expulsive efforts are often excessive
and prolonged, and it is quite possible
that one or more superficial veins
become so over dilated that their values
become incompetent and varicosity results.
I think these facts are sufficient to
explain the great influence which
pregnancy exerts in the production
of varicosity.
Tumours have sometimes been described
as being the cause of varicose, but as
we have seen, their influence would
seem to be small. Large movable
tumours such as ovarian cysts would
act much in the same way as a pregnant
uterus, but in order to have any ap-
preciable effect they must be of a
very large size.
Teesel tumours pressing on a large vein will act as contributory cause in producing varicosity.

Thus in come to the conclusion that the actual exciting cause of varicosity is some intermittent increase in the venous pressure whereby extra strain is thrown upon the superficial vessels on account of their unsupported condition, and that the actual starting point of the disease is influenced by the comparative strength and adequacy of the various valves.

We must now consider as to whether this explanation is sufficient. Can we, in fact, attribute all cases of varicosity to the causes included in the foregoing description? Mr. Bennett in his tables groups his cases under six headings as follows:

1. "Generally throughout leg and thigh."

Such case would be liable to occur as the result of extreme abdominal pressure, whereby the intra-venous pressure in the leg would be greatly increased, and the
Vessels dilated, with resulting incompetency of the valves at the orifices of the long and short saphenae veins and general varicosity of the superficial system. This result might be produced during the prolonged strain put upon the vessels at parturition.

2. "Generally, throughout leg below knee."

These are the cases which would most probably occur due to the action of gravity, standing, as the valves at the orifices of the saphenae seem to be competent.

3. "Popliteal region and outer side of leg."

Such cases might be explained by failure of the valve at the orifice of the external saphena vein.

4. "Internal Saphena only."

Here, as we have seen, failure of the valve at the orifice of this vein is the probable mode of origin of the condition.

5 & 6. Localised Varicose Masses including "Veins over saphena only." "Veins over calf of leg only." "Veins over ankle and foot only."

All such cases, I think, are explained by the failure of a valve at the orifice
of a large branch of a superficial vein, brought about by the superaddition of a strain due to abdominal pressure on veins already distended by the action of gravity.

As to the point of origin of the condition, this would seem to depend to some extent on the nature of the cause. Thus, cases due to gravity would arise naturally in the region of the ankle while cases brought about by abdominal pressure would tend to begin in the groin. At the same time, the venous system will tend to give way at its weakest point. It should be noted that the valves at the orifices of the internal or external saphenous veins are weak, and if these veins will most probably be the first the condition will take in persons so predisposed; if, on the other hand, these two valves are particularly strong and well protected, the tendency will be more towards some form of varicosity in the leg below the knee, such as a localised varicose mass. In this relation, any hereditary
or congenital weakness or defect must have a considerable influence in determining the point of view of the disease. Thus I think heredity must be looked upon as determining to some extent the locality of the varicose rather than as an actual cause of the condition.

Many observers however maintain that heredity is one of the main factors in the production of varicose. Thus Mr. Bennett from his observations concludes (p. 25) "That the disease for the most part arises from congenital and often hereditary defects or other abnormalities in the veins apparatus, there being no evidence to show that a vein originally perfect (excepting perhaps the long saphena) ever becomes varicose before middle age in the absence of such obvious causes as those previously referred to." This conclusion he bases on the fact that in a great number of cases he was unable to specify any definite cause, and also on the
fact that in many cases he was able to obtain a hereditary history. As to the first argument, I think it is not difficult to understand how no history of causation is obtainable. For an individual may undergo a severe strain which, though only temporary in character, is yet sufficient to start a well marked condition of varicose veins which may not manifest itself for some time afterwards, and in this way the patient does not connect the varies with the real cause of the condition. Such a result might occur secondary to a temporary constipation of which the patient had taken little or no notice. Secondly, with regard to a hereditary history, the evidence must be very carefully sifted. For varicose veins are a very common ailment, and a history of piles in the father, or of varicose veins in the mother following new more pregnancies, is of little or no value in proving a case of varicose veins to be hereditary.
In order to make good such an assertion, it would seem necessary to prove that the tendency was due to one of the following causes:

1. Large size of the vessels.
2. Valvular deficiencies.
3. Weakness of the walls.
4. Laxity of the supporting structures.

I only include this cause because Mr. Bennett describes a very interesting case (p.44), on which he lays much stress. In this case all the veins of the right limb were of enormous size and the right leg was, consequently, much larger than its fellow. But, be it noted, the valves in all these veins were competent. This seems to be sufficient evidence that the veins in question were not varicose. For if the valves were competent the veins could not be over-dilated and therefore they were not varicose. And, otherwise, large size and consequently greater carrying capacity of the veins would seem to be a preventive rather than an incentive to varicosity.
2. Valvular deficiencies. As to absence or inadequacy of valves in the veins we have already seen that the variations which occur have comparatively little influence and, as Mr. Bennett admits, could only act in a limited number of cases.

3. Weakness of the vein walls. This would seem to be the natural explanation of any real hereditary tendency; for if we compare the veins with the arteries we may imagine some degenerative change like atheroma, weakening the vein wall, and in this way tending to varicosity. Atheroma, however, is a disease primarily of the middle or muscular coat and is of wide distribution. Thus if such a change occurred idiopathically in the veins we should expect it to manifest itself in different parts of the body; such a condition however has not been described and there is no evidence of its existence. The degenerative changes that are found in a varicose vein are generally admitted to be the result, and not the cause of
The varix. So I think we must also exclude this explanation.

4. Laxity of the supporting structures. In cases where there is great redundancy of skin, heredity might be considered to act in this way. Such a condition would undoubtedly have some influence on the progress of the disease, but of itself, it seems an entirely inadequate explanation.

All these considerations seem to negative the idea that heredity of itself is capable of bringing about varicosity, although it may have a predisposing influence, and will in many cases determine the point of origin of the disease. It seems much more probable that the mode of origin is a mechanical one, and that some exciting cause which will increase the intra venous pressure is absolutely necessary.

There still remains for discussion the time honored question of the relative frequency of varix in the two limbs. In Mr. Bennett's tables we find that out of a total of 259 male cases, in 92 both limbs
were affected, in 93 the varix was confined to the left limb, while in 74 cases the right leg was exclusively affected. So that out of a total of 167 cases affecting one limb only there was a preponderance of nearly 57% in favour of the left limb. This difference is usually taken in conjunction with the fact that varicocele is much more common on the left side than on the right, and this is said to be due to the influence of the levodors rectum. But it must be remembered that the anatomical arrangement of the spermatic vein is different on the two sides, and therefore that the conditions are not comparable. Although the discrepancy is not great, still it exists, and if we exclude the levodors rectum as a negligible factor, we must look elsewhere for an explanation. In this connection I think it will be interesting to consider what we may call the Ethics of Standing. With most people it is a matter of common experience that if they stand for any lengthened period of time in
The same place, there is a tendency to rest the weight of the body first on one leg and then on the other, and that of the two, one usually rests for a longer interval of time on the left. This would lead us to suppose that the left leg is more generally employed than the right for this purpose, and that consequently the muscles are stronger on that side, just as in a similar manner the right arm is stronger in most ways than the left. This view would seem to hold good when we look at the positions one takes up in various athletic exercises.

In starting to run a race, the runner leans far forward in his left leg, so that when the signal to go is given, he may propel himself violently forwards with this limb, and so get on a good pace straight away.

In fencing and in foils, the weight of the body is rested almost entirely on the left leg, which is fixed, the right being free to move backwards and forwards.
as required, in this way giving the right-arm free play.

In boxing, the conditions are somewhat different as the weight of the body is rested almost equally on both legs, the left being slightly forwards; but in delivering a blow the boxer rises off his right foot, and rests his whole weight on his left, so that he may get the full advantage of bringing his weight into play.

In riding, a lady rises off the stirrup from the left foot, sitting on the near side of the horse, this being the regulation position. It is now recommended that ladies should sit on either side of the horse alternately, so as not to unduly develop the muscles of one side only.

This from experience, the recognised position in nearly all athletic exercises is one in which the weight of the body is rested on the left leg. The reason seems obvious. For just as the right arm is the one we use in nearly every case where there is a preference, and this partly from
habit and partly by education, so we find that of the lower extremities, the left is the one on which we depend for standing, and is so chosen in order to give free play to the right arm and right side of the body in whatever occupation we are engaged.

Now I think it stands to reason that if an individual rests habitually more in the left leg than in the right, there will be increased tendency to dilatation of the superficial vein of that limb, on account of the longer maintenance of the pressure. Whether this difference is sufficient to explain the greater frequency of varic in the left limb, it must without doubt tend in that direction.

At the same time we must not forget that this natural selection of the left limb as the main means of support will have a marked influence in development. Thus in childhood the gradual education of the left leg will tend to hasten its development and its vessels will be firmer and more able to resist increased pressure.
Thus, at any age before full maturity is reached, if the veins of the lower extremities are subjected to increased strain, whether by long standing or abdominal pressure, the vessels of the right limb being less developed will be less able to resist the effects of increased pressure than those of the left; consequently varix will be more liable to occur in the right leg and may be limited to it. In adults on the other hand, as the vessels of both limbs have now attained full maturity, the increased strain put upon the left leg in occupations where long standing is the rule would account for the greater frequency of varix in that limb; and as the greater number of cases occur in adult life the balance is rather in favour of the left side.

If these hypotheses are correct, we ought to find that in youth varicosity of the right leg would predominate, while in adult life the left limb would be most prone to the condition. On consulting Mr. Bennett's tables we obtain
The following figures
**Table A. (Male Cases)**

<table>
<thead>
<tr>
<th>Limb or Limbs Affected</th>
<th>Total No. of Cases</th>
<th>Age Before Twenty-five</th>
<th>Between 25 and 40</th>
<th>After Forty</th>
<th>Doubtful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both</td>
<td>92</td>
<td>40</td>
<td>46</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td>Left</td>
<td>93</td>
<td>13</td>
<td>29</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>Right</td>
<td>74</td>
<td>41</td>
<td>9</td>
<td>11</td>
<td>13</td>
</tr>
</tbody>
</table>

Thus we find that out of 93 cases affecting the left leg only, only 13 cases occurred before the age of twenty-five, while no less than 54 came on after that age (26 cases being doubtful); whereas out of 74 limited to the right leg, 41 occurred before the age of twenty-five, only 20 occurring after that age, the other thirteen cases being doubtful.

Mr. Bennett puts these 41 cases down to heredity and explains that here we may exclude the influence of a loaded rectum; but he fails to explain why hereditary cases should occur specially in the right leg, and not in the left where the loaded rectum would, if it had any effect, assist in the causation. Whatever be the true explanation, varix
Of the right leg seems to be much more frequent in early life, while the affection of the left limb is typical of adult life.

This brings us to a close our consideration of the subject of causation and I think we are justified in drawing the following conclusions:

1. That before a vein can become varicose it must fulfill two fundamental conditions:
   (a) its position must be dependent.
   (b) its surroundings must be such that it is freely dilatable in the erect attitude.

2. That the predisposing causes, such as weakness or imperfect development of the vessels, absence or inadequacy of the valves, facility of supporting structures, obstructions to the venous return, etc., must be clearly distinguished from.

3. The exciting causes, which consist of the action of gravity in the erect attitude and increased abdominal...
pressure.

Sufficient attention does not seem to have been devoted to this point, and it is undoubtedly difficult to draw a hard and fast line. Thus the action of gravity is only a predisposing cause up to a certain point, but whenever it causes overdistention of a vessel it becomes an exciting cause. Again, weakness of a septal valve is a predisposing cause, but whenever the valve gives way it may also be looked upon as an exciting cause. At the same time I think the distinction exists, and that by it we can definitely classify the various causes.

4. That these exciting causes bring about varicosity in a perfectly mechanical way, viz., by increasing the venous pressure.

5. That the resulting varicosity varies according as the increased pressure causes failure of a valve at the mouth of a superficial vein, or causes general dilatation of a group of
Superficial veins.

We are now in a position to consider the different methods of treatment and to estimate their value in the various forms of varic. These methods may be divided into three classes—preventive, palliative, and curative.

Preventive Methods.
These are very simple and consist in counteracting the exciting causes. Thus there will be two great indications.

1. Limitation of the increase of abdominal pressure, occurring in the performance of natural acts.

a) Constipation. Regulation of the bowel action, preferably by a strict attention to diet, or if necessary by mild purgatives, especially rectal tonics, the object in view being to obtain regularity of action, with the least possible increase of abdominal pressure. Special attention must be paid in cases where from any extraneous
cause, such as a pregnant uterus or a large tumour. The normal abdominal pressure is temporarily or permanently increased.

6. Parturition. Careful attention to detail so as to minimise as far as possible the effects of the great increase in pressure.

2. Avoidance of long standing. This must be specially insisted on in young people. Thus if a boy suffers persistently from weariness and pain in the legs after beginning an employment necessitating long standing he should at once be removed from the occupation until such time as his venous apparatus is more able to stand the strain.

In adults where varicosity tends to show itself as the result of long standing, the effect of gravity must be neutralised by assuming a sitting or recumbent attitude at intervals to relieve the strain. Slight exercise, such as walking up and down the room, will
also be of use in so far as the circulation will be stimulated by the constant strain taken off the superficial vessels. At the same time the action of the towels must be carefully attended to, especially if there is any tendency to constipation.

Mention must also be made of the use of some form of elastic support in threatening cases. This is partly a palliative and partly a curative method, but it may also be used as a preventive.

**Palliative Measures.**

Of these the elastic bandage is the chief. This is the most universal mode of treatment, and as the result of clinical experience, is admitted to be the best form of palliative treatment. If regularly and carefully applied, it results in many cases in the actual cure of the condition. It consists in the application of elastic or other support to the affected limb whereby an equal and even pressure is brought to bear on the varicose vessels.
so that they are never allowed to dilate beyond certain limits. This support may be removed after the patient has assumed the horizontal posture, but must in all cases be reapplied before rising, as otherwise its curative effects are entirely neutralized. It will be seen that this mode of treatment does away with one of the two conditions which are necessary for the production of varicose veins, namely, free dilatability of the veins in the erect attitude. Its effect is to at once relieve the symptoms and to do away with the constant dull pain which is so troublesome; and so long as the patient wears the bandage he is practically unconscious of his affection.

It is also maintained that if the bandage is applied for a sufficiently long period of time, in many cases absolute cure of the condition results. This would seem to be due to the fact that so long as the bandage is worn the veins are never allowed to over dilate and so in time the walls regain their
Normal tone, and thus maintain the vessels are able to withstand the ordinary variations in venous pressure. Such a result seems probable in cases where the condition is due to the action of gravity and has not proceeded too far. When the veins are enormously dilated and their walls thickened by calcareous deposits, cure by this method is impossible, or at least it is so tedious as to be impracticable. Also, whenever the valves at the orifice of a large superficial vein become incompetent and direct communication with the main trunk exists, the elastic bandage may do away with symptoms but cannot possibly effect a cure; for whenever the support is removed, the lateral pressure in the main vessel acts directly on the unsupported vessel and dilatation again occurs. Amongst the other objections to this method may be mentioned its inconvenience in cases of veins affecting the thigh, and also its inadmissibility in men who wish to enter the services.
Thus the use of the elastic bandage as a curative agent is restricted to cases occurring in the leg and ankle, which are not too far advanced, and in which there is no particular vascular inadequacy. In all other cases, its action is merely palliative.

Consequently, various operations have been devised with the view to obtain a radical cure. As far as I am aware, there are three types of operation at present in use with this end in view:

1. Obliteration or removal of the dilated veins.
2. Ligature of the main trunk with the view to alter the pressure relations.
3. Removal of a portion of skin in order to give increased support to the veins.

1. Obliteration of the dilated veins.

Such obliteration, whether by ligature, excision or other means, is without doubt a cure of the affected parts. For this purpose several operations are employed of which the most important are proximal ligature, double ligature and excision, and of these excision seems to be the most
Satisfactory. In many cases, indeed, where a vein is enormously dilated, and its walls thickened excision seems to be the only method of cure. Now it would seem natural that if this were a perfect method of treatment one would simply require to ligature or dissect out all the affected veins in any given case. This is no doubt possible and even advisable in localised cases but where the condition is widespread the operation is a serious one. Besides, it must be remembered that by removing the affected vessels we do not remove the cause of the varic; on the contrary by so doing we reduce the carrying capacity of the superficial system generally and thus increase the strain on the remaining vessels. Even in many cases a localised collection of varicose veins, on account of their great dilatability, may and probably do act as a safety valve to the rest of the superficial system. Therefore in removing such a collection of varicose veins, redoubled care must be taken to counteract the
predisposing and exciting causes, otherwise the condition is almost certain to return in the other veins of the limb. Such a result is extremely disappointing to the surgeon who operates for the condition. Thus it would seem that the method of obliteration, though giving satisfactory results in a certain number of cases, is not to be relied upon and in no way acts as preventive to the recurrence of the varix.

2. Ligature of a Main Trunk. The operation is entirely different in principle from the ligature employed to obliterate a varicose vein, and consists in the ligature of a large superficial vessel near its orifice. It is employed chiefly in the case of the internal saphena and often with extremely satisfactory results; it will be seen that when the valves at the orifice of such a vein are incompetent, ligature will at once alter the pressure relations and do away with the effects of the external pressure on the femoral, which is the main cause of the continuance
of the condition. In order to obtain the desired effect it is plain that the ligature must be applied near the orifice and above all the larger branches, otherwise the unaffected branches will continue varicose. At the same time such ligature must also act by obliterating the vessel for a short distance above and below the point of ligature, and in this way assist in the cure. But as a rule the coagulation does not proceed very far and the main branches remain patent. Now if these branches are extremely dilated and degenerated, the action of gravity may still be sufficient to maintain the dilatation even though the direct pressure from the varix is removed. This operation has been modified by Mr. Bennett who ligature the vein in two places and then divide it. The advantages of this method must be twofold viz.: 1. Retraining of the vein is prevented, and 2. The vein is allowed to contract and retract and in this way coagulation is assisted both above
and below the point of legature. This operation is extremely suitable in cases confined to the internal saphena but is not applicable to cases beginning in the ankle and affecting the veins of the leg below the knee, for in these cases the valves at the orifice of the internal saphena are usually competent. At the same time it is the only operation that can be effective when these valves are incompetent.

3. Removal of a portion of skin. This operation was devised by Mr. P.H. MacLaren to whose kindness I am indebted for permission to describe it and to make use of any cases which I saw while acting as clinical clerk and resident in his wards in the Edinburgh Royal Infirmary. It is based on the fact that one of the main causes in the production of varicosity is the deficient support afforded to the superficial vessels and also that in many cases there is a special redundancy of skin. It consists in the removal of an elliptical portion of skin from the back of
The leg and then simply stitching the cut edges together, one or two deep sutures being employed to relieve tension. The object of the operation is to give an additional support to the superficial vessels, and in this way to act as a natural elastic stocking. The principle seems a scientific one as it removes one of the two conditions fundamental to the production of varicose free dilatability of the superficial vessels. When the varix affects the thigh however this operation is evidently insufficient unless combined with ligation of the saphena high up. There are certain difficulties in the after treatment of this operation as the tension is necessarily great, and union by first intention difficult. These however are matters of technique and might be overcome. The chief advantage to be obtained by an operation such as the above is that without diminishing the carrying capacity of the veins to any extent, it acts as a cure for varicose and also as a preventive to varicosis.
it would seem to be the only operation in which this result is possible.

These are the means at our disposal and it remains to be discussed which
are the most applicable to the various forms in which varicosity manifest itself.
I shall simply indicate the methods which seem most suitable without again going into the various arguments.

1. Localised Varicose Mass. It would seem that the simplest and most radical
method of treatment is at once to excise the mass of veins. This will cure the actual condition, but as we have seen, will not prevent its return.

2. Varix of the internal saphena in its whole course. In every such case as the valves at the orifice of the vein are necessarily incompetent, ligation of the vein high up is indicated, preferably by double ligation with division. The dilated branches in the leg may be further treated according to the severity of the case, by the wearing of an elastic bandage for a time, by further ligation.
of the vessels, or by a skin-removal operation.
3. Varic of the external saphena. Here also
ligature of the vessel near its orifice
would seem to be the proper treatment;
if fairly localized such a case might
also be treated by excision.
4. General varicosis of the leg below the knee.
In this case ligature seems useless.
The only operation which appears practicable
is removal of a portion of skin.
5. General varicosis of the whole limb. In
these cases the elastic bandage would
seem to be the proper treatment. If any
operation were attempted, removal of
a portion of skin combined with ligature
of the saphena high up would seem
to hold out the greatest prospect of
success.
6. Varicose tumours at the saphena opening.
As Mr. Bennett has pointed out, double
ligature and division of the internal
saphena is indicated so that the
dilated orifice of that vein may retract
and contract.
These then, are the methods which seem most in accordance with the conclusions arrived at as to the causation of varic.

But as there may be various combinations of the above varieties, it will be well, before proceeding to operate in any individual case to examine it carefully and to satisfy oneself on the following points:

1. Is the condition due, wholly or in part, to the inadequacy of the valvular apparatus at the mouth of a large superficial vein or one of its main branches?

2. Is the condition so diffuse that neither ligature nor excision is applicable?

3. Is the condition so localised that excision seems to afford a fair chance of complete recovery?

4. Is the patient in a position to refrain, after operation, from occupations involving long standing, or does his daily employment necessitate this?

This would seem to be a point of considerable importance, for if the patient's occupation is one involving
In my standing it would seem wise either to advise some form of elastic support or to adopt some such operative method as will prevent the return of the varicosity.

Having satisfied oneself as to these points, one can then proceed to the operation which seems to hold out the greatest prospect of a permanent cure.

I think it is on the lines thus indicated that treatment must proceed, and that the foregoing operations, either separately or combined, are sufficient to successfully cope with varicose veins in the lower extremities.