blastosis) by Beard and his collaborators(3). Whether the close immunologic relationship between the different agents of the leukosis complex(3) is indicatory of a close relationship between these agents and those of chicken tumors can only be settled finally when sufficiently pure preparations of the respective agents become available.

It does not appear probable that all agents involved in the origin of several chicken leukoses are identical, at least, in size. Electron microscope studies of ultrathin sections of spleen and liver of chickens with visceral lymphomatosis have been reported(5). The particles observed in the cells of the affected spleen were found to vary from 740 Å to 940 Å in diameter, with an average diameter of 840 Å. The size of their dense core ranged from 280 Å to 350 Å, with an average of 320 Å. These particles appear, therefore, to be considerably larger than those observed in erythroblastosis(1) and in granuloblastosis (myeloblastosis). It should be pointed out that the method used for preparing the material of visceral lymphomatosis for electron microscope studies was the same as that used for ultrathin section studies of erythroblastosis and granuloblastosis.

Summary. Tumorous spleens and livers from chickens with granuloblastosis were examined in ultrathin sections. In the cytoplasm of the affected cells changes were observed similar to those seen in erythroblastosis, another member of the fowl leukosis complex. Particles were observed in the cytoplasm of cells of similar size and structure to that of particles in erythroblastosis. Average total diameter of the particles was found to be 670 Å and that of the central dense core was 260 Å. No particles of similar size or structure were observed in ultrathin sections of organs from young healthy chickens of similar breed.

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Molt of Capon Feathering with Prolactin.* (24146)

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Our previously reported findings have shown that Progesterone (Pg) will initiate proliferation of the feather papilla with consequent molt in both sexes of fowl(1). Although the treatment interrupted ovulation for a period in the laying hen, the response of the male nonetheless made it seem possible that this activation of the papilla could be a direct effect of progestin. We attempted, unsuccessfully, to demonstrate a local effect of Pg upon the feather papilla(2); hence we made another approach to the question. Laying hens were treated with Pg and with other compounds of anticipated progestational activity while concurrently run experiments tested the effects of follicle stimulating hormone (FSH), luteinizing hormone (LH) and prolactin (LTH) when administered singly and in conjunction with a Pg dose of established potency in molt(3). The various treatments (cortisone acetate excepted) all caused molt and also interrupted lay. There were, however, 2 important developments. With

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testosterone propionate (TP), the lag between cessation of lay and initiation of molt was of such magnitude that a transformation of a portion of the injected TP to a progestationally effective compound, immediately active in the papilla, seemed plausible. The other and more interesting observation related to the effect of prolactin. The LTH treated hens showed by far the most rapid onset of molt with the least effect upon laying behavior. Furthermore, Pg did not augment the effects of LTH as it had those of FSH and LH when given jointly. Since it was nevertheless impossible to disentangle entirely the role of the ovary, it was decided to duplicate the more significant experimental conditions from this series in the male castrate: these findings are discussed here.

Methods. Capons were treated with Pg; FSH, FSH + Pg; LH, LH + Pg; LTH, LTH + Pg for the same period of time as had been employed in the hen. Pg was given as single dose of a compound having slow absorption from local depots.† The FSH, LH and LTH used concurrently alone and in combination with Pg were Armour's preparations.‡ A single LTH treatment, only, was later repeated with a different preparation§ in unused birds. Further details are entered in legend to Table I. The birds were part of the flock raised and maintained at the University of Maryland Poultry Farm. They were caponized when about 4 weeks of age and were transferred to the laboratory as young adults in the early Fall. The capons were kept, 2 to a large cage (hen turkey size), in one battery. Food and water were available at all times; light hours were held at 14/day. Three birds were allocated to each treatment and the birds were so arranged that one uninjected and one Pg-only injected capon, respectively, appeared as one of a group of 4. In this manner all capons were subjected to similar disturbance at handling. All birds were caged for 4 months prior to start of experiment with monthly recording of length and depth of comb and of body weight. These same records were continued for 2 months beyond completion of test. In all fowl, feathers of suitable regeneration were microscopically examined for structural developments indicative of abnormally elevated thyroidal activity: no such reactions were found. The birds when first placed in cages were molting heavily. Thereafter they continued the minor sporadic shedding that is a castrate characteristic. This property, more apparent in certain regions, introduces some little difficulty in evaluation of degree of experimentally provoked molt. We recognized as induced molt a distinct activation of feather papillae initiated along the known molt lines (embryonic tract axes) and from which an orderly spread took place. Relative degree of molt (+ to 4+, Table I) was then scored as the estimated respective distance of that spread.

Results. The experimental castrate molt, when it occurred, began on day 18 from day 1 of treatment or 6 days after cessation of injections. It was always of sharply limited, brief duration. Pg led to molt wherever used. FSH and LH were negative; when injected in conjunction with Pg, the effect was comparable to that of Pg alone. LTH called forth an unmistakable activation of the feather papilla in all capons although the response was more violent in one bird than in another. A repetition of the LTH injections in the same dosage but with the highly purified preparation referred to was equally positive in molt. Table I shows that the effects in the papilla with this treatment were entirely comparable to those obtained with the first treatment. Curiously, however, the purified preparation provoked a local reaction wherever used; sites of injection were more highly affected in the capon (C 63), giving the slightest response in molt.

Discussion. Our observations that prolactin will stimulate feather papilla of the male castrate fowl extends the already established activities of this pituitary hormone in birds. Prolactin was first identified and described by Riddle, Bates and Dykshorn(4,5) and sub-

† Repositol Progesterone, Pitman-Moore Co.

‡ The FSH, LH and LTH preparations were most kindly furnished by Dr. I. M. Bunding, Armour and Co., Chicago, Ill.

§ The prolactin was a gift from the Endocrinology Study Section, N.I.H.

TABLE I. Molt Response of Capon to Prolactin, Follicle Stimulating Hormone and Luteinizing Hormone Given Singly and in Combination with Progesterone and to Progesterone Given Alone. Occurrence of molt was recorded on day 18 from day 1 of treatment in the feather tracts listed.

Capon No.	Treatment	Degree of induced molt by feather tract						
							Coverts	
		Breast	Back	Saddle	Thigh	Leg	Inner	Outer
36	None	0	+	0	0	0	0	0
40	"	0	0	0	0	0	0	0
63	"	+	0	0	0	+	0	0
38	Pg	+	2+	+	0	0	0	0
61	"	+	2+	+	+	+	0	+
46	"	+	2+	+	+	+	0	+
35	FSH	+	+	0	0	0	0	0
53	"	0	0	0	0	0	0	0
54	"	0	0	0	0	0	0	0
37	FSH + Pg	+	2+	2+	+	+	+	+
55	"	+	+	+	2+	+	+	+
56	"	+	2+	2+	+	2+	0	2+
39	LTH	3+	2+	+	3+	2+	+	3+
57	"	2+	3+	2+	2+	2+	2+	3+
58	"	+	4+	4+	3+	2+	3+	3+
41	LTH + Pg	4+	4+	4+	4+	3+	4+	3+
60	"	4+	4+	4+	3+	3+	4+	3+
42	"	3+	3+	3+	3+	2+	+	3+
43	LH	0	0	0	0	0	0	0
62	"	0	0	0	0	0	0	0
51	"	0	0	0	0	0	0	0
49	LH + Pg	2+	2+	+	2+	+	+	3+
50	"	+	2+	+	2+	0	0	+
47	"	+	+	0	+	0	0	+
36	LTH*	4+	4+	4+	4+	4+	3+	4+
40	"	3+	4+	3+	3+	3+	2+	4+
63	"	+	3+	3+	+	2+	+	+

Intensity of molt was scored + - 4+. Pg was given as a single intramusc. inj. of 25 mg, Jan. 13. FSH, 10 mg/day; LH, 5 mg/day; and LTH, 5 mg/day, were inj. subcut. Jan. 13-18, and 20-25.

* These LTH injections alone were repeated, 5 mg/day, with a highly purified preparation in untreated capons, March 3-8, and 10-15. Controls were untreated.

sequently became the subject of a great number of studies. Many of these findings, such as antigonadal action of prolactin and its growth-promoting properties in certain tissues, are highly important to the present results. However, the closest parallel exists between the states leading to broodiness in pigeon, dove and fowl and the experimental stimulation to molt we have described in the last. Prolactin can cause broody behavior in the laying hen while interrupting ovulation; it was effective to a lower degree in the cock(6). Prolactin diminished testis size of the pigeon through inhibition of endogenous FSH(7) and that same bird as male castrate will secrete crop milk when treated with LTH at the appropriate stages(8). Production of broodiness in intact Ring Doves by progesterone, desoxycorticosterone acetate and testosterone propionate(9) was ascribed to liberation of prolactin from the bird's own pituitary rather than to an antigonadal action as such. We have found these same substances productive of molt in the laying hen(3) and, although ovulation was interrupted, we questioned this as the primary mover. Our present findings, that LTH actively stimulates molt in the capon whereas FSH and LH proved negative, further suggests that prolactin may be the immediate agent in activation of the feather papilla.

Experimental effectiveness does not of itself demonstrate an identical role of the respective compound in the normal but there seems little contradictory in the juxtaposition of the sources of broodiness and molt; the prolactin secreted earlier could well prepare the change of plumage which frequently follows

upon termination of care of the young. It is obvious that any episodic release is triggered to an external event and in this connection a very curious and interesting observation has been made in some ducks. The drake here assumes no responsibility for his offspring and, upon observing signs of broodiness in his mate, takes his departure. He now joins a group of his fellows and proceeds to molt into the eclipse plumage(10). The pituitary has long been implicated in this special molt(11); does not the sympathetic performance of the drake suggest that prolactin may be the specific secretion involved?

Summary. Adult capons were treated with prolactin (LTH), follicle stimulating hormone (FSH), luteinizing hormone (LH), singly or in combination with a constant progesterone (Pg) dosage. In addition, Pg was administered alone. Pg was effective in activating the castrate feather papilla, these findings confirming earlier responses obtained in both intact sexes of fowl by others. FSH and LH were both ineffective in stimulating capon feather regeneration; in combination with Pg, the reaction was similar to that toward Pg alone. LTH uniformly caused molt of the capon feathering whether given alone, in combination with Pg, or alone as a highly purified preparation. The positive performance of LTH in the male castrate feathering described here, together with the observed lack of response toward FSH and LH in this fowl, suggest that prolactin may be the immediately effective agent in stimulating the feather papilla to production of a new plumage.

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Physiological Disposition of Heparin.* (24147)

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The property of heparin as inhibitor of blood coagulation has been known for a number of years(1). Although the exact mechanism for this action is still unknown, indications are that heparin acts primarily in preventing conversion of fibrinogen to fibrin. The extreme rapidity of its action, after injection, makes it a valuable therapeutic agent when employed clinically in early cases of coronary thrombosis. On the other hand the pharmacological effect of heparin disappears comparatively rapidly, consequently provision must always be made for prolonging blood coagulation time by continued administration of an anticoagulant. The physiology and metabolism of heparin has been slightly elucidated. Its importance and potential use have never been fully appreciated, possibly because the quantity of heparin in tissues is minute and previous methods for measuring and distinguishing it from other mucopolysaccharides are very tedious and open to question. With the preparation of radioactive heparin labeled with sulfur-35(2) the possibility was opened for quantitative metabolic studies of this substance. We reported results on clear-

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