

EFFECTS OF OBSCURE LESIONS ON ORGAN WEIGHTS OF APPARENTLY NORMAL RABBITS.

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The results of a series of weight determinations on a group of 350 male rabbits have been reported in a previous paper (1). All of these animals were in apparently good health and free from any external evidence of disease, but on postmortem examination it was found that many of them showed active or healed lesions of some kind. The presence of unsuspected lesions places these latter animals in a class intermediate between those that are normal clinically and pathologically and animals that show obvious signs and symptoms of disease.

The frequency with which gross lesions of various kinds may be encountered in apparently normal rabbits, and the effects of obscure disease processes on the weights of organs are subjects of considerable importance, and the purpose of the present paper is to report briefly the conditions that were found and the results of a comparison of organ weights in those animals of the group that were normal clinically and pathologically and those that showed gross lesions at autopsy.

Methods and Material.

A detailed description of the material on which this report is based and of the methods employed will be found in the first report (1).

The presentation of data bearing on weight relationships will follow the form used in the previous paper with the omission of distribution curves, as the number of animals in some of the subgroups is too small to justify the use of distribution curves.

Classification of Animals and Incidence of Lesions.

On the basis of postmortem findings, the rabbits of this series (350) may be divided into four groups: (1) animals showing no gross lesions

or other evidence of disease, (2) those with few or very slight lesions affecting not more than one organ or tissue, (3) animals with slight lesions of several organs or moderate lesions of one or more organs, (4) animals with marked lesions of one or more organs. For convenience, these groups may be designated as normal or absolute normal, slight, moderate, and marked, or Groups 1, 2, 3, and 4.

The distribution of the 350 rabbits was as follows:

Group.	No. of rabbits.	Per cent.
1	207	59.1
2	71	20.3
3	36	10.3
4	36	10.3
Total.....	350	100.0

Nature of Lesions.

A detailed description of the lesions noted and their distribution among the four groups of animals will not be given at this time. It seems sufficient to say that the conditions encountered with greatest frequency were:

Coccidiosis of the liver, active or healed.....	80	animals.
Infection or scarring of the kidneys.....	27	“
Purulent inflammation of the cranial sinuses.....	21	“
Otitis media, mastoiditis, or both.....	11	“
Lesions of the aorta*.....	16	“
Coccidial cysts in the abdominal cavity not associated with visible lesions of the liver.....	8	“
Pronounced verminous infection of intestinal tract.....	7	“
Focal peritonitis of undetermined etiology.....	4	“

* The majority of the lesions of the aorta occurred in the first 100 rabbits and most of them were comparatively slight degenerations. Subsequently only marked lesions were recorded.

Other conditions that were noted include focal infection of the lungs verminous infection of the liver, small encapsulated abscesses in the subcutaneous tissues and in the deeper tissues of the neck, coccidial cysts in the subcutaneous tissues of the umbilical region, cysts of the thyroid and parathyroids (several cases), hydrocephalus, healed fractures, and adenoma of the left kidney.

With the exception of the sinus and middle ear infections, the great majority of the lesions were either inactive or healed and in none of these animals was the infection sufficiently active to cause a nasal discharge or disturbance of coordination. For example, among the 80 rabbits with coccidiosis of the liver, there were only 20 with fresh lesions; 10 of these were slight (2 or 3 lesions seen), 6 moderate, and 4 marked. Scarring was the only condition noted in 56 cases. In 44 of these the lesions were slight, in 8 moderate, and in 4 marked. In the case of the kidneys the difference was even greater. Scarring was the principle lesion in 25 of the 27 rabbits, while 2 showed a definite acute nephritis, one slight and the other marked. Among the animals with scarred kidneys, there were 9 in which the lesions were classed as slight, 10 moderate, and 6 marked.

The three conditions responsible for nearly all lesions classed as moderate or marked were coccidiosis of the liver, renal abnormalities, and infections of the cranial sinuses, middle ear, and mastoids.

Results of Weight Determinations.

The results of the weight determinations for the entire series of rabbits and for each of the four subgroups are given in Table I. The combined results come first, with the subgroups following in regular numerical order; the values for actual weights precede those for weights per kilo of net body weight (relative weight). In comparing actual weights of organs and coefficients of variation, one should note the order of magnitude of mean body weights and of the coefficients of variation for body weight as these factors affect the actual weights and the coefficients of those organs whose weights are most affected by body weight (1).

DISCUSSION.

In considering the results recorded in Table I the first point to which attention may be directed is the frequency with which active or healed lesions were encountered. The incidence of gross lesions in this series of rabbits was almost exactly 40 per cent; from what is known concerning the occurrence of microscopic lesions in such organs as the brain (2, 3) and heart (4), it is not unlikely that a microscopic

TABLE I.
Results Obtained for Body and Organ Weights According to Groups.

Organ.	Group No.	No. of animals.	Arithmetical mean.		Median.	Minimum.		Maximum.	Standard deviation.		Probable error.		Coefficient of variation.
			gm.	per cent.		gm.	per cent.		gm.	per cent.	gm.	per cent.	
Gross body weight.	1	350	2,240.3	2,225	1,400	3,500	352.62	237.84	15.74				
	2	207	2,293.9	2,250	1,575	3,450	358.64	241.90	15.63				
	3	71	2,227.2	2,200	1,725	3,500	283.07	190.93	12.71				
	4	36	2,319.7	2,225	1,550	3,375	393.03	265.10	16.94				
Gastrointestinal mass.		36	2,166.0	2,050	1,400	3,100	357.24	240.96	16.50				
	1	350	416.35	410	115	710	80.89	54.53	19.42				
	2	207	402.07	415	235	710	80.58	54.35	20.04				
	3	71	428.40	420	295	690	66.00	44.52	15.41				
Net body weight.	4	36	406.60	392.5	305	640	68.90	46.47	16.94				
		36	378.60	382	115	540	83.30	56.19	22.00				
	1	350	1,848.5	1,800	1,150	3,010	323.27	218.04	17.49				
	2	207	1,868.5	1,830	1,275	2,950	324.07	218.59	17.34				
Heart. Actual.	3	71	1,793.9	1,800	1,215	3,010	274.49	185.14	15.30				
	4	36	1,909.3	1,807	1,150	2,950	382.70	258.13	20.04				
		36	1,779.0	1,695	1,175	2,685	321.86	216.09	18.09				
	1	348	5.26	5.12	3.2	10.18	0.96	0.64	18.23				
	2	206	5.23	5.13	3.2	9.50	0.98	0.66	18.74				
	3	71	5.14	5.00	3.6	7.68	0.74	0.50	14.05				
	4	36	5.35	5.20	3.75	7.70	0.87	0.57	16.26				
		35	5.13	5.21	3.55	10.18	1.28	0.86	24.97				

Relative.	1	348	2.81	2.81	1.95	4.42	0.35	0.24	12.32
	2	206	2.76	2.76	1.95	4.21	0.32	0.22	11.38
	3	71	2.86	2.86	2.27	3.75	0.32	0.22	10.81
	4	35	2.89	3.00	2.06	3.60	0.35	0.24	12.32
Liver. Actual.	1	350	84.30	80.00	50.00	150.00	19.72	13.30	23.39
	2	207	85.85	82.00	52.00	150.00	20.59	13.89	23.98
	3	71	82.10	80.00	50.00	135.00	17.49	11.80	21.30
	4	36	80.82	79.00	52.50	120.00	16.49	11.12	20.40
Relative.	1	350	83.56	83.00	50.00	140.00	20.88	14.08	24.98
	2	207	46.46	44.90	23.20	97.40	11.84	7.99	25.48
	3	71	48.83	44.60	23.20	80.60	11.19	7.55	22.92
	4	36	46.40	47.20	27.80	75.80	10.41	7.02	22.43
Kidneys. Actual.	1	348	44.21	39.40	26.00	97.40	14.76	9.95	33.40
	2	207	47.95	45.35	28.10	85.70	13.75	8.57	28.67
	3	71	12.70	12.50	7.15	22.73	2.07	1.40	16.30
	4	35	12.70	12.55	7.15	20.07	2.12	1.43	16.69
Relative.	1	348	12.77	12.86	9.08	22.73	1.98	1.34	16.21
	2	207	13.19	12.70	9.92	20.90	2.49	1.68	19.50
	3	71	6.97	6.84	3.45	17.28	2.29	1.54	17.36
	4	35	6.90	6.69	3.45	11.77	1.26	0.85	18.08
Relative.	1	207	6.89	6.92	4.89	8.77	0.89	0.78	16.81
	2	71	6.83	6.60	4.55	10.67	1.38	0.93	12.92
	3	35	7.45	7.17	5.49	17.28	2.90	1.96	20.21
	4	35							38.99

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.	%
Spleen. Actual.	1	347	0.990	0.90	0.08	3.20	0.436	0.294	44.04				
	2	205	0.972	0.89	0.08	2.40	0.419	0.283	43.10				
	3	70	0.919	0.80	0.28	2.20	0.405	0.273	44.07				
	4	36	1.065	1.015	0.23	3.20	0.393	0.265	36.90				
Relative.		36	1.156	1.075	0.31	2.40	0.521	0.351	45.07				
	1	347	0.531	0.49	0.035	1.714	0.214	0.144	40.30				
	2	205	0.532	0.482	0.035	1.466	0.236	0.159	44.36				
	3	70	0.522	0.476	0.186	1.043	0.207	0.14	39.65				
Thymus. Actual.	1	36	0.561	0.526	0.137	1.23	0.221	0.149	39.40				
	2	36	0.661	0.631	0.182	1.714	0.299	0.202	45.23				
	3	349	2.210	2.13	0.45	5.90	0.848	0.572	38.37				
	4	206	2.321	2.22	0.83	5.22	0.821	0.554	35.37				
Relative.	1	71	2.165	2.135	0.45	4.70	0.895	0.604	41.34				
	2	36	2.058	1.99	0.855	3.40	0.694	0.468	33.72				
	3	36	2.119	1.952	1.06	5.90	0.949	0.640	44.78				
	4	349	1.23	1.147	0.334	2.72	0.451	0.304	36.64				
Testicles. Actual.	1	206	1.247	1.192	0.443	2.71	0.430	0.290	34.48				
	2	71	1.202	1.198	0.334	2.72	0.473	0.319	39.35				
	3	36	1.082	1.086	0.446	2.135	0.417	0.281	38.54				
	4	36	1.217	1.045	0.512	2.59	0.505	0.341	41.53				
Relative.	1	290	4.86	4.85	0.81	9.12	1.63	1.10	33.54				
	2	184	4.74	4.86	0.81	9.12	1.64	1.11	34.60				
	3	49	4.72	4.91	2.29	8.98	1.32	0.89	27.75				
	4	26	5.60	5.52	2.10	8.65	1.65	1.13	29.46				
		31	4.70	5.05	2.16	9.02	1.57	1.06	33.40				

Relative.	290	2.61	2.62	0.47	4.93	0.70	0.47	26.90
	184	2.53	2.67	0.47	4.79	0.738	0.498	29.17
	49	2.59	2.59	1.46	4.32	0.607	0.409	23.44
	26	2.98	3.02	1.09	4.93	0.75	0.506	25.17
Brain. Actual.	31	2.58	2.70	1.09	4.16	0.747	0.504	28.95
	150	9.31	9.24	7.42	12.03	0.78	0.526	8.37
	84	9.45	9.29	7.52	11.54	0.78	0.526	8.25
	30	9.17	9.15	8.05	10.10	0.51	0.344	5.50
Relative.	15	9.34	9.35	8.47	10.25	0.497	0.335	5.30
	21	9.36	9.40	7.42	12.03	1.09	0.735	11.64
	150	5.113	5.06	3.33	8.16	0.87	0.58	16.92
	84	5.001	5.35	3.25	6.90	0.87	0.586	17.40
Thyroid. Actual.	30	5.30	5.30	4.19	7.04	0.72	0.485	13.40
	15	5.15	4.93	3.94	8.16	1.02	0.688	19.80
	21	5.23	5.19	3.33	8.16	0.82	0.55	15.68
	349	0.23048	0.185	0.085	1.570	0.16209	0.10933	70.33
Relative.	206	0.22734	0.185	0.085	1.570	0.16134	0.10882	70.90
	71	0.19580	0.180	0.090	0.445	0.07708	0.05199	39.36
	36	0.27540	0.207	0.110	0.810	0.17388	0.11728	63.14
	36	0.27364	0.185	0.100	0.900	0.21132	0.14254	77.23
Relative.	349	0.12324	0.0975	0.0504	0.7300	0.0757	0.05106	61.47
	206	0.12015	0.1033	0.0504	0.7300	0.07071	0.04769	58.85
	71	0.10927	0.0976	0.0562	0.2372	0.03357	0.02264	30.72
	36	0.1431	0.1138	0.0576	0.3520	0.07633	0.05148	53.34
Relative.	36	0.14885	0.11095	0.0587	0.4825	0.10287	0.06939	69.11

TABLE I—Continued.

Organ.	Group No.	No. of animals.	Arithmetical mean.		Median.	Minimum.		Maximum.	Standard deviation.		Probable error.	Coefficient of variation.
			gm.	per cent.		gm.	per cent.		gm.	per cent.		
Parathyroids. Actual.	1	349	0.01256	0.0120	0.002	0.0350	0.00486	0.00328	38.69			
	2	206	0.01258	0.0120	0.005	0.0350	0.00459	0.00310	36.48			
	3	71	0.01204	0.0110	0.002	0.0320	0.00489	0.00330	40.75			
	4	36	0.01311	0.0120	0.007	0.0280	0.00455	0.00307	34.71			
Relative.		36	0.01322	0.0115	0.005	0.0300	0.00625	0.00422	47.43			
	1	349	0.00692	0.00631	0.00109	0.02175	0.00278	0.00187	40.13			
	2	206	0.00679	0.00631	0.0026	0.02175	0.00290	0.00196	42.71			
	3	71	0.00682	0.00619	0.00109	0.01510	0.00265	0.00179	38.85			
Hypophysis. Actual.	3	36	0.00729	0.00623	0.00122	0.01569	0.00298	0.00201	40.88			
	4	36	0.00771	0.00710	0.00296	0.01835	0.00375	0.00253	48.64			
	1	348	0.028	0.028	0.015	0.044	0.00517	0.00349	18.46			
	2	205	0.02795	0.027	0.015	0.044	0.00521	0.00351	18.64			
Relative.	2	71	0.02421	0.027	0.015	0.042	0.00557	0.00376	23.01			
	3	36	0.02947	0.030	0.018	0.040	0.00549	0.003703	18.63			
	4	36	0.0287	0.030	0.019	0.038	0.00448	0.00304	15.60			
	1	348	0.0154	0.0153	0.00728	0.0294	0.0031	0.00209	20.27			
Suprarenals. Actual.	2	205	0.01565	0.01513	0.00728	0.0294	0.00305	0.00206	19.50			
	3	71	0.01521	0.0147	0.00808	0.0218	0.00283	0.00191	18.61			
	4	36	0.0158	0.01591	0.0095	0.02435	0.00331	0.00223	20.93			
	1	36	0.01656	0.01666	0.0095	0.0255	0.00355	0.00239	21.44			
Suprarenals. Relative.	1	349	0.38012	0.358	0.115	1.050	0.15501	0.10455	40.78			
	2	207	0.38498	0.355	0.115	1.020	0.15348	0.10352	39.86			
	3	70	0.3524	0.3285	0.180	0.830	0.13461	0.0907	38.20			
	4	36	0.42539	0.4550	0.180	0.785	0.13907	0.0938	32.70			
		36	0.4144	0.354	0.155	1.050	0.19407	0.1309	46.83			

TABLE I—Concluded.

Organ.	Group No.	No. of animals.	Arithmetical mean.		Median.	Minimum.	Maximum.	Standard deviation.	Probable error.		Coefficient of variation.
			gm.	%					gm.	%	
Relative.	1	242	0.09722	0.091	0.01865	0.2425	0.03779	0.02549	0.88	38.87	
	2	160	0.09843	0.0926	0.01865	0.200	0.03595	0.02425	0.964	36.57	
	3	41	0.0989	0.097	0.0273	0.2425	0.0414	0.02792	0.755	41.86	
	4	17	0.0806	0.0787	0.0453	0.1438	0.03043	0.02053	0.715	37.75	
Deep cervical lymph nodes. Actual.	1	24	0.09373	0.0813	0.02556	0.2205	0.04403	0.026698	0.904	46.97	
	2	124	0.15579	0.140	0.035	0.405	0.0732	0.04938	0.43	46.98	
	3	80	0.15872	0.1425	0.045	0.405	0.07662	0.05168	0.46	48.27	
	4	23	0.1433	0.140	0.070	0.250	0.0508	0.03426	0.36	35.45	
Relative.	1	9	0.18125	0.140	0.085	0.290	0.06878	0.04639	0.374	37.95	
	2	12	0.15708	0.130	0.035	0.280	0.06864	0.0463	0.374	43.69	
	3	124	0.08207	0.0724	0.02052	0.211	0.03712	0.02504	0.43	45.23	
	4	80	0.0821	0.0726	0.0327	0.211	0.03852	0.02598	0.46	46.92	
Mesenteric lymph nodes. Actual.	1	23	0.0825	0.0714	0.0358	0.1695	0.03528	0.0238	0.374	42.76	
	2	9	0.07463	0.06275	0.0470	0.121	0.02658	0.01793	0.374	35.61	
	3	12	0.08818	0.0842	0.02052	0.1425	0.03402	0.02295	0.374	38.58	
	4	133	3.488	3.32	1.34	9.19	1.31	0.88	0.88	37.53	
Relative.	1	81	3.66	3.57	1.35	9.19	1.43	0.964	0.964	39.07	
	2	26	3.40	3.32	1.72	7.10	1.12	0.755	0.755	32.94	
	3	10	3.26	3.32	1.80	5.87	1.06	0.715	0.715	32.51	
	4	16	2.91	2.86	1.34	4.60	1.34	0.904	0.904	46.05	
Relative.	1	133	1.828	1.763	0.72	3.71	0.642	0.43	0.43	35.12	
	2	81	1.89	1.847	0.72	3.71	0.684	0.46	0.46	36.19	
	3	26	1.88	1.76	1.165	3.39	0.534	0.36	0.36	28.28	
	4	10	1.60	1.507	0.826	2.77	0.555	0.374	0.374	34.70	
		16	1.56	1.61	0.772	2.57	0.505	0.341	0.341	32.38	

examination of tissues from all organs would show a material increase in the percentage of animals with lesions of some kind.

It is obvious, therefore, that the apparent state of health and the presence or absence of lesions do not run parallel. In this series of 350 rabbits there were 72 rabbits (20 per cent) with moderate or marked lesions, but these animals were apparently as vigorous and healthy as those that were entirely free from any gross evidence of disease. This situation might have been altered by a more prolonged period of observation. This is especially true of those animals with sinus or middle ear infections, acute coccidiosis, and acute nephritis as these conditions are not infrequently accompanied by signs or symptoms of disease. In fact, diseases accompanied by lesions less extensive than many of those seen in animals of this series frequently cause severe symptomatic disturbances or even death. Strictly speaking, therefore, the physical condition of an animal is an index of the effects of disease or of the manner in which an animal reacts to infections of various types rather than of the probable presence or absence of disease processes.

There is, however, a remarkably close numerical relation between the extent of the lesions found in this group of animals and the resistance ordinarily displayed by rabbits. For example, the number of animals found to be normal, or nearly so, (Groups 1 and 2) was 278, while only 72 (Groups 3 and 4) showed any considerable degree of abnormality. That is, approximately 80 per cent (79.42 per cent), or four out of every five rabbits, were practically free from gross evidence of disease, while one in five (20.56 per cent) showed evidence of a serious affection, and only one in ten (Group 4, 10.28 per cent) of a disease of marked severity. These figures agree almost exactly with repeated observations on the resistance of rabbits to various experimentally induced diseases as well as to toxic agents of many kinds. As stated by us (5), the resistance ratio of rabbits, high: intermediate: low, is approximately 1:3:1, while one animal in every ten may be expected to display a resistance of a very low order.

Similar conditions obtain in the case of organ weights. An examination of the data in Table I shows that the differences in the weights of organs of rabbits with no gross lesions, or lesions that were slight, moderate, or marked, are very small and that the figures for the sub-

groups are comparable to those for the entire series; in many instances the agreement is almost absolute and in all cases the values are within the limits of error for any one of the four groups.

Still, one can detect a definite relation between the results obtained and the pathological status of the animal. This may be brought about by a consideration of the relative magnitude of mean weights per kilo of net body weight and of the corresponding coefficients of variation. Thus, the distribution of largest and smallest mean weights and of the largest and smallest coefficients of variation according to groups is as follows (Table II):

TABLE II.
Distribution of Maximum and Minimum Mean Weights and Coefficients of Variation According to Groups.

Organ.	Mean weight.		Coefficient.	
	Maximum.	Minimum.	Maximum.	Minimum.
Thyroid.....	4	2	4	2
Hypophysis.....	4	2	4	2
Suprarenals.....	4	2	4	3
Parathyroids.....	4	1	4	2
Pineal gland.....	3	4	3	2
Popliteal lymph nodes.....	2	3	3	1
Axillary " ".....	2	3	4	1
Mesenteric " ".....	1	4	1	2
Thymus.....	1	3	4	1
Heart.....	2	1	4	2
Brain.....	2	1	3	2
Liver.....	1	3	3	2
Kidneys.....	4	3	4	2
Spleen.....	4	2	4	3
Deep cervical lymph nodes.....	4	3	1	3

From this tabulation, it is at once apparent that there is a close parallelism between the values obtained for the endocrine glands and disease processes. With a single exception, the heaviest organs and the greatest variation in weight occur in animals with the most marked lesions, while the smallest organs and the greatest constancy are found in animals with slight lesions. The one striking exception to this rule

is in the case of that organ of the group the weight of which is probably least reliable; namely, the pineal gland.

The relation between weights and lesions is less obvious in the case of other organs. The coefficients of variation follow the same order as for the endocrine glands but in the case of mean weights the relation appears to be reversed. In most instances, the largest weights are found in animals with few or no lesions (Groups 1 and 2), while the small weights occur in animals with moderate or marked lesions (Groups 3 and 4); in general, the reverse is true for coefficients of variation.

The exceptions to this general tendency are susceptible of various explanations. In some instances, the organs concerned are either the seat of lesions or are directly affected by disease processes. This applies particularly to the liver, the kidneys, the spleen, and the deep cervical lymph nodes. The weights of both the liver and the kidneys may be greatly increased or diminished but the probable end-result is somewhat different in the two cases. Active coccidiosis usually increases the weight of the liver and the same is true for active or acute infections of the kidneys. On the other hand, scarring of the liver from coccidiosis tends to diminish the weight, while in the case of the kidneys the effect of chronic disease is not infrequently in the opposite direction, so that the weights of scarred kidneys may be greatly increased (see maximum and minimum values, Table I). In like manner, the spleen is apt to be enlarged in animals with abdominal disease, while the deep cervical lymph nodes show a similar response to infections of the cranial sinuses.

In the case of the heart and brain, the occurrence of the smallest weights in normal animals is what might be expected of organs that are not known to play an active part in the general reaction to disease. Still, both of these organs conform to the general tendency in other respects and, as a matter of fact, this one discrepancy is more apparent than real as the differences between the mean weights of the heart and brain for animals of Groups 1 and 3 are so small that Group 3 might well be substituted for Group 1 in the column of smallest weights.

Another interesting condition that is brought out by this arrangement of organ weights and coefficients (Table II) is the divergent tendency of superficial and deep lymph nodes. In our experience, these

two groups of lymph nodes rarely behave alike, and this is true in the present instance. The superficial lymph nodes, popliteals and axillaries, are the only organs whose weights were most constant in strictly normal animals, while the deep lymph nodes, mesenterics and deep cervicals, showed the greatest irregularity in the same class of animals. The superficial nodes are extremely sensitive in their reaction to infection, and it is not surprising to find the most constant weights in normal animals, but the deep cervical and mesenteric lymph nodes appear to be influenced more by local than by systemic conditions or by conditions other than those that affect the superficial nodes.

The thymus, mesenteric lymph nodes, and the liver have the distinction of being the only organs with weights largest in normal animals, a finding which may be attributed to conditions affecting alimentation or general nutrition as these three organs are peculiarly susceptible to such influences.

Our object in directing attention to these details of mass relationships is merely to show that, in spite of the small numerical differences between the values obtained for the weights of organs of different groups of animals, there is a distinct suggestion of a correlation between obscure disease processes and the weights of many if not all of the organs of the body. The material on which this study is based is not sufficient to enable one to define the relation in exact terms or even to say with certainty that a definite relation exists. The number of animals in Groups 1 and 2 is probably sufficient to indicate what may be expected in the case of rabbits that are normal or nearly so; the uncertainty is attached to animals with moderate or marked lesions. But more material is now available, and when this has been analyzed we will be able to speak with greater assurance. Meantime, the evidence that has been presented is sufficiently definite to warrant certain tentative conclusions.

In the first place, it would appear that in estimating the weights of organs of large groups of supposedly normal rabbits the results are not materially disturbed by the inclusion of animals with slight or even with moderate lesions and are not greatly affected by animals with marked lesions. In general, it may be said that so long as the health and vigor of the animal remains unimpaired, the presence of

lesions is not associated with quantitative changes in the weights of organs that are sufficiently large to be of any statistical significance.

Possible exception may be made in the case of organs that are themselves the seat of disease, such as the kidneys and liver, and those organs which, by reason of their position or function, are directly affected by the disease processes, as in the case of the spleen and the deep cervical lymph nodes; but, even in these cases, the changes in mean values are relatively small so long as we deal with groups of considerable size. Extreme changes may be encountered in individual animals but changes in one direction are apt to be counterbalanced by those in the opposite direction, so that irregularity or variability becomes the outstanding feature when mean values are compared with those for normal or slightly abnormal animals.

This situation is in striking contrast with conditions that are found when diseases of the same nature have progressed to the point of clinical recognition. It is not surprising, therefore, to find a suggestion of differences in the weights of organs such as are found in cases of outspoken disease.¹ The organs in which such changes are most apparent are not those directly affected by the disease but are organs which are chiefly concerned with processes of animal economy or in the reaction to disease, especially the organs of internal secretion and the lymphoid tissues. The tendency of these organs to undergo changes in weight, which vary according to the lesions present, is strongly suggestive of a functional response on the part of these organs.

In this connection, Group 2, composed of animals with minor lesions, is of especial interest as the animals of this group gave the most consistent results; the weights of organs were either very large or very small but in either case there was less variation in weight than in any other group. This suggests that the presence of some slight lesion or focus of infection may serve as a stimulus and at the same time regulate functional activity in such a way as to maintain the weights of organs at or near the normal level and within limits that are

¹ The results of observations made on a group of animals with clinically recognizable diseases of spontaneous origin will be reported in a subsequent paper. Reference to conditions that are found in such animals are based on the results of this study.

even narrower than those of normal rabbits. This suggestion is strengthened by the reversal of these conditions in animals with more extensive lesions.

CONCLUSIONS.

It would appear that, in rabbits, any departure from the normal gives rise to some change in the mass and mass relationships of organs and the tendency to variation. These changes follow a regular order depending upon the degree of abnormality, but the magnitude of the change is of such an order that it is barely perceptible until the abnormality is sufficiently pronounced to be recognized by signs and symptoms of disease or by physical deterioration. In apparently healthy and vigorous rabbits only those with extensive lesions show differences in the mean weights of organs, when compared with the normal, that are of any material significance from a statistical point of view; but all changes are of importance from the point of view of the reaction to disease.

SUMMARY.

A group of 350 normal rabbits was studied with reference to the occurrence of obscure lesions of various kinds and the probable or possible effect of such lesions or disease processes on organ weights. The results of the investigation are presented in the form of comparative tabulations.

It was found that so long as the animals remained in apparently good health the values obtained for organ weights of animals with lesions did not differ materially from those for animals that were entirely free from lesions. There were, however, slight deviations from the normal which appeared to be significant in that they suggested a functional response similar in character to the more marked changes in mass and mass relationships that occur in rabbits presenting clinical symptoms of disease due to the same causes.

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