ORGAN WEIGHTS OF NORMAL RABBITS.

SECOND PAPER.

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In a previous paper (1), we reported results of a series of organ weight determinations on a group of 350 normal rabbits that were killed and examined between January 1, 1922, and July 1, 1924. The observations on which this report was based were continued for another year with a view to obtaining data covering a longer period of time and a second set of results which might be compared and combined with the first, thus affording material for a more comprehensive and more exact survey of conditions that obtain in normal rabbits.

The object of the present paper is to record the results of the second series of weight determinations and the results for the entire group of 645 rabbits.

Methods and Material.

The results to be reported are based on a study of two series of male rabbits representing carefully selected normal stocks. The first series (Series I) contained 350 animals; these were killed and examined between January 1, 1922, and July 1, 1924. The methods employed in conducting the investigation are described in detail elsewhere (1). The second series (Series II) was composed of 295 rabbits comparable in all respects to those of Series I and the investigation was carried out in the same manner. These animals were killed and examined in small groups, at intervals of 2 to 4 weeks, between July 1, 1924, and July 1, 1925. The total number of animals is, therefore, 645 and the time covered by the observations is 3½ years.

RESULTS.

The results are recorded in the form of a tabulated summary (Table I) which gives values for actual weights and for weights per kilo of

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TABLE I.

Values for Actual and Relative Weights for Rabbits of Series I and Series II and for the Total of 645 Rabbits.

Organ.	Group No.	No. of animals.	Arithmetical mean.	Median.	Minimum.	Maximum.	Standard deviation.	Probable error.	Coefficient of variation.
			gm.	*gm.*	*gm.*	*gm.*	±*gm.*	±*gm.*	*per cent*
Gross body weight.	I	350	2265	2225	1400	3500	352.8	237.9	15.57
	II	295	2257	2225	1600	3200	306.3	206.6	13.56
		645	2262	2225	1400	3500	336.4	226.9	14.85
Gastrointestinal mass. Actual.	I	350	416.4	410	115	710	80.9	54.5	19.42
	II	295	424.4	423	195	740	79.3	53.5	18.68
		645	419.9	415	115	740	80.8	54.5	19.24
Relative.	I	350	229.7	226	70.4	426	52.1	35.1	22.68
	II	295	235.2	230	118.0	452	49.9	33.7	21.21
		645	232.2	229	70.4	452	51.2	34.5	22.03
Net body weight.	I	350	1848.5	1800	1150	3010	323.3	218.0	17.49
	II	295	1833.1	1800	1210	2660	273.0	184.1	14.89
		645	1841.0	1800	1150	3010	301.3	203.2	16.36
Heart. Actual.	I	348	5.26	5.12	3.2	10.18	0.96	0.64	18.23
	II	295	5.31	5.22	3.3	9.02	0.93	0.627	17.51
		643	5.28	5.15	3.2	10.18	0.938	0.63	17.83
Relative.	I	348	2.85	2.81	1.95	4.42	0.35	0.24	12.32
	II	295	2.90	2.88	2.04	4.36	0.339	0.229	11.68
		643	2.87	2.82	1.95	4.42	0.344	0.232	11.98

Liver. Actual.	I	350	84.3	80.0	50.0	150.0	19.7	13.3	23.39
	II	295	87.5	85.0	47.0	185.0	19.3	13.0	22.04
		645	85.8	85.0	47.0	185.0	19.6	13.2	22.84
Relative.	I	350	46.5	44.9	23.2	97.4	11.8	8.0	25.48
	II	295	48.5	46.7	25.8	117.0	12.1	8.2	24.96
		645	47.4	45.8	23.2	117.0	11.9	8.0	25.10
Kidneys. Actual.	I	348	12.70	12.50	7.15	22.73	2.14	1.44	16.85
	II	294	13.22	13.05	8.33	20.00	2.06	1.39	15.55
		642	12.94	12.60	7.15	22.73	2.14	1.44	16.53
Relative.	I	348	6.97	6.84	3.45	17.28	1.26	0.85	18.08
	II	294	7.32	7.23	4.29	12.80	1.21	0.82	16.55
		642	7.13	6.98	3.45	17.28	1.25	0.84	17.53
Spleen. Actual.	I	347	0.990	0.900	0.08	3.20	0.436	0.294	44.04
	II	295	1.065	0.985	0.16	5.05	0.549	0.370	51.54
		642	1.023	0.940	0.08	5.05	0.512	0.345	50.04
Relative.	I	347	0.531	0.490	0.035	1.714	0.214	0.144	40.30
	II	295	0.587	0.528	0.107	2.930	0.326	0.220	55.53
		642	0.564	0.508	0.035	2.930	0.284	0.192	50.35
Thymus. Actual.	I	349	2.210	2.13	0.45	5.90	0.848	0.572	38.37
	II	295	2.360	2.25	0.37	6.30	0.842	0.568	35.67
		644	2.301	2.24	0.37	6.30	0.845	0.570	36.72
Relative.	I	349	1.230	1.147	0.334	2.720	0.451	0.304	36.64
	II	295	1.304	1.269	0.248	3.315	0.464	0.313	35.58
		644	1.264	1.215	0.248	3.315	0.463	0.312	36.62

TABLE I—*Continued.*

Organ.	Group No.	No. of animals.	Arithmetical mean.	Median.	Minimum.	Maximum.	Standard deviation.	Probable error.	Coefficient of variation.
			gm.	*gm.*	*gm.*	*gm.*	*±gm.*	*±gm.*	*per cent*
Testicles. Actual.	I	289	4.86	4.85	0.81	9.12	1.630	1.100	33.54
	II	294	4.50	4.48	0.92	9.01	1.415	0.954	31.44
		583	4.67	4.70	0.81	9.12	1.520	1.030	32.54
Relative.	I	289	2.61	2.62	0.470	4.93	0.729	0.492	27.93
	II	294	2.45	2.42	0.562	4.22	0.650	0.440	26.53
		583	2.53	2.53	0.470	4.93	0.708	0.478	27.98
Brain. Actual.	I	150	9.31	9.24	7.42	12.03	0.780	0.526	8.37
	II	295	9.11	9.15	5.80	11.33	0.687	0.463	7.54
		445	9.17	9.20	5.80	12.03	0.754	0.508	8.22
Relative.	I	150	5.11	5.06	3.33	8.16	0.870	0.580	16.92
	II	295	5.06	5.01	3.45	7.08	0.678	0.457	13.39
		445	5.08	5.02	3.33	8.16	0.743	0.501	14.62
Thyroid. Actual.	I	349	0.23048	0.185	0.085	1.570	0.16209	0.10933	70.33
	II	295	0.23560	0.210	0.085	1.730	0.13260	0.08944	56.28
		644	0.23280	0.200	0.085	1.730	0.14750	0.09949	63.35
Relative.	I	349	0.12324	0.0975	0.0504	0.730	0.07570	0.05106	61.47
	II	295	0.13030	0.1149	0.0481	1.230	0.08119	0.05476	62.31
		644	0.12650	0.1095	0.0481	1.230	0.07767	0.05239	61.39
Parathyroids. Actual.	I	349	0.01256	0.0120	0.0020	0.035	0.00486	0.00328	38.69
	II	292	0.01320	0.0120	0.0030	0.035	0.00551	0.00372	41.74
		641	0.01286	0.0120	0.0020	0.035	0.00508	0.00343	39.50

Relative.	I	349	0.00692	0.00631	0.00109	0.02175	0.00278	0.00187	40.13
	II	292	0.00730	0.00667	0.00178	0.01850	0.00289	0.00195	39.60
		641	0.00709	0.00642	0.00109	0.02175	0.00283	0.00191	39.91
Hypophysis. Actual.	I	348	0.0280	0.028	0.015	0.044	0.00517	0.00349	18.46
	II	294	0.0283	0.028	0.015	0.050	0.00553	0.00373	19.55
		642	0.0281	0.028	0.015	0.050	0.00526	0.00355	18.72
Relative.	I	348	0.01540	0.01530	0.00728	0.0294	0.00310	0.00209	20.27
	II	294	0.01566	0.01535	0.00780	0.0352	0.00322	0.00217	20.56
		642	0.01550	0.01530	0.00728	0.0352	0.00316	0.00213	20.38
Suprarenals. Actual.	I	349	0.3858	0.358	0.115	1.050	0.15460	0.10428	40.07
	II	295	0.3802	0.350	0.138	1.050	0.16460	0.11102	43.29
		644	0.3833	0.350	0.115	1.050	0.15950	0.10760	41.61
Relative.	I	349	0.2088	0.1967	0.0804	0.530	0.07503	0.05061	35.93
	II	295	0.2078	0.1850	0.0803	0.572	0.08460	0.05706	40.71
		644	0.2082	0.1920	0.0803	0.572	0.07950	0.05360	38.18
Pineal. Actual.	I	348	0.01609	0.014	0.005	0.030	0.00429	0.00289	26.66
	II	292	0.01540	0.015	0.005	0.040	0.00501	0.00338	32.53
		640	0.01577	0.015	0.005	0.040	0.00465	0.00314	29.48
Relative.	I	348	0.00885	0.00868	0.00273	0.01873	0.00245	0.00165	27.68
	II	292	0.00853	0.00836	0.00228	0.02470	0.00290	0.00196	33.99
		640	0.00871	0.00853	0.00228	0.02470	0.00266	0.00179	30.53
Popliteal lymph nodes. Actual.	I	242	0.25539	0.245	0.085	0.720	0.08241	0.05559	32.27
	II	294	0.25612	0.245	0.090	0.570	0.07690	0.05187	30.02
		536	0.25570	0.245	0.085	0.720	0.07940	0.05360	31.05

TABLE I—*Concluded.*

Organ.	Group No.	No. of animals.	Arithmetical mean.	Median.	Minimum.	Maximum.	Standard deviation.	Probable error.	Coefficient of variation.
			gm.	*gm.*	*gm.*	*gm.*	±*gm.*	±*gm.*	*per cent*
Popliteal lymph nodes. Relative.	I	242	0.13573	0.1361	0.0525	0.3820	0.04873	0.03287	35.90
	II	294	0.14250	0.1388	0.0500	0.3335	0.04415	0.02978	30.98
		536	0.14066	0.1380	0.0500	0.3820	0.04620	0.03116	32.84
Axillary lymph nodes. Actual.	I	242	0.17585	0.175	0.040	0.400	0.06141	0.04142	34.92
	II	292	0.16320	0.157	0.070	0.485	0.0562	0.03790	34.43
		534	0.16970	0.165	0.040	0.485	0.05909	0.03986	34.82
Relative.	I	242	0.09722	0.0910	0.01865	0.2425	0.03779	0.02549	38.87
	II	292	0.09005	0.0856	0.03410	0.2400	0.03170	0.02138	35.20
		534	0.09368	0.0875	0.01865	0.2425	0.03480	0.02347	37.14
Deep cervical lymph nodes. Actual.	I	124	0.15579	0.140	0.035	0.405	0.0732	0.04938	46.98
	II	289	0.15640	0.130	0.050	0.660	0.0787	0.05308	50.31
		413	0.15623	0.135	0.035	0.660	0.0765	0.05160	48.96
Relative.	I	124	0.08207	0.0724	0.02052	0.211	0.03712	0.02504	45.23
	II	289	0.08580	0.0738	0.03070	0.295	0.04140	0.02790	48.25
		413	0.08467	0.0739	0.02052	0.295	0.04022	0.02713	47.50
Mesenteric lymph nodes. Actual.	I	133	3.488	3.32	1.34	9.19	1.310	0.880	37.53
	II	293	3.460	3.34	1.07	11.47	1.133	0.764	32.75
		426	3.460	3.34	1.07	11.47	1.190	0.803	34.39
Relative.	I	133	1.828	1.763	0.72	3.71	0.642	0.433	35.12
	II	293	1.915	1.830	0.67	6.91	0.642	0.433	33.52
		426	1.885	1.825	0.67	6.91	0.642	0.433	34.05

net body weight (relative weight) as defined in the first paper (1). In each case, the results for Series I and II and for the total are recorded separately in the order mentioned. It will be noted that in the case of the gross body weight, the kidneys (actual), testicles (relative), suprarenals (actual), and axillary lymph nodes (actual), the figures given for Series I differ in a few respects from those given in the original paper. The changes represent corrections of slight errors in the original figures.

DISCUSSION AND CONCLUSIONS.

The results recorded in Table I require very little comment. It is at once apparent that there is a remarkably close agreement between corresponding values for Series I and Series II. In many instances, the agreement is almost absolute despite the occurrence of wide variations in the weights of individual organs. For example, the differences recorded for mean weights of Series I and II lie between 0.296 and 0.008 times the probable error of the difference; the values mentioned are those for the relative weights of the kidneys and the actual weights of the deep cervical lymph nodes, respectively. The closeness of the agreement thus shown is highly significant in view of the magnitude of the probable errors.

It is evident that, while any one of the three groups of figures would give an acceptable measure of mean weights and of the variation in weight of the organs concerned, neither the standard deviation, the probable error, nor the coefficient of variation gives more than a vague idea of the magnitude of the difference that may be found when mean weights are compared. In all cases, this difference proves to be much smaller than would be expected. This fact in itself suggests that the variations in weight are not due entirely to random sampling but a discussion of the reasons for the discrepancy between actual findings and theoretical expectations must be deferred until the material has been analyzed with reference to the occurrence of variations. Meantime, we may emphasize the fact that it is possible to obtain a remarkably close agreement of all values for organ weight, irrespective of whether the variations in weight are large or small, provided a sufficient number of observations is made and the observations are so distributed in time as to permit equalization of the

effects of factors that cause these variations. Similar conditions obtain for smaller groups of animals provided the conditions under which the determinations are made are constant or closely comparable, but as the numbers are decreased and the conditions varied the agreement becomes less and less until the differences found may reach those indicated by the probable error or standard deviation. Still, the difference between weights for groups of even ten animals rarely exceeds these limits which are based on the weights of individual organs and not on group averages.

Finally, in submitting these values for normal stock rabbits, it seems advisable to caution against the acceptance of such values as standard measures of organ weight applicable under all circumstances. These investigations have shown that for most organs it is not possible to obtain values that represent anything more than rough approximations to conditions that may be found at any particular time or under any particular set of natural circumstances. The values for mean weight, as recorded above, are to be regarded merely as focal points about which weights in general may fluctuate with upper and lower limits of probable variation of individual organs and of mean weights fixed by the probable error or the standard deviation. A mean weight may fall anywhere within the limits thus fixed or in the case of the weight of an individual organ, it may exceed these limits (*cf.* maximum and minimum values) and still be within the range of normal. In like manner, the median and the mode indicate approximate midpoints and points of greatest weight frequency, while the coefficients of variation serve as a general index of the degree of uniformity that may be expected for different classes of organs and of variation in the weights of individual organs of any given class. Naturally, the smaller the coefficient the closer the agreement that may be expected under a given set of circumstances as the results are less apt to be disturbed by irregularities in the weights of individual organs or the occurrence of organs whose weights are exceptionally large or small.

The limitations that must be imposed upon the acceptance of any value as a standard of normality will become apparent when we consider the values obtained for the various small groups comprising this series and factors that affect these values. For the present, it is

sufficient to say that this study of organ weights has shown that we are not justified in attempting to fix rigid standards of normality for organ weight. All values of which we have any knowledge are subject to wide variation and what is strictly normal under one set of conditions may be decidedly abnormal under another; existing conditions determine what the normal value should be in a given case. The most that we can do is to define certain broad limits within which such values lie. This we have attempted to do in Table I.

SUMMARY.

The results of a second series of organ weight determinations on normal rabbits are reported and the values obtained are compared with those for the first series. Figures are also given which represent the results obtained by combining the two series of animals or from weight determinations made on 645 apparently normal rabbits selected from stocks used for various experimental purposes.

BIBLIOGRAPHY.

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