ARTERIAL BLOOD-PRESSURE RECORDS BEFORE AND AFTER MUSCULAR EXERTION.

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THERE exists a remarkable divergence of expert opinion on the question as to whether the results of systolic arterial blood-pressure readings by the method of circular compression represent in all cases the true blood pressure. Those who hold the opposite opinion consider that, more particularly in cases where these readings reach the higher limits which are met with—say from 200 to 300 mm. Hg—the manometric index records something beyond the pressure of the blood itself; in other words, that a part of the force spent in obliterating the lumen of the vessel is due to the resistance of the arterial wall itself. Whilst the majority of those who have worked in this domain of clinical medicine favour the former view, yet several observers—among whom may be mentioned Drs. William Russell, George Oliver, and W. P. Herringham—have given reasons for dissent from the prevalent opinion.

It would seem that light may be thrown on the question, even though we cannot hope thus to actually prove the matter, by observations taken before and after violent muscular exertion in healthy men, seeing that it can hardly be maintained that the blood-pressure readings as measured after such exercise can be influenced by the resistance of the arterial wall. For, in the first place, there is in such conditions a state of vaso-dilatation, so that the effect of hypertonic contraction can be excluded, and, secondly, it is premised that the subject observed is free from arterio-sclerosis. If, then, on the one hand, as the result of muscular exertion of this kind, a considerable arterial blood pressure should be reached, this would point to the possibility of an equally great height being attainable as the result of disease; but if, on the other, but a moderate elevation—say well below 200 mm. Hg—be met with, this would afford even stronger evidence of the improbability that the heart in morbid conditions would be capable of overcoming pressures much greater than this.*

The only observations made on these lines which I have met with in the literature are as follows:

T. C. Janeway found, in an experiment with the Erlanger apparatus (5 cm. armlet) on a healthy young man of 26 years, a rise of pressure after he had run up three flights of stairs = 40 mm. systolic and 20 mm. diastolic, the observations being taken during the sitting posture.¹

W. Russell says²: "I submit that the 20 mm. rise after violent exercise marks the limit of the reserve of power of the normal average heart."

K. A. E. Fries made observations on the pulse and blood pressure in foot-racers.³ He determined the pulse-rate and blood pressure in athletes in races of various lengths, using the Recklinghausen-Landergren modification of the Riva-Rocci sphygmomanometer to measure the latter. In general he finds that the pressure rises during the first 35 to 40 minutes of running (10 kilometres), and then falls to considerably below its original level. After one English mile the rise might be from 10 to 40 mm. Hg, the pulse then beating 120 to 160. After a "Marathon" race (40.2 kilometres) the fall below the pressure at starting might be from 10 to 20 mm. Hg.

* It may be urged in criticism that the mere fact of this compensatory vaso-dilatation during severe exertion lessens the work of the heart, and therefore renders any question of little value, seeing that in disease there is frequently vaso-constriction. It is doubtful, however, how far this argument is a sound one.

My own observations were of two kinds. Through the courtesy of several of the competitors for the *Evening News* Marathon race last autumn I was enabled to make observations on them immediately before and after practice runs varying in distance from 3 to 13 miles. Secondly, I made observations on three hospital residents before and after they had run quickly down and up several flights of stairs. The results confirm in the main the observations quoted above.

Four competitors for the Marathon running race were examined. Oliver's haemomanometer was the instrument used (a modification of the Riva-Rocci method). The observations were taken on the arm, this being of course at the level of the heart, and the subject being in the sitting posture. The first observations were taken in every case immediately before the competitor started his course, and the last directly after he had finished (within a minute approximately). The details are given in the table at the foot of this page.

The readings of diastolic pressure and pulse were only approximate. Nos. I, II, and III were, apart from some cardiac hypertrophy, healthy men. No. IV exhibited some thickening of the superficial vessels and cardiac hypertrophy. No. I was very slightly dyspnoeic at the time of the second observation. No. II stopped running on account of his leg "giving"; no signs of exhaustion. No. III was dyspnoeic at the time the second observation was made, and seemed somewhat exhausted. No. IV was likewise rather dyspnoeic. The weather was very hot at the time of all the observations. It will be seen that three of the cases showed a rise of from 25 to 28 mm. systolic pressure, the diastolic either remaining constant or rising to a less degree. One case (No. II) showed a fall of systolic pressure. The observations on the hospital residents were taken under similar conditions to the others, the first being made in each case before the subject started running down and up several flights of stairs, and the last directly after he had finished (within about a quarter of a minute). The observations were taken on the forearm.

	Before Exertion.		After Exertion.		Difference between Systolic Pressures.	Difference between Diastolic Pressures.
	Syst.	Diast.	Syst.	Diast.		
No. I. Mr. P. M., 24 yrs.	115	100	152	—	37	—
No. II. Mr. A. J., 28 yrs.	120	95	138	90	18	- 5
No. III. Mr. C. W., 23 yrs.	135	90	145	90	10	0

Syst. = systolic pressure. Diast. = diastolic pressure.

The diastolic readings were only approximate. No. I ran three times up and down stairs, No. III twice, and No. II once. Nos. I and III were markedly dyspnoeic as the result of the exertion; No. II was less so. At the time No. I ran the weather was very hot. The results show a rise of from 18 to 37 mm. systolic pressure.

CONCLUSION.

My results point to a rise of from 20 to 40 mm. Hg, corresponding to a height of perhaps 160 to 170 mm. as the measurement which is probably near the limit of reserve power of the normal heart. Consequently these observations at least throw doubt upon the idea that readings obtained in the neighbourhood of 300 mm. really represent true blood pressure.

REFERENCES.

¹ *The Clinical Study of Blood Pressure*, p. 122. ² *Arterial Hypertonus, Sclerosis, and Blood Pressure*, p. 54. ³ *Hygeia*, Stockholm, 1907, p. 1206.

	Before Run.			Distance Run.	After Run.			Difference between Systolic Pressures.	Difference between Diastolic Pressures.
	Systolic.	Diastolic.	Pulse.		Systolic.	Diastolic.	Pulse.		
No. I. Mr. G. B., 35 years ...	143 mm.	100 mm.	64	About 12 miles	168 mm.	100 mm.	100	25 mm.	0
No. II. Mr. H. A., 35 years ...	125 mm.	100 mm.	64	Between 12 and 13 miles	105 mm.	—	—	- 20 mm.	—
No. III. Mr. F. C., 37 years ...	142 mm.	100 mm.	60	10½ miles	170 mm.	120 mm.	—	28 mm.	20
No. IV. Mr. T. D., 51 years ...	162 mm.	100 mm.	88	About 3 miles	189 mm.	100 mm.	108	27 mm.	—

The results are recorded in millimetres of mercury = mm.