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Research Article

A NOTE ON THE CARDIAC OUTPUT OF A SINGLE INDIVIDUAL OBSERVED OVER A PERIOD OF FIVE YEARS

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In 1924 we (1) reported the results of a study of the output of the heart in normal resting adults. At that time we commented on the fact that two of our subjects differed in the degree of variation exhibited by their cardiac outputs at different times but under identical circumstances. We reported four observations of one individual whose cardiac output varied from 4540 to 6780 cc. per minute and five observations of another subject in whom five measurements scattered over a year varied only from 3700 to 3960 cc. per minute. Since that time further observations of the second subject have been made, with results which seem of interest sufficient to warrant recording them.

The first group of measurements was made by the method of Burwell and Robinson (2), in Baltimore, Maryland, between March, 1923 and March, 1924. The second series was carried out in Nashville, Tennessee, by the method of Bock, Field, Gildea and Lathrop (3), between January, 1927 and February, 1928. All observations were made under conditions as nearly identical as could be arranged. The measurements were made in the morning, with the subject fasting, and after he had rested for thirty minutes or more in a reclining chair.

The results are exhibited in table 1. It will be observed first, that the pulse rate, basal metabolic rate, and respiratory quotient are remarkably constant throughout the whole series of observations. Second, the cardiac output, with the exception of three mesurements made in June, 1927, varies only from 3620 cc. per minute to 3960 cc. per minute. The cardiac output was constant not only from day to day and year to year, but also in three successive measurements

at 1½ hour intervals on January 31, 1927 in which the variation in the output of the heart was only 100 cc.

This general agreement constitutes not only a demonstration of the degree of perfection of physiological regulation but also impres-

TABLE 1

The output of the heart per minute and related figures

Date	Method	Pulse rate	Basal metabolic rate	Respiratory quotient	Oxygen per minute	Carbon dioxide per minute	Arterio-venous difference oxygen	Arterio-venous difference carbon dioxide	Output per beat	Output per minute
			per cent of normal		*cc.*	*cc.*	*volumes per cent*	*volumes per cent*	*cc.*	*cc.*
March 31, 1923	Burwell and Robinson	67	−10	0.78	238	186	6.44	5.02*	59	3,700
April 17, 1923	Burwell and Robinson	66	−8	0.85	236	200	5.91	5.02*	60	3,940
April 19, 1923	Burwell and Robinson	68	−10	0.81	236	191	5.97	4.48*	58	3,950
June 2, 1923	Burwell and Robinson	72	−10	0.78	238	186	6.01	4.69*	55	3,960
March 13, 1924	Burwell and Robinson	66	−8	0.78	248	193	6.33	4.94*	57	3,920
January 31, 1927:										
8:30 a.m.	Bock et al.	68	−5	0.81	243	197	6.19*	5.01	58	3,930
10:00 a.m.	Bock et al.	68	−4	0.80	247	198	6.46*	5.17	56	3,830
11:30 a.m.	Bock et al.	68	−4	0.80	249	199	6.38*	5.10	57	3,900
March 21, 1927	Bock et al.	67	−6	0.79	246	194	6.30*	4.97	58	3,900
June 14, 1927	Bock et al.	73	−10	0.81	232	188	4.43*	3.59	72	5,240
June 16, 1927	Bock et al.	67	−10	0.81	236	191	4.77*	3.86	74	4,950
June 24, 1927	Bock et al.	71	−7	0.82	243	199	5.16*	4.23	66	4,700
February 10, 1928	Bock et al.	65	−8	0.83	231	192	6.38*	5.29	56	3,630

* Calculated.

sive evidence of the agreement in this subject, of two quite different methods of measuring the output of the heart.

Why three successive measurements during ten days in June 1927 should have given higher figures than any other of the thirteen is not known. The weather at this period was warm but the tempera-

ture in the laboratory was only 27°C. and the subject was not conscious of discomfort due to heat. The subject's general physical condition may have had some bearing on the result. He was tired, working long hours, and under a certain amount of mental tension. The increase in cardiac output at this time was not due to any increase in basal metabolic rate but to a fall in the arterio-venous difference. In two of these three measurements the average pulse rate was slightly above his usual basal level but not as much so as the cardiac output per minute, so that the output per beat was elevated. The peripheral blood pressure at these times showed no change from its usual level of 115 systolic and 85 diastolic pressure.

SUMMARY

Thirteen measurements of the cardiac output of a single subject over a period of five years are reported. The output of the heart remained relatively unchanged throughout that period.

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