An address on the clinical measurement of diastolic blood pressure and cardiac strength : opening address of the Winter Session at the North-East London Post-Graduate College, October 27th, 1910 / by Sir Lauder Brunton.

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An Address

ON THE

CLINICAL MEASUREMENT OF DIASTOLIC BLOOD PRESSURE AND CARDIAC STRENGTH.

OPENING ADDRESS OF THE WINTER SESSION AT THE NORTH-EAST LONDON POST-GRADUATE COLLEGE, OCTOBER 27TH, 1910.*

BY

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MR. PRESIDENT AND GENTLEMEN,—I thank you for the honour you have done me in asking me to address you to-night, and also for the choice of subject which you have given me. I am informed that you would like me to speak on the clinical aspects of blood pressure, a subject in which I am particularly interested. It is said, and I believe with truth, that when a man grows old he reverts to the subjects of which he was fond in his youth, and on the 25th of next month it will be exactly forty-five years since I made my first experiment on blood pressure under the guidance of my friend, the late Professor Arthur Gamgee. At that time instruments for recording blood pressure were very few in number altogether, and there was not such a thing in the three kingdoms. The apparatus that I used was not a recording one, and was of the very simplest kind. It was a crude imitation of Marey's haemodynamometer, and consisted of a pomatum bottle, half filled with mercury, and with three holes bored through the cork. In the first of those was fixed an upright tube, about 18 in. long, in which the mercury oscillated freely, and gave the maximum and minimum pressures. The second was similar in size, but had a constriction at one part, so that the mercury oscillated very little in it, and thus the mean pressure was indicated. The third tube was bent, and communicated with the

* The latter part of this address was also given at the meeting of the Reading Pathological Society on October 20th, 1910.

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artery. The instrument was very crude, but was nevertheless very serviceable, and by its means I was able to formulate, I believe for the first time completely, the mode of action of digitalis on the circulation. I concluded that it had a threefold action. First, that it slowed the heart through the vagus nerve; secondly, that it increased the power of the heart; and, thirdly, that it contracted the arterioles, and thus raised the blood pressure. The slowing of the heart through the vagus had been noted by several observers before. Traube had noticed a rise in pressure, but he had attributed this entirely to a more powerful action of the heart, and in his earlier work[1] overlooked the effect of the drug upon the vessels. Von Bezold[2] had also noticed a rise in blood pressure, and Lenz[3] a slowing in the flow of blood, but neither appears to have attributed these phenomena to contraction of the vessels. Blake,[4] twenty years previously, had insisted upon the effect of digitalis upon the vessels, but he disregarded its action on the heart; and thus it was that, I think, the complete idea of the action of the drug, such as is now held, was first formulated in my thesis presented to the University of Edinburgh in 1866. It is true that Traube[5] in 1865 mentioned that he had found digitalis to have an action on the vasomotor nerves (*Digitalis wie ich nachträglich gefunden habe auch auf das vasomotor Nervensystem erregend wirkt*). To him therefore belongs the priority of the discovery of the action of digitalis on the arterioles; and, taken along with his previous work, this passage shows that he had obtained a complete knowledge of the action of the drug, yet he did not formulate it in its entirety until 1871.[6] In 1869 I went to work with Ludwig at Leipzig, and after my return to London I published in the British Medical Journal of June 3rd, 1871, a fairly complete account of the apparatus and methods used for ascertaining blood pressure and all the causes which influence its variations. These papers were republished in a small book entitled *Experimental Investigation of the Action of Medicines*, but only 500 copies were printed, and the book was out of print in about six weeks after it was issued.†

It is very likely that many of you, perhaps most of you, are completely acquainted with the physiology of blood pressure, but there may be some here who are not, and for their sakes perhaps you will allow me to follow the plan which I see is adopted in many magazines. Where a story is continued through several numbers, some of these magazines place at the beginning of each new instalment a short summary of what had gone before. It does not greatly inconvenience those who have read the previous instalments, and it is very useful to those who have not.

I will therefore, before proceeding to the subject proper of my paper, say a few words about blood pressure in general, and the headings into which I shall roughly

† Reprinted in *Collected Papers on Circulation and Respiration*. First Series. London: Macmillan and Co., Ltd.; New York: The Macmillan Company. 1907.

divide the paper are: (1) Blood pressure—what is it? (2) How is it measured in the laboratory? I shall then discuss (3) how is it measured clinically? (4) what do its variations indicate? and (5) how do they help us in treatment?

I.—*Blood Pressure.*

Blood pressure, or arterial tension, is the pressure at which the blood is kept in the arterial system, and which drives it through the capillaries in the healthy body, or makes the blood spout out in a stream from a severed artery. If we suppose the arteries to be empty and the heart begins to beat, it will gradually fill the arterial system. Very little blood will flow at first through the capillaries, but as the arterial system becomes fuller and fuller and its walls more distended, the point will at length be reached when as much blood will flow out in the interval between the beats of the heart as is driven in by each pulsation. The pressure or tension which then exists in the arteries is the blood pressure. It is a most important factor in the circulation, because by it the flow of blood is maintained during the time the heart is resting, and when we remember that the heart rests—that is, is in a state of diastole—thirteen hours out of the twenty-four on an average, we can readily understand the important part which the blood pressure plays. It drives the blood through the capillaries and thus supplies the tissues with nourishment and removes waste from them.

II.—*Measurement of Blood Pressure in the Laboratory.*

The first estimations of this pressure were, I think, made by watching the height to which the blood would spout from a cut artery, but an improvement upon this method was made by Hales, who connected the artery with a glass tube and measured the height to which the blood would ascend. Poiseuille improved upon the method of Hales by using a bent tube partly filled with mercury, and this tube is constantly used at present in some clinical instruments. Ludwig made an immense advance by putting on the mercurial column a long rod furnished with a writing point, by which the movements of the mercury up and down were recorded upon a revolving cylinder. To this recording instrument he gave the name of "kymographion," or more shortly kymograph. The disadvantage of the mercurial column is that when once it is set in movement it oscillates on account of its own inertia, and these oscillations may either greatly magnify or greatly diminish the alterations in the real blood pressure. In order to get rid of this fallacy several instruments have been invented having little inertia and giving a truer record of the movements in blood pressure. The most important of these are probably Fick's and Hürthli's.

The chief variations which blood pressure undergoes are, first, its amount, and secondly, its oscillation, and alterations in both these factors are instructive. In the British Medical Journal for 1871, June 3rd, vol. i,

page 583, I gave a tolerably complete table of the causes of alterations both in blood pressure and pulse-rate, and discussed them much more fully than it is necessary to do here.

III.—*Clinical Measurement of Blood Pressure.*

In a paper in the BRITISH MEDICAL JOURNAL, July 20th, 1909, and in other places, I have described most of the instruments used for measuring blood pressure clinically. With these instruments it is comparatively easy to measure the systolic pressure. With the smaller instruments in which the radial artery is obliterated by the pressure of an elastic bulb I find that the personal equation of the observer counts for a good deal, and that two men taking the same pulse may give values varying by no less than 10, 15, or even 20 mm. of mercury. This, of course, depends partly upon the training of the observers, and with practice the differences will become much less, and truer values will be obtained. But with the broad armlet, compressing the arm until the pulse is obliterated at the wrist, I find that the personal equation counts for very little, and that with two observers, one of whom has had considerable practice, and another who is trying the method for the first time, the difference in the result is rarely more than 5 mm. of mercury. It is thus very easy to ascertain precisely the systolic pressure in the vessels, but it is very different when one comes to take the diastolic pressure, more especially as authorities are not quite agreed as to what is the best method of doing this. According to some, the diastolic pressure is to be found by noting the maximum oscillation of the mercurial column, or of the indicator of the aneroid, by which the pressure is being measured. The chief difficulty in the way of this is, that the oscillations will frequently remain of nearly the same extent for 20 or 30 mm., or even more. It is exceedingly difficult to follow the oscillations accurately by the eye, and although they can be graphically recorded on such instruments as Erlanger's or Gibson's sphygmomanometers, yet these are cumbrous, and although they may be employed in hospitals or consulting rooms, they are not adapted for ordinary clinical work. The point of maximum oscillation can be observed on an ordinary von Basch's instrument, and I think even more easily on Oliver's portable sphygmomanometer. Von Recklinghausen's apparatus is much used on the Continent, but, so far as I can see, the advantage it possesses is that of giving larger oscillations than von Basch's, and I do not think it is quite as good as Pachon's oscillometer, which I have brought to show to you in case any of you may not have seen it before. The advantage of this instrument is that the sensibility of the aneroid indicating the oscillations is always the same whatever be the pressure at which it is working. But with all these instruments there is still the difficulty to which I have already alluded, namely, that the oscillations may contiuue nearly alike in amplitude over a considerable variation in pressure.

Variations in Pressure.

Even with a recording instrument such as Erlanger's the oscillations continue nearly alike in size through as much as 25 mm. difference in pressure, and in a tracing of his which Janeway[7] reproduces it is not the maximum oscillation but the point where the oscillations abruptly grow smaller which is taken to indicate the diastolic pressure.

Strassburger[8] takes the diastolic pressure by keeping the finger on the wrist while the pressure is being increased, and noting the point at which the radial pulse begins to feel smaller. Here, again, the estimation of the point is not easy. I think perhaps the readiest way is to place a stethoscope or phonendoscope on the brachial artery just above the elbow, and gradually to increase the pressure in the armlet. At a certain point the pulse will begin to be heard, loud and hammering, and the point where the sound increases is generally sharply marked. The loud hammering continues for a while and again ceases. The first commencement of the hammering noise may be taken as indicating the diastolic pressure, and the upper limit as indicating the systolic. On releasing the valve and allowing the pressure to diminish the sound again reappears at the upper level, continues for a while, and again disappears at the lower level. The advantage of this method is that it is easily applied, requires no special apparatus, and gives indications which are more easily appreciated than those of other methods

A considerable improvement in this method has lately been made by Oliver, who fixes a kind of small phonendoscope over the artery by means of a band, so that the operator's hands are left free.

If we take the point of lower pressure at which the sound of the pulse appears loudly on raising the pressure and again disappears completely, or at least becomes much feebler, as indicating the diastolic pressure, we get a pressure as definitely marked as the systolic is by the disappearance of the pulse when the pressure in the armlet is sufficient It is possible that the true diastolic pressure may be indicated by the loudest intensity of the sound ; but the same objection applies to the estimation of loudness of sound as to magnitude of oscillation—namely, that they seem much alike over considerable differences of pressure, and the personal equation enters too much into the estimation to render the observations of any value.

Further experiments, either on a schema or on anaesthetized animals, will show definitely whether the sudden increase in sound may be taken as the diastolic pressure, or, at any rate, what relation it bears to the diastolic pressure.

For convenience sake, in describing the relations between the diastolic and systolic tensions, we may use as symbols Ts for systolic tension and T*d* for diastolic tension or pressure As the term "pulse tension" is commonly used to signify the pressure within the arteries generally, some other word must be found to indicate the

difference between systolic and diastolic tension. This difference, which is indicated in experiments by the oscillations of the mercurial column connected with an artery, has therefore received the name of "pulse pressure." It is obtained by deducting the diastolic from the systolic tension, and it may be indicated as P*p*. Then T*s* − T*d* = P*p*.

By adding together the systolic and diastolic pressures and dividing their sum by 2 the mean pressure or tension is obtained—$\left(\frac{Ts + Td}{2} = Tm\right)$.

Diastolic pressure has as yet received comparatively little attention, because of the difficulty of ascertaining it, yet it is a factor of great importance, because by its amount, and by the difference between it and the systolic pressure we obtain valuable data in regard to the strength of the heart and the condition of the arterioles.

The relation of pulse pressure to systolic tension has been worked out by various authors. According to Strassburger,[9] the relationship is very constant, and is nearly 1 to 4, or, more precisely, as 100 to 25 4. Janeway's[10] estimation is very nearly the same. He considers the systolic pressure in young males as varying from 100 to 130, and puts the diastolic pressure

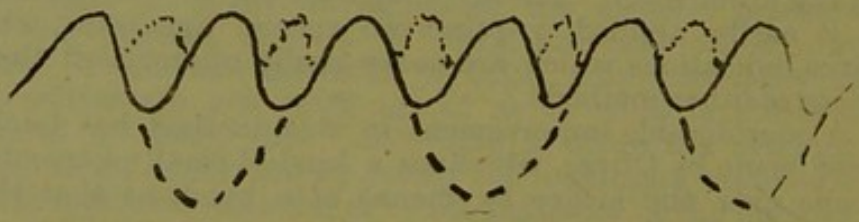

Fig. 1.—Diagram to show the effect of pulse-rate on oscillation of tension or pulse pressure.

from 25 to 30 mm. below the systolic. We may, I think, take roughly the relationship of the diastolic to the systolic as 3 to 4, and the pulse pressure to the systolic tension as 1 to 4. But it is quite evident that the pulse pressure or oscillation will depend very much upon the pulse-rate. If the pulse is slow more time is afforded for the blood to run through the arterial system into the venous system during diastole, and so the arterial tension will sink more than usual in the intervals between each pulse. If the pulse, on the contrary, is quicker than usual, there is less time for the escape of blood, and so the oscillation will be less. This may, perhaps, be made more clear by a diagram. The black line indicates such a tracing as one might obtain from a mercurial manometer connected with a vessel when the heart is beating at a moderate rate. If we lessen the beats to one half, as by stimulating the vagus, the oscillations become much greater, as in the line of strokes, whereas, if we increase the pulse-rate, as one can do by dividing the vagus, the oscillations will become much less, as in the finely dotted line. In this diagram I have supposed the heart to remain of exactly the same strength

and I have not taken into account some other factors, such as size of the blood wave, which might complicate the result. When we consider only the pulse rate, we see that with a rapid rate the pulse oscillation will diminish, and with a slow rate it will increase. Another factor which influences the amount of oscillation is the power of the heart. Supposing that the pulse rate should remain the same, if the heart be feeble it will take longer to drive the blood it contains into the arteries. It will not raise the tension so rapidly, and the time between the end of each systole and the beginning of the next will be shorter. The oscillations will, therefore, be less. If the heart be stronger it would drive the blood in more equally, and the interval between the end of one systole and the beginning of the next will be longer, and thus the oscillations will be increased. Another and perhaps a still more important factor is the condition of the vessels. When these are contracted blood flows slowly out of the arterial system and the arterial tension sinks slowly during diastole. When the vessels are dilated the contrary is the

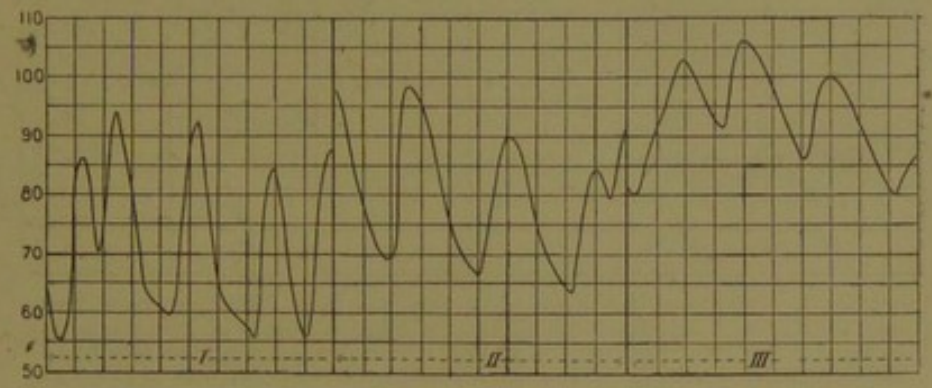

Fig. 2.

case. I think I may perhaps make my meaning clearer by using as an example some curves of blood pressure which A. B. Meyer and I took in 1867 in Du Bois Reymond's laboratory in Berlin (Fig. 2). The first section of the diagram shows the normal pressure, the second, the pressure after digitalis had begun to exert its action, and the third when the action of digitalis was well marked. The general effect of the drug, as you will notice, is to slow the pulse and raise the tension. The drug has increased the actual force of each beat of the heart, as in the third tracing the systolic tension rises to 100 or 105 as compared with 85 to 93. In the second the oscillation is very considerably diminished. It is diminished, too, in spite of its effect upon the pulse, and in the third tracing it is only about 35 to 60. Thus I may say that diminished oscillation with raised tension such as you see in the diagram indicates the peripheral resistance to the flow of blood. The heart may be actually more powerful than in the normal condition, but it is less powerful relatively to the resistance it has to overcome. If the power of the heart were increased

proportionately to the resistance in the vessels the oscillation would be equally great, and if it were increased more than proportionately to the resistance the oscillation would become greater than the normal. If thus we find in a case that the difference between the systolic and diastolic tension is diminished without any further rise, or even with a fall in tension, it is an indication that the heart is probably beginning to fail, while on the other hand, as Strassburger has shown,[11] that if in a case of gouty kidney with raised tension and cardiac hypertrophy the tension itself is increased above the normal it shows that the power of the cardiac beat has not simply increased, but has increased even in relation to the raised tension.

The accompanying tracing (Fig. 3), which was kindly made by Dr. Tunnicliffe some years ago, would appear to show this. The first division shows the commencing action of digitalis; the second when the action is well marked; the third the toxic action where the vagus action is paralysed, and the fourth when the heart is failing. In the

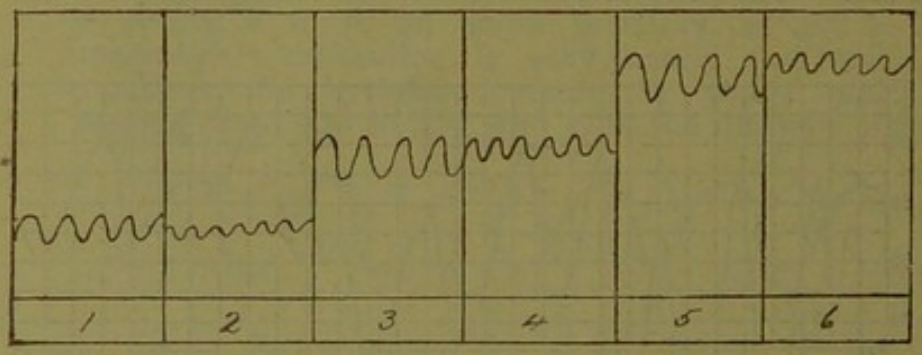

Fig. 4.—Diagram to represent the relation between pressure oscillation and cardiac strength. In *1* the tension is low (as indicated by the slight elevation of the mean pressure above the base line), but the heart is strong, as shown by the amplitude of oscillation; *2*, low tension, heart feeble; *3*, medium tension, heart strong; *4*, medium tension, feeble heart; *5*, high tension, strong heart; *6*, high tension, feeble heart.

second division the pulse is considerably slowed, and possibly this may be the cause of the greater oscillation and not greater comparative strength of the heart.

With a low tension great oscillation shows dilated vessels, with a strong proportion to the arterial resistance, but if with a low pressure we find only a slight pulse pressure it indicates that the heart itself is feeble, and the vessels are not improbably dilated, although, of course, a feeble heart, even with a normal condition of the vessels, would give those signs. For the sake of convenience I have tried to tabulate those different conditions so as to allow of more easy diagnosis. (Fig. 4.).

Supposing that by the aid of our instruments we have made out the condition of the heart and vessels, the question next arises, What has given rise to the too strong or too feeble action of the heart and the contraction or relaxation of the vessels? To attempt to discuss this question would take hours or days or perhaps even weeks, for it involves the whole physiology and pathology of

digestion, absorption, metabolism, and excretion, and as Dr. Jamieson Hurry has shown in his admirable paper on vicious circles cardiac mischief deranges the digestion and excretion and this again reacts upon the heart.

Blood Pressure as a Guide to Treatment.

But some of these questions we may perhaps consider with advantage to-night. Beginning with low pressure I find the two conditions that generally produce it are over-smoking and commencing phthisis. Nicotine has got the most extraordinary power of contracting the vessels and

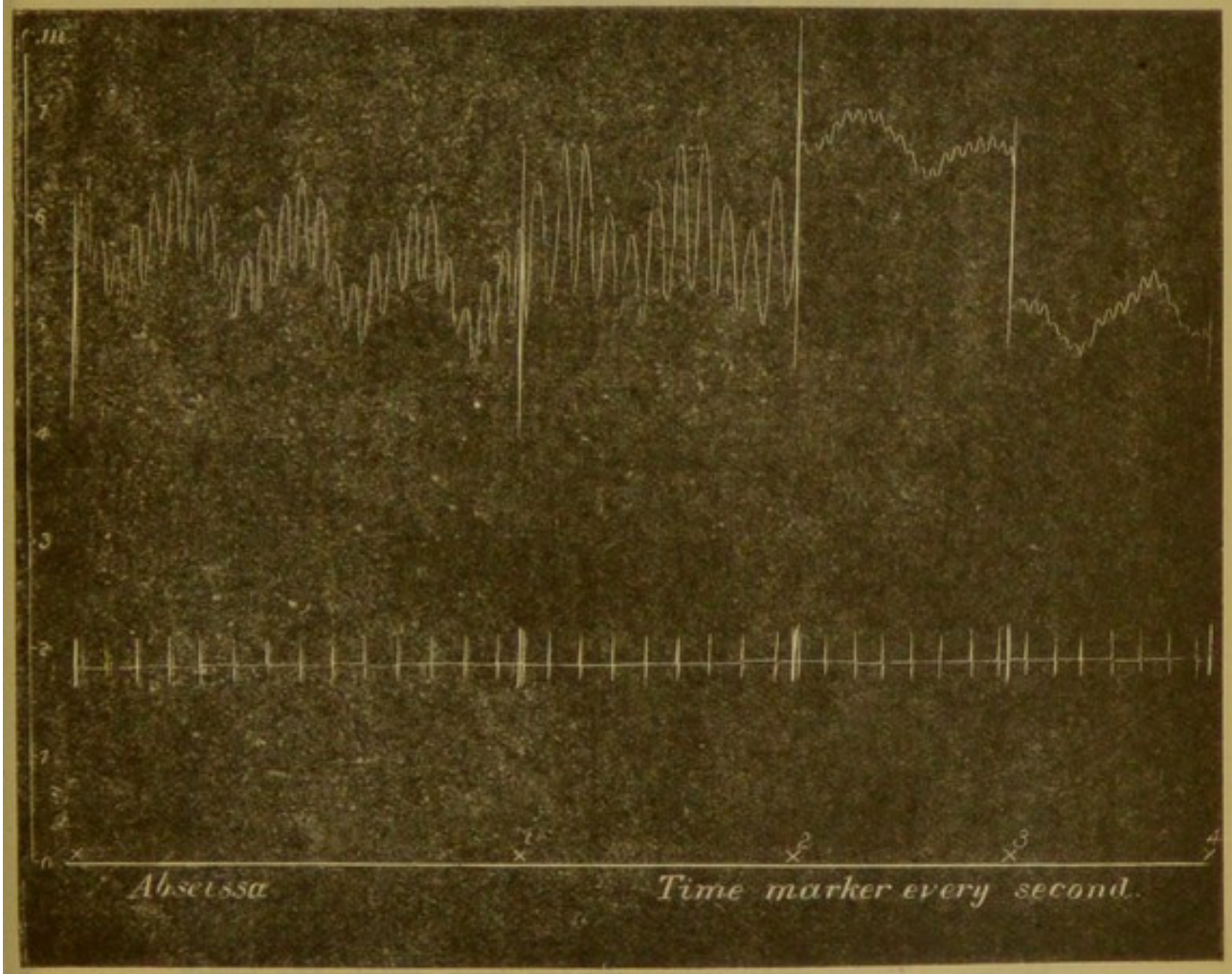

Fig 3.

raising the blood pressure. One day while A. B. Meyer and I were working at the action of digitalis in 1867, Professor Rosenthal, who superintended the laboratory in Professor Du Bois Reymond's absence, demonstrated to us the action of nicotine when injected into the veins. The mercurial column immediately shot up with such violence that it drove the float right out of the tube. I never saw anything like it before, and have only once seen a similar occurrence since, in an experiment which Schäfer and Oliver were making on adrenalin. A single pipe appears to raise the tension for the time being, but it

seems as if tobacco, and probably also opium, cause the organism to produce antibodies, which in the intervals between taking the drug, exercise an opposed action. Certain it is that in a very large number of cases I have been able to tell the patient, a good deal to his astonishment, that he smoked too much, without having asked him beforehand any question in regard to smoking. I have met with a few cases where I find a low blood pressure without being able to explain it, except as a result of nerve exhaustion. Where the patient has reduced his tension much by over-smoking, it is generally necessary for him to give up tobacco entirely for a while, as even a small quantity, I think, keeps up the condition. If the low pressure is not due to tobacco the lungs ought to be carefully examined, and sometimes, when the results of auscultation are quite negative, the presence of tubercle may be indicated by the tuberculin reaction. In such cases sanatorium treatment should be adopted.

But it is in cases of high tension that I think the sphygmomanometer is most useful, because by early detection of a rise in pressure, and by the adoption of proper regimen and medicines, the tension may be kept at a lower standard, and dangers which would otherwise accrue to the heart or vessels and to the brain may be avoided. In such cases, as the treatment requires to be carried on, not only for months but for years, it is advisable to interfere as little as possible with the patient's ordinary habits. The only rules that I make in regard to diet is that the patient should take very little, if any, red meat or strong soup. He should eat slowly and masticate thoroughly. He should take neither strong tea, strong coffee, strong wines, nor strong spirits. In regard to exercise, what I insist upon is that rest should be taken for at least twenty minutes after meals, and then exercise should be taken very slowly. Sudden strain of every kind should be avoided, but moderate exercise without strain is rather beneficial. Even in patients suffering from angina pectoris, gentle exercise is useful, provided the patient will begin very slowly, and will take care neither to go too fast nor too far. In regard to treatment we must see where the vicious circle may best be broken. It is quite extraordinary how much the heart can do even if its aortic valves are very deficient, provided the myocardium receives good blood and well aërated. But when the blood becomes impaired in quality or by deficient aëration, then symptoms of distress come on. I have had a patient at hospital who was accustomed to carry hods of bricks up ladders for about eight hours daily. He showed no symptoms of distress, and was quite unaware there was anything the matter with him at all till he caught cold, and then interference with the aëration of the blood caused the strong ventricle to yield, the mitral valves to become relatively incompetent, and all the sequelae of venous engorgement to come on. The lungs become congested, increasing

the difficulty of breathing; the liver becomes enlarged, the portal circulation sluggish, digestion and absorption are interfered with, the kidneys become congested, excretion impaired, albuminuria and oedema of the limbs come on, and the physical distress and inability to lie down break the sleep and exhaust the patient. Here, of course, the treatment is to keep the patient in bed with perfect rest, to allow him to do nothing that any one else can do for him, to improve his blood by giving him easily digested food and stomachic tonics, to accelerate excretion by mercurials and salines, and to help the return of the venous blood by massage. Elimination of waste is most important, and mercury in the form of blue pill or calomel should be freely used, and diuretics of the purin class, like diuretin, are useful. Here, too, we find the use of digitalis. The tracings I show you indicate that digitalis contracts the vessels and raises the tension. A theoretical objection would, therefore, be—Why give digitalis in a case where the heart is already labouring, where the patient is blue, and where the circulation is deficient? But a consideration of these tracings will show that, although digitalis contracts the vessels and increases the power of the heart, it actually lessens the work the heart has to do. The plan recommended by Strassburger and improved by Josué[12] for reckoning the actual work of the heart is to take the mean pressure as ascertained by adding the systolic and diastolic pressure together and dividing the sum by two, multiplying these by the pulse-pressure and by the pulse-rate. I am not certain that either the formula or the calculation is quite correct, but as far as I can work it out, if I take the tracings which I have shown you, the normal is equal to 1,406 mm. of mercury in a minute, after the digitalis begins to work it is only 1,229, and when the action is fully established it is only 818, so that in spite of the heart having greater resistance to overcome, the amount of work it does in a given time has actually diminished, and so digitalis gives it rest. At the same time the raised tension increases the nutrition of the tissues, and accelerates elimination by acting as a diuretic. The way in which the action of the digitalis is aided by the association of blue pill is still unknown, but as a matter of practical experience there can be little doubt of the efficacy of the combination. Digitalis thus gives rest to the heart, but rest to the heart cannot well be obtained without rest to the body, and so absolute quiet is necessary. It is also a great help to the heart if some of its work can be done for it. Massage, therefore, I look upon as a most important adjuvant to rest in cardiac disease. It is quite evident that another adjuvant where the vessels are too much contracted is vascular dilatation, and in many cases where you wish to restore the healthy circulation of the vessels it is wise to dilate the vessels as well as stimulate the heart. Amongst drugs the best for this purpose are, I think, the iodides and nitrites. In some cases of cardiac asthma nitrites seem to

be little or no use, while iodides give great relief at once. The trouble is that iodides frequently derange the digestion and cannot be continued. Sometimes one can get over this difficulty by using the organic compounds of iodide, sajodin, iodipine, iodiglidine. I have just heard of a new drug—beta-sulphopyrin—which prevents iodism, but I have not yet tried it. Where we wish a rapidly-lowered pressure I think the nitrites such as the nitrite of soda, nitroglycerine, nitroerythrol and spirit of nitrous ether are indicated. Of late years a method of treating cardiac disease has come into practice. By some it is much lauded, but by others it is much slighted. This is the so called Nauheim treatment, first introduced by the brothers Schott, and consisting in baths, massage and resistance exercises. It is now twenty years since I first examined into this treatment. An old friend of mine who was an army surgeon in India came home with very bad mitral regurgitation. He took a house in Norwood and came up to me once or twice a week for advice. I did the best I could for him by means of drugs, but he did not improve in spite of all my endeavours, and at the end of the summer I told him he must go across to Nauheim. He accordingly went. I followed him to see the method of treatment and to see how he was getting on. He came back very greatly improved, and before the winter set in he was able to return to India to serve out three years and retire with a pension from that time on. This was a test case, because I had done my best to cure my friend, but the Nauheim treatment succeeded where drugs had failed. In August last, my heart having become dilated in consequence of nervous strain, I went to Nauheim on my own account, and was under the care of Professor Schott. The improvement I made was very great, the dilatation became much less, the shortness of breath greatly diminished, and the general strength correspondingly increased. I tried to analyse the conditions that had brought about this satisfactory result, and I came to the conclusion that baths, massage, and resistance exercises all had a great deal to do with it, but their effect was greatly increased by the rest, mental and bodily, enjoined during the treatment. It may interest you to know the treatment which I followed. Breakfast at 8 o'clock, bath at 9 20. Kirsch's Hotel, where I was staying, was about three minutes away from the baths, so that I slowly walked there. After staying in the bath a few minutes the attendant rubbed me down with hot sheets. I then dressed and returned to the hotel. I then undressed again, went to bed, and stayed there for an hour, going to sleep if possible, but at any rate lying quiet, and if I read at all it was contrary to orders. It was hardly worth while to dress again, so as a rule I simply lay quiet for an hour or more, and then the masseur came, who after massage put me through a number of resistance exercises. It was then time for lunch, so that the whole forenoon had been taken up with the treatment. After lunch I read a

little, wrote a letter or two, took a short stroll in the park, and then returned to dinner at the hotel, and then went very early to bed. The effect of the baths was first of all to somewhat slow the pulse and to dilate the peripheral vessels, as was shown by the skin under water becoming of a rosy colour, while that which was out of the water remained white. The effect upon the blood pressure was not constant, and I was unable always to take it under similar conditions. The effect of abdominal massage was rather to raise the tension, probably by driving blood out of the splanchnic area, while the effect of the resistance exercises was somewhat to lower it. Of course as far as regards the good effect of the treatment in my own case there can be no doubt whatever. It may be said that I might have got the same good results by having it carried out at home, but this is just the point. I could not have had it at home. I might have had the baths, I might have had the exercises, but most certainly I could not have had the rest. I have advised a Weir Mitchell rest cure in a good many cases, and in several of them I have been persuaded by the patients and the patients' friends to allow the cure to be carried out at home, but these cases have all failed with one exception, which was that of a married lady without children. The whole of the first floor was given up to her, and she was as completely isolated there as she would have been in any nursing home, and the same is the case with Nauheim. At present I know of no other place where you can get the same complete combination of treatment with rest and arrangements for gentle exercise as there, and it is this that makes the treatment so successful. The *rationale* of it is that it accelerates the circulation and eases the heart by dilating the vessels, while the heart itself is reflexly slowed by the baths. At the same time the mental and bodily rest which is insisted upon is the greatest of all the factors, and is the one that is the most difficult to obtain at home.

The best treatment for an exhausted heart as for an exhausted body is rest.

REFERENCES.

[1] Traube, in 1861, paper reprinted in his *Gesammelte Beiträge zur Pathologie u. Physiologie*, Band 1, S. 266 (Berlin, 1871). [2] Von Bezold, *Untersuchungen über die Innervation des Herzens*, 2te Abdg., S. 205 (Leipzig, 1863). [3] E. Lenz, Experimenta de ratione inter pulsus frequentiam, sanguinis pressionem lateralem et sanguinis fluentis celeritatem obtinente, Inaug. Diss., Dorpat, 1853, p. 355. [4] James Blake, *Edin. Med. Journ.*, 1839. [5] Traube, *Centralbl. f. d. Med. Wiss.*, 1865, No. 56, reprinted in *Ges. Beitr.* [6] Traube, *Berlin. klin. Woch.*, 1871, reprinted in *Ges. Beitr.*, Band 3, S. 68. [7] Janeway, *The Clinical Study of Blood Pressure*, p. 99 (New York and London: D. Appleton and Co.), 1904. [8] Strassburger, *Zeitschr. f. klin. Med.*, Band 54, S. 377. [9] Op. cit., p. 395. [10] Janeway, op. cit., p. 109. [11] Strassburger, op. cit., p. 399. [12] Josué, *Bull. et mém. de la Soc. Méd. des Hôp. de Paris*, Tome 25, Sér. 3, 1908, p. 332.

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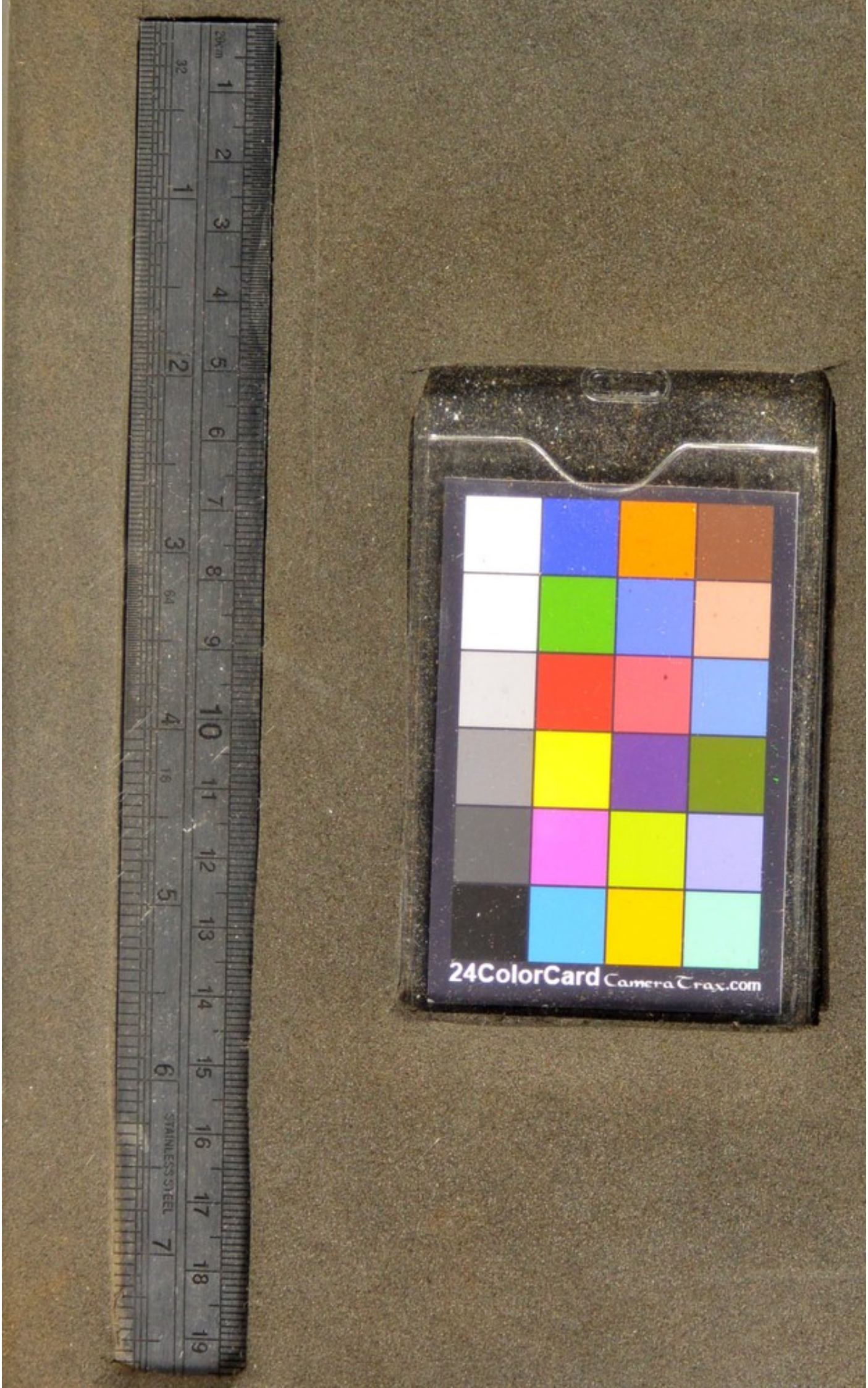
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