

in accord with observations of hormone-induced ovulation in mammals. By counts of ruptured follicles, 7 ovulations were effected in one hen, 6 in another, 5 in each of 6 hens, and 4 in each of 5. In a number of birds the full complement of ovulated yolks was recovered from the oviduct and body cavity. Recovered yolks ranged from 12.4 to 23.1 g in weight, a rather large range for these hens. Only a single egg was found in the oviduct of any hen following a given injection and only a single yolk was recovered from any egg.

The PMS pretreatment induced great follicular growth in most birds and mechanical factors may account partly for failure of the oviducts to include more yolks. However, it is unlikely that mechanical difficulties accounted entirely for the uniformly observed singly occurring one-yolked eggs in the oviducts of the LH-treated hens.

Summary. Ovulations were induced in hens by the intravenous injection of a luteinizing preparation into hens pretreated with pregnant mare's serum for 6 to 11 days. Ovulation was induced in some hens following each of 3 successive LH injections. As many as 7 multiple ovulations were effected in individual PMS pretreated hens following a single LH injection.

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Effect of Thyroidectomy, Castration, and Replacement Therapy on Thymus, Lymph Nodes, Spleen in Male Rats.*

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A quantitative relationship between the thymus gland and other lymphoid tissues has been shown to exist for the effects of castration¹ and adrenalectomy^{2, 3} in the rat. Clinically, castration and hyperthyroidism are conditions in which the thymus and lymphoid tissues

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¹ Chiodi, H., *Rev. de la Soc. Arg. de Biol.*, 1938, **14**, 74.

² Reinhardt, W. O., and Holmes, R. O., *PROC. SOC. EXP. BIOL. AND MED.*, 1940, **45**, 267.

³ Houssay, B. A., del Castillo, E. B., and Pinto, A., *Rev. de la Soc. Arg. de Biol.*, 1941, **17**, 26.

may vary from normal. The following experiments were undertaken to obtain a quantitative expression of these relationships. The effects of castration, thyroidectomy, castration and thyroidectomy, and treatment with thyroxin or testosterone propionate, singly or in combination with the operative procedures mentioned, have been studied in order to clarify any possible relationship in the reactions of the thymus, lymph nodes and spleen to the hormonal stimuli mentioned.

Methods. Male rats 60 days of age of the Long-Evans strain were divided into 4 main groups. Each group consisted of either unoperated normals, castrated, thyroidectomized, or castrated-thyroidectomized animals. Animals in each of these groups were in turn subjected either to treatment with thyroxin or testosterone propionate or served as normal or operated controls. A total of 12 groups (133 animals) constituted the experimental material.

Treatment was begun on the day following operation and continued daily for 35 days. The animals were autopsied at the age of 95 days, being sacrificed under chloroform anesthesia by bleeding from the heart.

Thyroxin was administered by subcutaneous injection of the crystalline product dissolved in alkaline solution in quantities of 7 or 50 μg per day (100 $\mu\text{g}/\text{cc}$). Testosterone propionate was administered subcutaneously in sesame oil (1.0 mg/cc) in amounts of 500 μg daily.

The animals received the regular stock diet XIV and were maintained under the same experimental conditions. Operations were checked for completeness at autopsy. Oxygen consumption tests performed on the thyroidectomized animals one week prior to autopsy gave further evidence of the completeness of operation.

At autopsy, thymus, spleen, cervical lymph nodes (superficial and deep) and mesenteric lymph nodes were dissected out in a routine manner by the same person to avoid variation, weighed, and fixed for histological examination, as in a previous study.²

Results. Table I presents the data obtained, those weights significantly different from the normal controls being italicized. Inspection of the table will show trends in weight of the thymus and lymphoid tissues of various groups, which, while not statistically significant according to the criteria employed, are of interest in their variation from the normal.

In general, it may be stated that castration alone or in combination with thyroxin treatment will cause definite increases in the weights of the thymus, lymph nodes and spleen. Testosterone pro-

TABLE I.
Weights of Thymus, Lymph Nodes and Spleen in Male Rats.

Type of animal	Treatment	No. of animals	Avg body wt, g	Thymus	Cervical nodes	Mesenteric nodes	Spleen
Unoperated	Controls	21	296	222 ± 13*	245 ± 19	358 ± 22	1135 ± 48
	Thyroxin (50)†	7	285	235 ± 13	315 ± 21	390 ± 23	1122 ± 111
	Testosterone						
	Propionate (500)	12	282	121 ± 12†	301 ± 17	261 ± 12	1070 ± 73
Thyroidectomized	Controls	14	263	183 ± 13	235 ± 16	386 ± 31	958 ± 74
	Thyroxin (7)	9	292	233 ± 22	250 ± 31	331 ± 16	1160 ± 76
	Testosterone						
	Propionate (500)	7	245	82 ± 9	167 ± 10	325 ± 30	630 ± 63
Castrated	Controls	10	283	419 ± 28	374 ± 34	449 ± 20	1384 ± 76
	Thyroxin (50)	10	286	510 ± 34	411 ± 29	456 ± 30	1657 ± 199
	Testosterone						
	Propionate (500)	10	284	114 ± 14	286 ± 25	365 ± 45	1187 ± 82
Castrated Thyroidectomized	Controls	10	194	218 ± 18	329 ± 25	323 ± 23	1080 ± 62
	Thyroxin (50)	12	231	301 ± 33	242 ± 50	402 ± 23	1210 ± 136
	Testosterone						
	Propionate (500)	11	241	84 ± 15	197 ± 20	306 ± 29	1190 ± 153

*Mean wt in mg ± standard error of mean.

†In this study, those means showing a significant variation from normal controls are italicized. Significance was determined by calculation of a significant ratio greater than 3.0.

‡Figures in parentheses indicate the daily dose in micrograms.

pionate in combination with thyroidectomy caused decreases in weights of these tissues. Thyroidectomy prevented the marked increase in weight which followed castration alone. Thyroidectomy alone reduced the weights of thymus and spleen to a small extent. This reduction was repaired by the daily administration of thyroxin. Although not statistically significant, there is evidence of a positive additive effect of thyroxin treatment of castrated animals. The same may be stated of the weight decreasing effects of testosterone treatment of thyroidectomized animals. Testosterone propionate prevented the increase caused by castration, in the weights of the thymus, lymph nodes and spleen.

Histological examination was undertaken of representative hematoxylin and eosin stained celloidin sections of the thymus, spleen and lymph nodes of the various groups. Changes in the histology of the thymus after the above treatments are well known. Examination of the spleen in those groups showing significant increases in weight gave evidence of enlargement of the lymphatic nodules with coincidental hyperplasia of the diffuse white pulp. Changes in the lymph nodes, both cervical and mesenteric, were quantitative in nature, no specific morphological changes being noted.

In order of responsiveness to the stimuli applied in these experi-

ments the tissues may be graded in order of decreasing reactivity (weight changes) as: thymus, cervical lymph nodes, mesenteric lymph nodes and spleen.

To determine whether changes in the thymus were positively correlated with similar changes in the lymph nodes, a correlation ratio was obtained between the thymus and the cervical lymph node weights employing the above and comparable data. A positive coefficient of correlation of 0.591 ± 0.080 was obtained. This would indicate that when changes occur in the one tissue, similar changes in the same direction are apt to occur in the other.

Summary. 1. Evidence is presented that there is a relationship in the reactions of the thymus, spleen, and lymph nodes to the effects of castration, thyroidectomy, and treatment with thyroxin or testosterone propionate, or combinations of these in the male rat. 2. Castration and thyroxin cause comparable increases in the weights of thymus, lymph nodes and spleen. Thyroidectomy and treatment with testosterone propionate tend to decrease the weights of these tissues. Thyroidectomy and testosterone propionate prevent the increase in the weights of thymus, spleen and lymph nodes which follow castration. The order of decreasing sensitivity to the stimuli employed is as follows: thymus, cervical lymph nodes, mesenteric lymph nodes and spleen. 3. A positive coefficient of correlation of 0.591 ± 0.080 was calculated from the data derived from the above experiments for the thymus and the cervical lymph nodes. This is further evidence of a similarity in reaction of these tissues.

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Electrophoretic Patterns of Concentrated Cerebrospinal Fluid.*

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The protein content of cerebrospinal fluid is of significance in the diagnosis of neurological disorders such as brain and spinal cord tumors, neurosyphilis, peripheral neuritis, etc. Very little is known, however, about the origin or composition of spinal fluid proteins, or

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