England in 1895) to 3, and become less matters of chance, there will be some room for calm clinical study, for self raining, for learning something during studentship of that very important and terribly neglected better half of the training of a true doctor, the knowledge and observation of a human being; that which was expressed in the wise saying of Andrew Clark, "I first attended to the man and then to the malady."

Could Brodie, or Green, or Lawrence, or Graves, or Stokes look down upon the work of this Council, they would be amazed to witness how far we have departed from their ideals of the training of a medical man.

THE CROONIAN LECTURES: A CONTRIBUTION TO THE STUDY OF THE BLOOD AND THE CIRCULATION.

Delivered before the Royal College of Physicians of London.

By GEORGE OLIVER, M.D., F.R.C.P.

LECTURE I.—THE CIRCULATION.

MY observations on the circulation in man have been mainly directed to the determination of the radial calibre and blood pressure, with the view of ascertaining the causes—physiological and pathological—which produce variation or which may prevent variation in these important aspects of the pulse.

APPARATUS EMPLOYED.

The observations on the pulse were made by means of two instruments; one the arteriometer—so-called because it measures the calibre of the artery—and the other the pulse pressure gauge. The former instrument, however, not merely directly records the calibre, but indirectly indicates the blood pressure; for the calibre is, as a rule, determined by the pressure in the normal condition of the circulation. Hence the arteriometer has been largely relied on in these observations, especially too as the varying resistance of the tissues over the artery does not affect the readings obtained by it. The two facts—calibre and pressure—are, however, not always in accord in the pathological field; and for the purpose of discriminating between them the pressure gauge has been found useful. A hydrostatic method of measuring the volume of the limb has also been adopted. The following is the method which has been found the most satisfactory. The observations have as a rule been made on the arm. A large trial jar is placed in an overflow basin. After it has been very carefully adjusted to an absolutely horizontal position by a spirit level, it is filled exactly to the brim with tepid water (95° F.). The arm, on which an aniline line has been drawn around it above the elbow, is immersed until the line is touched all round by the surface of the water. The overflow is then measured before and after the experiment. In the experiments on animals made in conjunction with Professor Schäfer in the Physiological Laboratory of University College, the usual appliances of a well-appointed laboratory were employed.

THE ARTERIOMETER.

No results have been accepted unless confirmed by two or three separate applications of the instrument, and the corrections it has furnished have often been very considerable. The tactile estimation of others in regard to the lumen have been tested by it with similar results. The outcome of these observations, therefore, suggests that it is not always such an easy matter as is usually supposed accurately to distinguish between the beat of the pulse and calibre of the artery. Perhaps this defective discrimination is apt to arise mainly from the ictus so monopolising the tactile appreciation that the observer's estimate of the calibre is liable to be biased by it, and from the difficulty of duly appreciating more than one sensation through the sense of touch at the same time. The well-trained finger is not so apt to go astray in gauging the lumen when high tension exists as in estimating it when the minimum pressure is much reduced, for then it would seem as if the increased difference between the minimum and maximum pressures is apt to afford an exaggerated impression of the calibre.

PHYSIOLOGICAL VARIATIONS OF THE RADIAL PRESSURE AND CALIBRE.

1. *Posture*.—A change of posture in health is almost invariably accompanied by an immediate and decided alteration in the radial blood pressure and calibre. They both fall as the recumbent posture is assumed; taking the average of observations, the variation in the pressure is from 20 to 40 mm. Hg., and that of the calibre from 0.4 to 0.6 mm. As a rule when the health is good, and pre-

sumably when the vasomotor tone is satisfactory, these postural variations are so well adjusted to the changes of posture that they take place together, without any detectable interval between them, and without any oscillatory disturbance intervening; but even in apparent health slight transitional variations lasting but for a few seconds, and immediately following the change of posture are not uncommonly met with before the normal level for the posture assumed is attained. Such transitory intervening variations are probably accounted for by the hydrostatic moment not being compensated for by the dynamic moment, but in a few seconds the compensation is duly adjusted.¹ As life advances beyond the middle period the range of postural variation in the radial pressure and calibration becomes, as a rule, gradually lessened, and may even be abolished. The period when restricted variation may set in is, however, a pretty wide one, and may be said to extend from the 55th to the 75th, or even 80th year.

How are these normal postural variations produced? The effect of gravity on the circulation when the posture is changed would be exactly the reverse of that which obtains in health; for in the erect posture the blood would collect in the capacious venous system within the abdomen, and gravitate into the legs, and when the recumbent posture was assumed the blood would become more evenly distributed. Under such conditions the radial artery would enlarge in the recumbent and diminish in the erect posture—a result which actually does obtain when the effect of gravity is allowed to manifest itself from failure in the compensating mechanism.

Therefore, in normal man the hydrostatic influence of gravity in the erect postures must be compensated by the vasomotor mechanism, and especially by the splanchnic portion of it—a fact which has been so well established by Mr. Leonard Hill.² This observer found that in the monkey the compensation is more developed than in rabbits, cats, or dogs, and that it is still more developed in man. There is, however, evidence that gravity does still influence the blood pressure and calibration of the arteries; but the effect of this interference is comparatively insignificant.

For example, the subject being recumbent, a radial calibre of 1.6 mm. at the level of the arch of the aorta may become 1.7 mm. 10 inches below, and 1.4 mm. 10 inches above that level. But even this slight influence of gravity is eliminated from the postural measurements by placing the wrist always at the same distance—for example, 4 inches—below the level of the aortic arch.

In the recumbent posture gravity may be made available for supplying a large amount of additional blood derived from the limbs for circulation in the rest of the body, a fact which may be observed when, on putting both legs up and supporting them, a radial calibre in the recumbent posture may advance in two minutes from 1.7 mm. to 2.2 mm. Such a position of the limbs may prove useful in certain emergencies, as in syncope.

2. *Exercise*.—General exercise, and exercise confined to the forearm at first raises, and then after a variable interval diminishes, the radial blood pressure and calibre when taken in the sitting posture. When this reduction was apparent as the result of general exercise the pressure and the calibre rose when the subject assumed the recumbent posture. Local exercise increases the volume of a limb to a marked degree.

In a subject, aged 22, it was observed that screw-driving for fifteen minutes raised the volumetric measurement of the arm from 1.632 c.cm. to 1.800 c.cm., and for ten minutes more to 1.833 c.cm., and that after the expiration of two hours after the cessation of the exercise the volume of the arm still exceeded the initial measurement by 13 c.cm.

In the first stage of exercise the enlargement of the artery and the increase of the blood pressure are obviously the result of excitation of the heart's action—of the increased discharge of blood into the arteries—and of the active determination of blood towards the muscles; and perhaps, also, this result is increased by muscular pressure on the peripheral vessels (arterioles and veins). But how is the reduction brought about? It has been repeatedly observed that the diminution of the radial calibre is not in the first instance the result of exhaustion or fatigue, though it undoubtedly becomes still more pronounced when the fatigue stage of exercise sets in; and that it is primarily and intimately associated with muscular effort, and therefore is much longer in supervening

¹ The same fact was repeatedly observed by Mr. Leonard Hill when experimenting on the effects of change of posture on the blood pressure in animals (*Journal of Physiology*, 1895).

² *Loc. cit.*

when exercise is taken on the level than when climbing is attempted.

There are probably two prominent causes which induce the reduction of an artery like the radial. In the first place the muscles, for example, of the arm during exercise—especially local exercise—receive an enormously increased supply of blood, which is delivered to them through many branches, given off between the axillary artery and the portion of the radial under observation; the blood pressure and the calibre at this point must therefore necessarily fall in proportion as the supply to the muscles is increased. Then, again, in general exercise the most actively employed muscles, such as those of the legs, will probably receive a larger proportionate share of blood; and, furthermore, at a certain stage of the exercise this deviation of the blood downwards will be increased by loss of vasomotor tone, permitting gravitation to determine some accumulation of blood in the lower parts. Probably all these causes contribute to the radial reduction which occurs in the active postures at a certain stage of general exercise, as in walking and especially in climbing; but in all probability the predominant cause is the active derivation of blood into the capacious periphery of the circulation located in the muscles. Diminution of vasomotor tone in the second stage of exercise is probably the cause of the rise of the radial pressure and calibre observed in the passive posture (recumbency) when gravitation ceases to influence the circulation.

The rapid accession of blood is obviously the cause of the immediate enlargement. But though this may be accounted for by the turgescence of the vessels which accompanies muscular contraction, I think the persistence of the swelling for several hours after the cessation of all muscular action points to the supervention of some other event beyond the mere temporary distension of the vessels, such as the exudation of fluid from the blood into the substance of the muscle? This view is supported by the results of some experiments by Lazarus Barlow.³

3. *Digestion.*—During the first hour after a full meal, as a rule, the radial pressure and calibre fall very considerably in the sitting, and rise proportionately in the recumbent posture. The leading cause of this alteration on the radial pulse would seem to be the increased flow of blood to the digestive tract and the large vascular glands within the abdomen, which in the erect postures reduces the blood pressure in the upper half of the body mainly through the agency of gravity, but ceases to do so in recumbency, because in that posture gravity fails to operate.

Mr. Leonard Hill by his valuable experiments on animals has demonstrated that the splanchnic vasomotor mechanism occupies an all-important place in compensating for the simple hydrostatic effects of gravity on the circulation of the blood produced by changes of posture; and that where the perfection of this compensatory mechanism is impaired the influence of gravity on the systemic circulation becomes of vital importance, so that in the feet-down position the blood drains into the abdominal veins and recedes from the upper portions of the body.⁴ It would seem that during the digestive act a comparatively transient impairment of the splanchnic vasomotor mechanism—probably more pronounced in some individuals than in others—does take place; but in healthy subjects it is quickly followed by complete compensation—in fact, by over-compensation—for the primary fall in the arterial pressure is succeeded by a rapidly developed rise beyond the degree recorded before the meal, and this rise, which corresponds with the acme of fullness of the systemic arteries gradually subsides before the next meal is taken.

4. *Fatigue.*—The ordinary effects of change of posture in the healthy subject on the radial pressure and calibre which have been described—namely, an increase of both in the sitting and a decrease in the recumbent posture—may be reversed by fatigue. Repeated observation has shown that the essential fact in the transitory conditions of tiredness or fatigue is a diminution of the vasomotor compensation which at other times perfectly counteracts the hydrostatic effects of gravity on the distribution of the blood.

5. *Menstruation.*—Throughout the menstrual period the

calibre of the arteries, as exemplified by the radial, ceases to respond to change of posture. Later on it will be shown that this is a sign of arterial tension. Probably therefore during menstruation vaso-constriction invades the arteries, and extends to those of middle size like the radial. This transitory phase of arterial contraction resembles that which is quite common for limited periods in the gouty, and that which always accompanies attacks of migraine.

VARIATIONS OF ARTERIAL TENSION FROM THE PHYSIOLOGICAL ASPECT.

The fundamental fact in regard to the circulation in normal subjects is that it is a system of elastic tubing which is never at any one time and in all parts filled with the circulating fluid, so that there always exists in every part a pretty wide margin for the production of the extremes of variation of pressure consistent with health, which may be induced by alterations either in the volume of the fluid or in the size of the tubing. In the central parts of this system it is highly probable that the blood pressure varies within much narrower limits than it does in the peripheral arterial tubes, in which it may be considerably increased or diminished according to the ebb and flow of the activity of organs, and that consequently the volume of the blood and the size of the peripheral arteries is continually varying in different parts of the body. Inasmuch as the functional activity of any one part affects not merely its own blood supply, but influences that of every other part, the peripheral blood pressure must be an ever fluctuating quantity—within certain limits. The condition of the vasomotor mechanism largely determines the order which the fluctuations follow, and, inasmuch as the most delicate test of the integrity or otherwise of that mechanism is afforded by the effects produced on the radial calibre and pressure by change of posture, this test has been adopted throughout this inquiry.

PATHOLOGICAL VARIATIONS OF RADIAL MEASUREMENT.

When the radial calibre either varies repeatedly in the reverse order to that which obtains in health, or persistently ceases to vary on change of posture, some pathological condition may be inferred to exist; and these deviations from the normal formula of radial measurement, when persistent, groups together certain morbid conditions.

The Postural Variation is Reversed.—Mr. Leonard Hill has demonstrated that when paralysis of the splanchnic vaso-constrictors is brought about in animals, as by anaesthetics or by operative procedures, pressure applied to the abdomen by means of a bandage at once restores the blood pressure, so long as the heart is normal or is not too weak to effectually propel the increased supply of blood furnished by the compression of the abdominal veins.⁵ It has been repeatedly observed, that when the radial calibre is reduced in the sitting posture, the application of abdominal pressure, while the arteriometer remains *in situ*, will as quickly raise it to what it attains in recumbency as was the blood pressure restored by the same procedure in Mr. Hill's experiments. Furthermore, the same result is attained, as has been frequently proved, by making the subject in the recumbent posture execute a series of from six or more slow prolonged and deep inspirations after forced expiration, while the abdominal muscles are contracted as in the Italian method of singing—a form of respiratory gymnastics which apparently aspirates the blood to the heart, effectually compresses the abdominal veins, and induces a stronger stroke of the heart and an increased transference of blood from the venous to the arterial side of the circulation.⁶

The following is an example of this restoration of the normal balance of the blood supply to the arteries by this means:

	Radial Calibre.	
	Sitting.	Recumbent
Before forced inspiration	1.4 mm.	1.9 mm.
After six forced inspirations	1.9 mm.	1.4 mm.

These observations indicate that when the vasomotor mechanism is impaired, as is shown by the reduction of the radial pulse in the upright postures, the blood unduly collects in the splanchnic area; in fact, a portion of the blood is thus

³ *Journ. of Physiol.*, 1894.

⁴ *Loc. cit.*

⁵ *Loc. cit.*

⁶ This procedure as a mode of treatment was brought to my notice by Dr. Edward Blake, who has, he informs me, successfully applied it for some years past in the treatment of dilated and weak hearts.

abstracted from the arterial side of the circulation and is transferred to the venous side. This radial sign of a damaged state of the vasomotor mechanism is commonly met with in anæmia, in all the various forms of nervous exhaustion, in the febrile state, in convalescents, and in cardiac incompetency. It would seem that the underlying pathological condition is asthenia, and especially asthenia which springs from impoverishment of the blood or from denutrition of the nerve centres. It is pretty constantly present in neurasthenia and in closely allied ailments of the nervous system. It is therefore probable that in cases of this type a paretic condition of the vasomotor constrictors is a prominent pathological feature, which may, moreover, in a great measure account for many of the symptoms which such cases manifest.

In the erect posture the reduced supply of blood to the arteries which are distributed to the upper portions of the body, and the drain of blood into the lower parts and especially into the abdominal area, will undoubtedly favour the development of cerebral anæmia and the occurrence of various abdominal disturbances and ailments to which the sufferers of denutrition of the nerve centres are so liable. Influenza during the past seven years has developed a large crop of these cases.

The gravitation of blood into the splanchnic area in anæmia and neurasthenia will doubtless foster the prevalence of digestive and intestinal disorders. In cases of vasomotor inadequacy it is not at all an uncommon observation to find the liver slightly enlarged, and with a tender margin. Thirteen years ago Germain Sée⁷ recorded the proneness of neurasthenic subjects to dilatation of the stomach; and in more recent years the same clinical association has been pointed out by Dujardin-Beaumetz,⁸ Champagnac,⁹ and quite recently by A. S. Eccles.¹⁰ The last observer has moreover shown that "a large proportion of the gastro-intestinal cases successfully treated by the 'rest cure' have been associated with neurasthenia."¹¹

The augmented supply of arterial blood to the tissues—and especially to the impoverished nerve centres—which obtains when the recumbent posture is assumed, should prove remedial in all cases in which the maximum radial calibre is habitually present in the recumbent posture; and the results of observation have distinctly shown that this is the case. In exceptional cases of this type, absolute rest should be adopted for a time, but when exercise is feasible, the proper adjustment of it tends to accentuate the restorative value of recumbency which is enjoined between whiles. As the arteriometer has shown that in these cases of damaged compensation the sitting posture maintains the mal-distribution of blood which perpetuates many of the symptoms, it is obvious that that posture does not secure physiological rest at all; it should therefore be abolished for a time, and should be replaced by recumbency, in which the blood is fully and normally distributed.

THE CALIBRE IS UNIFORM.

In clinical observation, an unvarying radial calibre is frequently to be met with, and when persistent it always signifies some important pathological condition. It may come and go, or it may be persistent.

1. *Temporary uniformity* is often met with as a result of vasomotor contraction, and the consequent rise of arterial tension. Good examples are afforded by migraine and by passing gouty states. When the contraction is chiefly peripheral or terminal, the radial blood pressure rises; but when it involves the radial itself, the blood pressure within the artery generally falls, but rises in the central arteries. In chronic gout, the radial calibre may be large and uniform with raised blood pressure, or it may be small, and uniform with a normal or subnormal blood pressure. When the gouty state is relieved, and there is no arterio-sclerosis present, the uniformity of the calibration in both classes of cases gives place to variation, and the blood pressure in the first falls,

while in the second it may rise. Transitory attacks of high arterial tension of apparently peripheral origin (probably constrictive in nature) are of frequent occurrence in the elderly;¹² and it has been observed that throughout each attack the radial calibre becomes fixed, while in the intervals postural variation reappears. The subjects of such attacks, though they may themselves be free from the ordinary manifestations of gout, frequently belong to families in which a history of true gout exists. It has been observed that in transitory tension a rise in radial blood pressure of a little over the normal variation for posture (30 mm. of Hg.) will determine postural uniformity in the calibre; and that when this excess disappears, the arterial wall will once more respond to change of posture.

2. The predominant cause of *persistent uniformity* is structural change in the arterial wall. The blood pressure may or may not be increased. This invariability is exceedingly common in arterio-sclerosis, either alone or accompanying chronic interstitial nephritis, angina pectoris, or chronic gout, and in acquired syphilis.

In arterio-sclerosis it has been observed that even the presence of a very marked degree of anæmia, as may be met with in chronic Bright's disease, does not prevent the postural invariability of the calibre from manifesting itself—even though it is found that in such cases the blood pressure is higher in the recumbent than it is in the sitting posture.

The size of the lumen of the artery is largely determined by the blood pressure; but in all cases after a time it diminishes very considerably. Acquired syphilis differs from arterio-sclerosis, however, in the fact that the calibre shrinks to a far greater degree, especially after the lapse of several years from the primary infection, and especially, too, when the disease is producing its secondary and tertiary manifestations; a reduction to one-half of the measurement, which it may again acquire after treatment by mercury, has not infrequently been observed.

RADIAL MEASUREMENT IN EXPERIMENTAL PHYSIOLOGY.

Anæsthetics.—Ether increases while chloroform reduces the radial calibre. Nitrous oxide occupies an intermediate position, causing a slight rise which may be followed by a fall; the fall, however, fails to be detected when the gas is inhaled along with oxygen. Oxygen, like ether, enlarges the calibre. The A.C.E. mixture reduces it, but to a less degree than chloroform. Mr. Leonard Hill has shown experimentally that, while chloroform rapidly paralyses compensation and damages the heart, ether does not, in moderate amounts, impair the vasomotor mechanism, and only does so very gradually and to a limited degree when pushed in enormous amounts, and it, moreover, stimulates and maintains the heart's action.¹³ This difference in the physiological action of these anæsthetics suffices to account for the reduction of the radial artery by chloroform on the one hand, and for the augmentation of it by ether on the other.

The practical application of these observations will be obvious. The position of the abdomen in relation to the head must be of much greater importance in chloroform than in ether anæsthesia, for in the former the splanchnic drain will be much increased in the vertical posture, or even when the head and shoulders are raised somewhat above the abdomen, while in the latter, unless the ether has been administered in large quantity or for a prolonged period, there is no undue collection of blood in the abdominal area. Deep inspiration and abdominal compression reduce the veins when containing an excess of blood; hence the value of artificial respiration and of pressure over the abdomen when death is threatened by vasomotor paralysis during chloroform anæsthesia, and hence also the utility of that most favourable sign, the act of vomiting, which is a most efficient mode of abdominal compression.

Vasodilators.—Some few observations with the arteriometer have indicated that the nitrites and nitro-glycerine rapidly lower the radial blood pressure and calibre. The subjoined table of data shows that the action of $\frac{1}{100}$ th grain of nitro-

⁷ *Des Dyspepsies Gastro-intestinales*, 1883.

⁸ *Journ. de Médecine de Paris*, 1889.

⁹ *Gazzetta degli Ospitali*, Naples, 1891.

¹⁰ The Relationship between Digestion and Neurasthenia (Dilatation of the Stomach and Constipation), by A. S. Eccles, M.B., *Proc. Roy. Med. Chir. Soc.*, London, 1894.

¹¹ *The Practice of Massage*, p. 150.

¹² Professor Clifford Allbutt refers to cases of this type under the denomination of "senile plethora," *BRITISH MEDICAL JOURNAL*, vol. i 1895, p. 535.

¹³ *Loc. cit.*

glycerine is rapid and decisive, and lasts but a short time—in this case not beyond an hour. This result may be explained by the lessening of the blood pressure within the artery consequent on dilatation of the peripheral vessels. This fact has been proved by perfusion through excised organs, and was ably illustrated by Professor Leech in the Croonian Lectures in 1893. Inasmuch as the radial artery is but a conduit between the heart and the peripheral vessels, the blood pressure within it necessarily falls as these dilate, and the calibre of it is thus correspondingly reduced. From the observations made it would, however, seem that the vasodilatory action extends to the splanchnic area, so that in the erect posture a large amount of blood gathers in the capacious veins within the abdomen, and largely contributes to the reduction of the systemic arteries. This position is supported by two facts: the enormous rise of the radial calibre when the subject assumes the recumbent posture, and the production of a similar rise in the sitting posture by the application of pressure to the abdomen.

The Effect of 1-100 gr. Nitro-glycerine on the Radial Diameter. Subject, a Woman, aged 27, suffering from Raynaud's Disease.

—	Sitting.	Recumbent.
Before the dose	7.0 mm.	0.8 mm.
Fifteen minutes after	1.0 "	1.3 "
Forty minutes after	0.5 "	1.8 "
Abdominal pressure	1.5 "	—
Fifty-five minutes after... ..	0.5 "	1.4 "
Sixty minutes after	1.0 "	0.8 "

In the Bradshaw Lecture, delivered before this College in November last, Dr. Bradbury ably supported the claim of the solid organic nitrates (erythrol tetranitrate and mannitol hexanitrate¹⁴) as vasodilators of more enduring action than those in present use, and therefore more likely to prove useful than they in the necessarily somewhat continued treatment of several morbid conditions associated with increased peripheral resistance. Dr. Bradbury showed as the result of perfusion experiments on excised organs and of sphygmographic observation, that the vasodilator action of these substances was, though less energetic and slower to manifest itself, very much more prolonged than that of the nitrites and nitro-glycerine.

The Effects of Erythrol Tetranitrate (1 gr.) on the Radial Diameter. Subject as in previous Table.

—	Sitting.	Recumbent.
Before the dose	1.2 mm.	0.7 mm.
Fifteen minutes after	1.7 "	1.2 "
Sixty minutes after	1.2 "	1.3 "
Two hundred and ten minutes after	0.7 "	1.2 "
Abdominal pressure	1.2 "	—

With the view of comparing the action of the solid organic nitrates on the arteries by the side of that of nitro-glycerine, some observations were made with erythrol tetranitrate on the same subject,¹⁵ which provided the data recorded above, and the results obtained, though obtained by totally different methods, entirely support Dr. Bradbury's conclusions. It has been shown that the vasodilator effect of nitro-glycerine is already pronounced within fifteen minutes, but it requires the lapse of thirty minutes before it becomes apparent after swallowing 1 grain of erythrol tetranitrate (see preceding table). Moreover, the vasodilator action of erythrol nitrate is only

established at the expiration of one hour, when, indeed, that of nitro-glycerine has completely passed away; and, furthermore, after the lapse of three hours and a half, it is still well maintained, with some probability of continuing some hours longer, though no later observation was made. The relative vasodilator activity of nitro-glycerine and erythrol tetranitrate is expressed in the degree of reversals of the postural measurements.

The reduction of the blood pressure, especially of the minimum pressure, produced by the vasodilator affords to the finger an illusory impression of enlargement of the artery.

Dr. Leech, in his second Croonian Lecture (1893), in referring to this point, says: "How are we to account for the markedly greater distinctness of the pulse which is so often noted after nitrites, and for the increased height of the up-stroke—the so-called percussion wave—of the tracing which is almost invariably seen after small doses of nitrites?" He refers this change in the pulse to two causes, namely: (1) dilatation of the arterioles, which induce a more complete collapse of the artery, and an increased difference between systole and diastole of it both to the finger and in the tracing; and (2) relaxation of the artery itself. "The difference between the calibre of the artery in systole and diastole being augmented it is felt to be more distinct and more full." This explanation accords with the results of my observations; only I am inclined to regard arteriolar dilatation as sufficient to account for all the facts of the case.

The vasodilators afford the most satisfactory experimental evidence of the manner in which the postural formula is reversed in various transitory, physiological, and persistent pathological conditions, all characterised by a reduction of vasomotor tone which impairs compensation for gravity.

A CASE OF LEONTIASIS OSSEA, MEGALO- CEPHALIE, OR HYPEROSTOSIS CRANII.

By W. HALE WHITE, M.D.,
Physician to Guy's Hospital.

FROM time to time several curious deformities of the head have been recorded under the names at the title of this communication. Virchow¹ used the term leontiasis ossea, but he does not describe a case like the one I am about to relate. In many of his patients the face or the orbits were affected, the development of bone was often local, and commonly mental symptoms or headache were present. Baumgarten,² in an essay I have not been able to see, is quoted as stating that very likely those in which the face is affected were examples of acromegaly. Starr³ describes a case under the title of megaloccephalie. In his patient the head, face, and neck slowly increased in size, the hard and soft tissues were equally affected, and the whole of the bony calvarium was uniformly hypertrophied. The patient, who was always stooping and walked slowly, suffered from great mental irritability, general nervousness, and numbness of the hands. Putnam⁴ has reported four cases under the title of hyperostosis cranii. His first, a woman, suffered for many years from seropurulent discharge from the ears, and from headache, loss of teeth, deafness, discoloration of skin, double facial paralysis, cataract, and feeble gait. For at least ten years immediately before death, which took place from chronic suppurative inflammation of the pericranium, the head grew broad and the eyes prominent. There was much thickening of the walls of the skull, obliteration of sutures, and narrowing of cavities. The second patient had two large exostoses in the neighbourhood of the vertex, and diffuse hyperostosis of the skull. He suffered from headache, convulsions, optic neuritis, and deafness. In the third case, that of a man, the surface of the head was uneven from small exostoses, and the thickening seemed to be universal. The principal symptoms were pain, nausea, vomiting, and impairment of hear-

¹⁴ See BRITISH MEDICAL JOURNAL, 1895, vol. ii, p. 1213.

¹⁵ I am indebted to Dr. Fletcher Little for the opportunity of making these observations on a case of Raynaud's disease under his care at the Temperance Hospital.

¹ Die Krankhaften Geschwülste, Bd. ii.

² Leontiasis Ossea. Paris, 1892.

³ American Journal of Medical Sciences, December, 1894, p. 676.

⁴ Journal of Nervous and Mental Disease, August, 1895, p. 500.