sinuses, blood was freely extracted from the left lateral, straight and occipital sinuses through the torcular Herophili which procedure marked the termination of her general sepsis.

On January 31, four months after the illness, the patient gave birth to a remarkably fine child weighing seven and one-half pounds. On March 15 the wound had entirely cicatrized over the posterior part of the cranium. A small fistulous opening remained in the mastoid which communicated directly with the tympanic cavity.

The radical operation which had previously been so rudely interrupted was now completed. The malleus and incus were removed, also the outer attic wall and the Eustachian tube obliterated. The area over the region of the sigmoid and lateral sinuses was covered by a dense mass of fibrous tissue which was left intact. The mastoid wound was entirely closed and healed by first intention. Two months later the tympanic cavity and antrum are well lined with skin and the patient discharged. Hearing in that ear is the watch at 16 cm. ($6\frac{1}{2}$ in.).

THE FACTORS IN THE ESTIMATION OF BLOOD PRESSURE.*

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The first factor in the interpretation of blood pressure must be a satisfactory instrument. It should, to be of service for general work, be portable, quick of adjustment and accurate. These qualities are possessed in eminent degree by the tonometer of Recklinghausen. It does not detract from the achievement of Riva-Rocci that later modifications have improved the technic; his merit will always lie in the impetus given to the study of blood pressure as a routine feature of the general examination; the aim now must be to analyze the findings properly.

The tonometer of Recklinghausen is based on the principle, first introduced into physical science by Bourdon and later incorporated into the kymograph of Fick, that if a very shallow, curved, elongated air chamber, fixed at one end, communicate at one end of the arc with a pressure apparatus, while the other is closed, any increase of pressure will be made manifest by a flattening or elongation of the arc, thereby imparting a certain movement to the end that is free. By a very simple device this movement of the air chamber is communicated to an axis, on which, guarded by a hair-spring, there is fastened a long needle, whose tip is made to move along a graduated scale, previously standardized, and the final figures are read off from the dial.

A notable advantage in the Recklinghausen apparatus is found in the pump. A metallic air-pump, constructed somewhat on the principle of the bicycle pump, is substituted for the ordinary double rubber bulb. The pump permits of increase or decrease of pressure at the will of the examiner; the instrument is at all times under perfect control; measurements can be made with greatest accuracy and promptly verified. By an ingenious arrangement of valves, easily controlled, this increase or diminution of pressure can be made to take place slowly. The whole apparatus is manipulated, without any force,

by one hand, while the other is free to take the pulse. The pump is light, durable and only requires an occasional application of vaselin to valves and piston head.

The cuff is very broad, has a relatively small elastic chamber and a very strong band of thick canvas. It is applied by a buckle and strap, so that it can be snugly fitted to the arm. It is 12 cm. wide. The distention of the rubber pocket can never be very great, though the pressure run to considerable figures. The whole apparatus has, when packed, a weight of four and one-half pounds, and can be easily carried to the bedside of the patient.

The distinct advantage of the Recklinghausen apparatus is in its ability to measure both systolic and diastolic pressures. It will be seen that the mere determination of systolic pressure, though a step in advance, offers little help in the solution of clinical problems; the important thing is the relation of systolic and diastolic pressure. Aside from the actual pressure, measurable directly in centimeters of water, the tonometer makes it possible to observe the rhythm in time and power of the heart's contractions. It will frequently happen that the pulse seems perfectly regular at the wrist, when the ocular evidences of the slightly unequal movements of the needle will show the contrary; the pulse may seem to show an equal filling of the artery at each contraction, but the dial will record differences in this regard. Again, in many organic affections of the heart, a peculiar vibratile oscillation of the needle accompanies the excursions of the pulse, instead of the gradual rise and undulating decline, so that the tonometer offers all the advantages of a sphygmographic tracing, along with the information as to blood pressure.

Care must be taken that the examinations are not too long continued, for the interruption of the circulation in an extremity, if prolonged, will of itself cause changes in the blood pressure.

I start with this postulate: The arterial system has a capacity such that, if all arteries were perfectly limp and dilated, it could never be filled by the available amount of blood. The conditions necessary for a proper circulation are only secured by a certain permanent state of contraction common to all, or nearly all, of the arteries; a state of contraction still further increased with the functional inactivity of the parts supplied, and diminished, but never wholly relinquished, with the proper exercise of function. This brings the general conception of the circulation directly into line with what is known of the safeguarding devices with respect to the heart proper, and, as Gad has shown, with respect to the respiration, in which a state of partial but permanent inhibition always supplies a natural reserve to meet emergencies of all kinds.

This view is directly at variance with older physiologic doctrine. Thus Landois says:

The system of blood vessels, with its many ramifications and subdivisions endowed everywhere with contractility and elasticity, is not only filled with blood; it is overfilled. Hence the mass of blood produces a certain pressure, which produces a stretching of the elastic vessel wall. This, of course, applies only to conditions during life; after death the muscular tissue of the vessel walls becomes relaxed and some fluid finds its way out into the tissue.

In the same way the doctrine that frequency of pulse-beat increases the blood pressure will doubtless receive revision. Foster says:

If, while the force of the individual beats remains constant the frequency is increased or diminished, and, vice versa, if

* Read in the Section on Practice of Medicine of the American Medical Association, at the Fifty-ninth Annual Session, held at Chicago, June, 1908.

while the frequency remains the same the force is increased or diminished, the pressure is proportionately increased or diminished. This clearly must be the case, but obviously it is possible that the beats might, while more frequent, so lose in force, or while less frequent so increase in force that no difference in the mean pressure should result. And this, indeed, is not infrequently the case. So much so, that variations in the heart beat must always be looked on as a far less important factor of blood pressure than the peripheral resistance.

Clinical experience seems to demonstrate that actually the pressure is not influenced by the pulse-rate in the way that might be imagined. Weigert,¹ in a study of 241 cases of acute infectious diseases, found that the lowest pressures in many of these were observed not during the height of the fever, but in the first few days of returning normal temperature; at a period when the pulse was much slower than it had been; when the individual complained of a peculiar gone or good-for-nothing feeling, and when there was always some danger from any peculiar sudden effort. At this period there frequently is an abnormally slow pulse, coupled with this minimum pressure.

Conversely, I have recently had the opportunity of observing a case of paroxysmal tachycardia in a young man of 18, exceptionally tall and fairly well developed, whose heart, on January 14, when he presented himself, beat so fast and irregularly that the pulse could not be counted. The blood pressure in cm. of water, measured by the tonometer, was 122, diastolic 100. The patient was put to bed on light diet and took triple bromids with mild laxatives for two days, when the blood pressure was 128, diastolic 100, the pulse-rate being 72; January 24, the patient being now up and about and again attending a technical school, the pulse-rate was 84, the blood pressure was 134, the diastolic 96; April 25, the pulse-rate was 102, the pressure 132, the diastolic 104. The pressure was practically the same at every stage, regardless of pulse frequency.

There is as yet no normal standard of blood pressure, and it is difficult to see how any uniform basis for comparison shall be found. Different observers have employed different instruments; from this fact alone there would naturally arise some discrepancy; but even with the same instrument the figures have not been even approximately uniform. Tables hitherto given have been based on observations of maximum or systolic pressure only, because it was impossible to get the diastolic pressure with the method employed. The Erlanger instrument is suitable only for hospital or office use; the tonometer of Recklinghausen is the only instrument thus far devised that conveniently gives us both of the data with certainty and promptness.

The accompanying table gives the figures as stated by different observers:

Landols, for larger mammalia and probably for man, 140-160 mm.
Falvre, direct measurement, 110-160 mm.
Albert, direct measurement, 100-160 mm.
Kube-Wiegandt, in uremic patient, 150 mm., direct measurement.
Basch, in temporals, 90-120 mm.; in radials, 110-160 mm.
Federn, 80-90 mm.
Bruce, 100-130 mm.
Tschlenoff, in radial, 70-100 mm.; in tibial, 60-70 mm.
Huethle, 100 mm.
Frey, in digital arteries, 100-110; in radials, 150-160 mm.
Eckert, in temporal, 175 mm.
Hensen, in 25 healthy men, aged 17-30, 137 mm.; in 30 women, aged 17-30, 132 mm.; normal range, 100-160 mm.
Gumprecht, in men, 140 mm.; in women, 120 mm.
Weiss, in men, 120 mm.; in women, 100 mm.
Schille, 80-130 mm.
Neisser, 90-100 possible 160 mm.
Jellinek, in 500 soldiers, 100-160 mm., may be 180 mm.
Neu, 80-130 mm. (regards 130 as abnormal, most frequent 95-115 mm.).

Erlanger, systolic, 110 mm.; diastolic, 65 mm.

Graupner, 115-125 mm.

Sawada, 90-120 mm.

Schilling, 90-120 mm.

Janeway, 110-125 mm.

Sahli-Gassel, 135 mm., high limit of health.

Eichberg, in members of class in medical school, systolic, 86-120 mm.—diastolic, 56-88 mm.

No single reading should be considered a basis of final judgment. It is necessary to see the patient a number of times and to make the observations under diverse conditions, if possible, before estimating the blood pressure as an element of diagnosis. Error has arisen from neglect of this injunction, which has been especially insisted on by Sahli, Krehl and others.

To obtain a fair idea of the blood pressure normal to the individual, observations should be made with the patient fasting and again just after a meal; with the patient reclining and seated or standing; with the patient at rest and after a sudden muscular effort. This will give data for estimation of the actual work of the heart, and also an idea of its recuperative power, a feature of more significance in an estimate of the condition of the circulation than the mere value in figures. It may be assumed that, while an approximate standard exists, taken as an average of many observations as to what should constitute the normal pressure, this varies with each individual, and that it does so with the same individual at different times. The term "amplitude" is suggested by Klemperer for the difference between the systolic and diastolic pressure. Variations in amplitude in the same individual constitute a most important part of the study.

The amplitude increases for organic disease of the kidney, arteriosclerosis and aortic insufficiency. It diminishes for other organic diseases of the heart, affecting the valves or myocardium. It is interesting to note that in a healthy circulation the amplitude increases with moderate exercise, while every deficiency of the circulation manifests itself by a reduction of the amplitude, even when the systolic pressure is increased; this fact enables us to differentiate certain of the nervous disturbances of the heart from those due to organic mischief. In the case of the athlete with damaged heart, the initial amplitude was 114 c.c. in the recumbent position; in the sitting position, 108; after walking upstairs, 94; ten minutes later, 68. In one healthy young man the initial amplitude was 32; after walking, 48; in another test, initial amplitude was 36, after climbing stairs 46; on another occasion 30, after effort 48. According to Gerhardt, the systolic pressure in broken compensation is high, but the amplitude becomes small as the heart grows weak and again becomes greater as more powerful contractions are resumed.

The effect of exercise on the blood tension is a matter of daily personal experience. Any unusual effort makes us conscious of the beating of the heart. This implies an increase of work on the part of the heart, and an increase of arterial tension. The increase of tension is not directly proportioned to the work performed. Thus Masing² has shown that the labor of lifting 10 kg. produces a rise disproportionately greater than the labor of lifting 5 kg.

The fact that such an increase occurs makes it necessary to consider the previous conditions of the patient at the time of the observation. But the very fact of such increase as a normal reaction furnishes an important diagnostic aid. The healthy individual, after measured exercise, will present the increase of pressure.

1. Samml. klin. Vortr. (Volkman's), No. 459

2. Deutsch. Arch. f. klin. Med., November, 1902, lxxiv, 253.

usually with increase of pulse-rate, the increase being more marked in the systolic than the diastolic pressure; but soon after the completion of the work, if not too greatly prolonged or too severe, the tension returns to the normal. For example, in a healthy young man, with an initial systolic blood pressure of 140 c.c., the pressure rose after walking up two flights of stairs to 170 c.c., but within five minutes was back again to 140 c.c. A striking contrast to this was offered in the case of a former circus athlete, now aged 53, who had a marked mitral insufficiency with arrhythmia and arteriosclerosis and a pulse of 96. The initial pressures here were, with the patient lying down, systolic 236 c.c., diastolic 122 c.c.; with the patient sitting, 240-132; after walking up two flights of stairs, 216-122; ten minutes later, 190-122. Here the tension was not only lower immediately after the exercise than before, having fallen from 240 c.c. to 216 c.c., but it continued to decline when the patient was again at rest, and after fifteen minutes was still 50 c.c. lower than at first. A reaction of this kind always indicates a damaged myocardium.

Even in the presence of recognizable valvular lesion, the effect of such a test will, if the heart muscle be competent, give instant information. A man, aged 34, with an old mitral insufficiency, gave, while resting, systolic 168, diastolic 122; after exercise, systolic 188, diastolic 122; after five minutes, systolic 166; next day, while resting, systolic 158, diastolic 122, thus showing adequate compensation.

It is possible by practice gradually to increase the amount of work that can be performed, while still permitting the prompt return of the circulation to the state of normal tension, and this constitutes a proper system of training, as that term is generally understood. The injurious effects of training will inevitably appear sooner or later if such training carries the work beyond the point where a quick return to the normal tension is possible. The true limit of the training capacity of the individual is thus to be found in the interrogation of the arterial tension. Naturally the work that can be imposed on a damaged circulation and yet remain within its training capacity will always be less than that imposed upon a normal individual; in the selection of the test to be employed care and discrimination must always be exercised. Cases of advanced organic disease, of aneurism, of convalescence from exhausting acute disease, may be altogether unsuitable for its performance.

When the effort is prolonged but moderate, the pressure rises, but soon adjusts itself to a mean higher level, in which any slight additional effort produces no effect. Thus in the case of the young man just mentioned with a normal pressure of 140 c.c. the systolic pressure after walking one mile was 154 to 112 diastolic. Walking up two flights of stairs then made no difference, the pressure remaining at 154-112.

The quantity and viscosity of the blood necessarily influence the blood pressure. Moderate blood-letting up to 2.8 per cent. of body weight is not attended by any noteworthy decline of pressure. Blood-letting up to 4 or 6 per cent. of the body weight reduces the blood pressure to zero. The blood pressure is increased by any addition to the volume of the circulating fluid, as by injection of defibrinated blood, or normal salt solution, either directly into the veins or into the subcutaneous tissue, respectively. After copious meals there is also an increase of blood pressure, attributable in part to addition to the volume of circulating fluid. There is as

yet no satisfactory means of determining the viscosity of the blood. Boveri³ found that hypertension from adrenalin or tobacco was always accompanied by a notable increase of erythrocytes. Paul Arnold⁴ also notes that chronic increase of the blood pressure, as a rule, leads to increase of red corpuscles and hemoglobin. Boveri remarked on the distinct parallelism between the viscosity of the blood and the number of erythrocytes, so that a polycythemia would usually indicate an increased viscosity.

The most important factor in the control of blood pressure is the nervous system. It had been known that almost every phenomenon connected with life, whether it be a physical or mental phenomenon, produced, temporarily at least, a modification of pressure over a larger or small portion of the vascular area. Taking the physiology of the nervous control for granted, it is of interest to note that recent experiments have added much interesting light. Curschmann⁵ finds that the effect of painful faradic currents applied in such a way as to avoid motor points of irritation, in normal individuals, is generally to increase the blood pressure; in persons with organic or functional hypertension the increase is disproportionately greater. In organic analgesia the experiment produces no modification of pressure, nor is there any change in hysterical analgesia until the hysteria is relieved—thus seemingly proving that there is an actual sensory lesion in hysteria. Klemperer,⁶ while admitting the influence of physical work in increasing the blood pressure, says that the amount of this increase is largely determined by psychic factors. Masing⁷ determined that the increase of blood pressure with any given effort was less according as there was less determined effort of the will. Kiessling⁸ shows that efforts which are unusual, requiring more mental concentration, are accompanied by a greater rise of blood pressure. Direct stimulation of the cortex in curarized animals is attended by a signal rise of blood pressure.⁹ In man an analogous result follows hypnotic suggestion (Klemperer⁶). Here, with the muscles perfectly limp, the suggestion of work, such as mounting stairs or drawing a tight cork from a bottle, raised the pressure from 178 c.c. to 206 c.c. It then dropped to 176, and with a further suggestion, rose to 210 c.c. The mere intention of doing work, the willing to do it, increased the pressure.

Passive movements, except those causing pressure on the thorax or abdomen, may be performed for a long time without increase of pressure. Klemperer says that the least factor in the increase of pressure attending any given work is due to the necessary muscular activity; the participation of the cerebral cortex is the principal cause. This fact may well explain the advantage of passive movements in cases of heart lesion, either alone or, as at Nauheim, if coupled with effervescing baths, and gradually changed into resistance movements.

Dyspnea increases the blood pressure very materially.¹⁰ This applies not only to acute suffocative conditions but to dyspnea of long standing. The amount of this increase varies greatly in different individuals, depending on the degree of the dyspnea and the power and adapta-

3. Clin. med. ital., September, 1906.

4. Dissertation, Würzburg, 1907.

5. Berl. klin. Wchnschr., 1907, p. 132.

6. Ber. ü. d. Verhandl. d. Kong. f. innere Med., 1907.

7. Deutsch. Arch. f. klin. Med., 1902, lxxiv, 253.

8. Dissertation, Greifswald.

9. Weber: Arch. f. Anat. u. Physiol., supplement, 1906, p. 309.

10. Jaeger, O.: Dissertation, Leipsic, 1906.

bility of the heart. The walls of the vessels contract when the blood becomes distinctly venous in type. It is the increasing venosity of the blood, according to Landeis, which causes the emptying of the arteries after death. The vasomotor center in the medulla is the direct agency in this phenomenon, the ganglionic cells being exceedingly sensitive to changes in the composition of the circulating fluid.

Contrary to what might be expected, acute infectious diseases have but little influence on the blood pressure. If we stop to reflect, the fact need cause no surprise, since the compensating mechanisms of the body are so abundantly provided that an acute condition, though it strain the limit of reserve, does not utterly exhaust it. Gerhardt¹¹ shows that in febrile diseases, as the heart grows weak, the arteries contract (probably under vasomotor influence), thus preserving the pressure. A very exhaustive study has lately been made by Weigert¹ of Dresden. In many of the acute infections the pressure fell during the height of the fever and returned to the normal as convalescence was established. There was no proportionate decline in pressure with increasing gravity of the symptoms. The report is based on a study of 241 cases, and the pressures recorded are all systolic. In typhoid fever there was a decline at the height of the fever. In pneumonia no change was noted at any stage, not even in the crisis. In scarlet fever without complication there was no change; the same was true of diphtheria without complications. The observations of the blood pressure furnished no certain prognostic indications nor suggestions for treatment. How little could be learned from the blood pressure with regard to the gravity of the case was shown in a case of ulcerative endocarditis, with general bacteriemia, in which six days before death the pressure was 140 mm.; three days later it was 95 mm.; then, despite increasing frequency of the pulse, it rose to 115 mm., and shortly before death attained 125 mm. In another case of ulcerative endocarditis with streptococci in the blood the pressure on the second day was 136 mm.; the next day it was 122; then it rose to 155 mm. on the tenth day, and on the eleventh, the day of the patient's death, it was 145.

However, Cook and Briggs¹² found in typhoid cases a hypertension increasing with complications, parallel to the severity of the disease and to deepening intoxication. The occurrence of perforation, confirmed by operation, was indicated by a sudden jump in pressure before the appearance of any other symptom, the pressure rising from 106 to 144; while in another case with seeming certainty of perforation, as shown by leucocytosis, rapid pulse and sharp abdominal pain, without rise of blood pressure, the operation failed to show any sign of perforation. Similarly, Teissier and others have found in the sudden increase of pressure a precursor of hemorrhage. Crile, too, found this increase of blood pressure in cases of perforation confirmed in four cases by operation or autopsy. In making this observation frequent tests will be indispensable, and only very marked, sudden fluctuations can be of value.

The acute condition may pass without notable change in blood pressure, but the subsequent history of these cases, as recently studied by Thayer in typhoid, shows that after the lapse of several years the damage done may become manifest. Thayer's patients all showed an increase of blood pressure as compared with other indi-

viduals of the same age. Many had developed arteriosclerosis. The greatest rise was observed in the later decades.

Determination of a high or low pressure is in itself of no value. The lowest values compatible with life are found by Neu¹³ to be from 40 to 45 mm., and these occur only with subnormal temperature in the moribund state, though Neu¹³ has seen patients recover after the pressure had fallen as low as 50 mm. The greatest variation that has come under my personal observation was noted in the case of a shoemaker, aged 64, with arteriosclerosis, a man of temperate habits, with no recognizable lesion except a slight bronchitis, where the amplitude was 212 c.c., the systolic pressure being 394, the diastolic 182 c.c.

It is in chronic conditions that the study of blood pressure is of the greatest advantage for diagnostic and therapeutic purposes. Friedrich Müller states that the constant increase of blood pressure is the earliest symptom of a developing arteriosclerosis, and Groedel¹⁴ maintains that the constant increase of blood pressure, in the absence of aortic insufficiency and of interstitial nephritis, is in itself sufficient to establish a diagnosis of arteriosclerosis. Hypertension does not necessarily exist in every case of arteriosclerosis; on the contrary, normal pressure may be present in advanced cases, but where the increased pressure is found the presence of arterial changes is indicated.

Hypertension, however, is not in itself a disease. Graupner¹⁵ says that it is an accompanying or resulting symptom of many anomalies of nutrition—diabetes, gout, syphilis, chronic lead poisoning and certain kidney affections, all of which lead to changes in the splanchnic distribution. Changes may be present in the aorta, in the cerebral or brachial arteries, without any change in tension. Romberg and Hasenfeld have shown that hypertension occurs only when the arteries of the splanchnic territory are extensively involved. Sclerosis of the arteries is a very slowly progressive change. Its nature has been most exhaustively studied by Jores.¹⁶ The association with nephritis has long been recognized. Groedel found in seventy-one cases of nephritis a minimum pressure of 130 mm., and more than half had a pressure of 170 mm. or more.

The general assumption has been that hypertension is in itself very dangerous, inasmuch as it leads to alteration of the vessel wall, possibly to rupture, or induces cardiac hypertrophy and subsequent dilatation, so that in every case baths, iodine compounds and nitrites should be used. This view is strongly combated by Krehl¹⁷ and by Bier. They regard the high pressure as compensatory. In chronic kidney disease the high pressure causes a more rapid flow through the reduced vascular area in the kidney, and this more rapid flow allows of necessary elimination. In many cases, with a more effective action of the kidney, the pressure promptly declines. Krehl cautions against unnecessary interference with this beneficial automatic arrangement for maintaining the competency of the kidney, except in so far as regulation of the diet may reduce the proportion of waste products to a minimum. For reduction of blood pressure will retard the elimination from the kidney and increase the

13. Experimentelle und klinische Blutdruck-Untersuchungen, Heidelberg, 1902.

14. Ber. ü. d. Verhandl. d. xxi. Kong. f. innere Med.

15. Berl. klin. Wchnschr., 1907, No. 15.

16. Wesen und Entwicklung der Arteriosklerose. Wiesbaden, 1903. Bergmann.

17. Deutsch. med. Wchnschr., 1905, No. 7.

11. Samml. klin. Vortr. (Volkmann's), No. 470.

12. Johns Hopkins Hosp. Rep., xl.

patient's danger. In six cases of chronic kidney disease with hypertension reported by Graupner the blood pressure fell as soon as the function of the kidney improved; the compensatory increase of tension was no longer necessary. Similarly Krehl regards the hypertension in arteriosclerosis as part of the natural regulation with which we should not interfere. On this point, however, issue may be taken, provided a healthy heart muscle exists. If the heart be insufficient, or if its power of adaptability be greatly reduced, then it is probable that the hypertension assists the circulation. But with a normal heart the increase of tension in arteriosclerosis is due to mechanical conditions, thickening of vessel walls, reduction of caliber, loss of elasticity—all purely mechanical obstacles, whose effects can be modified by treatment.

The indication of the necessity for treatment, for attempting to reduce the hypertension, is to be found in the response of the heart to blood-pressure tests after a measured amount of work. If the heart muscle still has a certain training capacity, then it does not require the compensatory hypertension. The question is always one of adaptability of the heart.

Many agencies reduce the blood tension. Warm, effervescent baths, as used in the natural state at Nauheim, are of most signal value and thousands are benefited annually; under their influence, if judiciously employed, the blood pressure increases to a physiologic maximum and then falls, while the functional capacity of the heart increases by combining the baths with exercise. The effect of iodine in arteriosclerosis is perhaps to be explained by the control which it exercises over the polycythemia, and by its reduction of the viscosity of the blood, rather than to any influence on the anatomic change. The effect of the nitrites is universally acknowledged.

It is in the direction of prevention, however, that we should most earnestly apply our efforts. With our knowledge of the influence of the nervous activity in the causation of the hypertension, with the recognized rôle of excessive waste products in the blood in the same direction, the treatment to be instituted lies more in educating the patient to right living than in the administration of medicine. Avoidance of alcohol and tobacco, moderation in eating and drinking, proper hours of rest, and the elimination of excitement and nerve strain become the principal therapeutic measures. To cultivate repose is thus not only an obligation imposed by good breeding; it is an imperative law of physical health. The study of the blood pressure furnishes the guide as to the efficacy of the treatment, as well as to the time for its continuance. Assuredly it is not possible to agree with Romberg in this statement: "With regard to the measurement of blood pressure we thus have much more accurate information than formerly regarding one of the conditions under which the circulation is carried on. But even as no conclusions as to the efficacy of the circulation can be drawn from the height of the blood pressure, no clue as to the details of the mechanism is found in the composition of the blood pressure and its comparison with the maximum of pressure."

These factors give no measure of the relative participation of heart and blood vessels in the existing changes of the circulation, because the extent of the pulsatile oscillation is influenced not only by the heart but by the tension and elasticity of the vessels, and the

tension of the vessels is by no means in a fixed ratio to the maximum of pressure."

The following conclusions seem justified:

1. The routine interrogation of the blood pressure should constitute part of the regular examination of each case.
2. Both systolic and diastolic pressures are necessary in the solution of the problem.
3. Systolic values of more than 130 mm. call for further study.
4. The most important feature of the study of blood pressure is found in its behavior under tests with measured amount of work.
5. Increase of blood pressure is often conservative, and then calls for no interference.
6. A pressure that is at all times above normal may be the only, as it often is the earliest, evidence of arteriosclerosis.

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DISCUSSION.

DR. W. F. DUTTON, Pittsburg: The etiology of hypertonic contraction readily resolves itself into two great divisions, the influence of the nervous system and the composition of the blood. I am not referring to the mechanical conception which would make the arteries mere elastic tubes but to that of living tissue. I have been experimenting with methylene blue. When administered in large doses a retention of the drug in the tissues takes place, owing to a disturbance of renal function, and manifests itself by a diminished excretion of the drug in the urine and feces. After a saturation of the tissues every additional dose is followed by a lessened functional activity. This effect is most apparent in the arteries, and it causes at once a hypertonic contraction and hyperemia of the renal capillaries as well as other pathologic conditions. This method is one to determine the condition of the arteries. The tightening or relaxation of the radial arteries is of clinical importance. The conception is false that the blood-pressure is heightened inside all hypertonically contracted blood vessels only. The two factors of the vessel wall and of the contained blood must be separated. There should be an estimation of the pressure inside of the artery, no matter what the thickness of the walls may be. Nervous reflex, however, may be due to blood impurity.

I do not believe that von Recklinghausen's instrument differs greatly from others. The only thing that can be depended on in its use is the estimation of the resistance of the blood. None of these instruments is perfect. The one, however, that I believe to be the most convenient for the general practitioner's use is that of Riva-Rocci as modified by Cook. The hypertonic, or the sclerotic or atheromatous condition of the arteries is determined by the sense of touch. I believe that the more the general practitioner practices this determination of the arterial condition by the sense of touch, the more perfect he will become—and more so than by the use of these complicated instruments. Arterial sclerosis and atheroma are totally different. Continued stimulation of the arterial wall leads to structural changes, and the fact that a fibrous hyperplasia of the tunica intima takes place shows that the vessel changes are not due to mere nerve influence, but to the blood itself. The intensity of internal changes in the kidneys indicates a presence of excrementitious substances in the blood seeking an outlet. There lies, in part, an explanation of vascular, cardiac, and renal changes. Most text-books endeavor to present the subject in such a way as to make one think that atheroma, sclerosis and hypertonic contraction are one and the same thing. But the surgeon might treat a broken leg for tumor of the brain just as well as the physician might treat atheroma for sclerosis.

DR. N. S. DAVIS, Chicago: In certain arterial diseases the arterial wall still retains its power to contract; I have observed that other physicians often overlook this fact. It is a fact that not only healthy normal walls but diseased arterial walls possess this tonicity or power to contract. Furthermore,

many times a diseased arterial wall has a greater degree of tonicity and power to contract, or is more easily stimulated to contract, than a healthy arterial wall. When the artery is compressed the cessation of the flow of blood through it depends not entirely on the pressure of the blood inside the artery, but first on the thickness and tonicity of the arterial wall—in other words, on the rigidity of the arterial wall; and second, on the size of the lumen of the artery. Therefore, when a hemomanometer is applied to an arm and the arteries in it compressed it must be remembered that the compressibility of the artery as well as the pressure of the blood within the artery is being measured. The so-called arterial tension really means the compressibility of the artery.

DR. I. J. WOLF, Kansas City, Mo.: I am especially interested in two points that Dr. Eichberg brought out. First, mental influence is capable of producing a rise and fall in the blood pressure the same as physical labor. This is somewhat akin to what Parlow demonstrated regarding the work of the stomach: that the influence of the mind is as powerful in causing a flow of gastric juice as food itself. The other point emphasized, which I have often noticed in my clinical work, is that the increase in blood pressure is generally compensatory, and that to interfere with this compensatory increase in blood pressure is often dangerous. In such cases, when patients present themselves with a high blood pressure, the question is not so much what the blood pressure is at present, but what it has been before. If it was, for instance, 280 before and the kidneys were doing good work with such a blood pressure, it would certainly be dangerous to try to reduce it, or, if already lowered, to reduce it still further by the use of nitrites or the like. In such cases, though the blood pressure may seem dangerously high, the use of digitalis is more indicated and better able to remove untoward symptoms than the use of blood-pressure-reducing remedies. If, in addition, it is seen that through proper diet and hygiene the patient's blood pressure is not increased beyond the necessities of the case, the patient's welfare is guarded. High blood pressure does not necessarily mean a competent heart; nor does it exclude the use of digitalis.

DR. JOSEPH L. MILLER, Chicago: In many cases of hypertension it is not necessary to institute any treatment. All no doubt will agree that most frequently these cases are due to the condition of the kidneys. The question then arises whether or not a lowering of the blood pressure reduces the elimination from the kidneys. There has been a considerable amount of work done on this subject and on the relation between the lowering of the blood pressure and the elimination from the kidneys. The most accurate work on this subject has shown that, when the blood pressure was reduced from 20 to 25 mm. of mercury, for example, and a careful determination of the elimination of water and solids from the urine was made covering a number of days, there was a decided reduction in the elimination of solids through the kidneys.

DR. S. ST. JOHN WRIGHT, Akron, Ohio: Blood pressure is only one of many pressures which modern methods of living affect. The changed relations existing between patient and physician demand consideration. In these days of meters and instruments of precision, which are now in most homes, the doctor must still be a leader as was the family doctor of old. He can not afford to be without apparatus. For the neurotic and morbidly introspective patient an array of apparatus might be injurious. In such a case the trained finger of the doctor, educated by the sphygmomanometer, will give him a working knowledge of the blood pressure and reassure the patient.

DR. C. F. HOOVER, Cleveland: There are instances in which lowered arterial tension in patients with Bright's disease causes a profound depression. In cases of chronic interstitial nephritis—and this is a fact that I have verified a number of times—with the elimination of a very small amount of urine in twenty-four hours, the use of diuretin or caffeine is not followed by diuresis; in these cases there is a high arterial tension and an oliguria. But when I lower the arterial tension there is a marked diuresis. Caffein or diuretin are without effect on the excretion of urine; but when

trinitin is administered, lowering the arterial tension, diuresis occurs promptly. Dr. Wright wants a man of modern times and not of the old school. It is the use of the blood-pressure apparatus which teaches clinicians how to estimate blood pressure by touch.

DR. JOSEPH EICHBERG, Cincinnati: It was not with a view of measuring the blood pressure alone that I presented the instrument; but I wish to call attention to its availability in the routine examination of patients. It is not in determining the absolute blood pressure that much can be learned; not from its high or low reading, but from consideration of the blood pressure in connection with the symptoms. In the study of heart disease, the determination of the heart murmur alone really means nothing. After recognizing a certain cardiac murmur a proper analysis must necessarily determine its source. And so with the determination of the blood pressure; in hypertension only a proper study can determine whether the heart, the arteries or the nervous system is at fault. The most important feature in connection with the blood pressure is the determination of the compensatory action of the heart, the adaptability of the heart after a measured amount of exercise. Having determined the blood pressure of an individual at rest and in exercise, one should then note how the heart behaves. If the heart is competent, if fully able to compensate, the high pressure is not a dangerous factor. The criticism of the instrument which I present is well deserved in the main. The instrument of von Recklinghausen has the defects inherent in all instruments of this nature, but the errors are easily controlled. It does depend on the condition and tension of the metallic spring; but this element in error can be checked at any time by comparison with a standard gauge. The instrument is portable and can be readily carried to the bedside of a patient. It enables one to obtain promptly both the diastolic and the systolic pressure. It has manifest advantage over other instruments that require the use of mercury. Erlanger's instrument can not be carried around; its place is in the office or in the hospital ward.

UTERUS AND STOMACH.

THEIR ANATOMIC, PHYSIOLOGIC AND PATHOLOGIC
RELATIONSHIP.*

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In no specialty do we hear so much of reflex symptoms and reflex neuroses as in gynecology. Those of gastric origin are an especially prolific source of local gynecologic treatment and, as a recent article by Reder¹ indicates, of operative interference also. From a purely clinical standpoint, hardly any two abdominal organs stand in closer relationship than the stomach and the uterus. Thus we have the nausea and loss of appetite during menstruation, the vomiting and craving for certain special foods during pregnancy, the various gastric disturbances accompanying the menopause and the frequent association of gastric and gynecologic diseases. This has led many writers to believe that there must be some special nervous connection between these two organs. In presenting this subject, my motive is to show once more how much is hypothesis and how little is fact in this field of study. I was also able to collect forty-four additional observations of the association of gastric and gynecologic symptoms, taken partly from the clinical records of the Washington

* Read in the Section on Obstetrics and Diseases of Women of the American Medical Association, at the Fifty-ninth Annual Session, held at Chicago, June, 1908.

1. Trivial Pathologic Conditions of the Uterus and Adnexa Considered as Causes of Severe Gastric Disturbances: *Amer. Jour. Obst.*, 1905, III, 667-74.