material stimulate follicular growth, but that this growth, and the progress of follicular development to its culmination in ovulation, can, once started, proceed without the presence of the original external stimuli. It is clear from the work of Fraps(9) that the developing follicle secretes hormones capable of exciting further activity by the bird's hypophysis. Obviously, the initial effect of the presence of the male is to stimulate FSH secretion. Any conclusions about the exact further effects of his presence, and of the presence of nesting material, must await further analysis.

Summary and conclusion. Female ring doves were exposed to stimulation by the presence of males and of nesting material for varying periods of time, from 0 to 6 days, after which these stimuli were withdrawn. The birds' ovaries were examined 7 days after the beginning of the period of stimulation. Consideration of the incidence of atretic follicles and of completed ovulations leads to the conclusion that the presence of the mate and of nesting material stimulates growth of ova, and that this growth, and the progress of the ova toward ovulation, gradually become independent of the external conditions which originally stimulated it.

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Tissue Oxygen Consumption in Rats Treated with Cortisone and with an Anabolic Androgen.* (26316)

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Hormones probably affect the cellular metabolism by modifying the activity of enzymes and by altering the permeability of the target cells(1). One of the characteristics of tissue metabolism related to enzyme activity is tissue respiration. Tissue respiration is, for example, decreased when the enzymes involved in catabolism of glucose are damaged(2). Tissue respiration may be influenced, both *in vitro* and *in vivo* by various hormones. Cortisone, a typical anti-anabolic (or catabolic) steroid, was found to alter Q_{O_2} in rats(3,4) and so did some anabolic androgens(5). It is apparent that certain anti-anabolic actions of cortisone on the metabolism of connective tissue may be offset by some anabolic steroids(6,7,8). It is known that the effects of some anabolic androgens on protein(9), carbohydrate(10) and mineral metabolism(11) and especially their promoting influence on growth and healing(6,7,8) are quite opposite to the metabolic action(12) of cortisone-like substances.

The purpose of this study was to find if the known metabolic antagonism between cortisone and an anabolic androgen occurs also in the action of these hormones on tissue respiration. We may expect that the in-

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TABLE I. Oxygen Consumption (Q_{O_2}) of Diaphragm, Liver, Heart and Kidney of Rats Treated with Cortisone and 17-Ethyl-19-nortestosterone (ENT). Mean ± S.E.

Group	Treatment	Organ	No. of rats	No. of slices	Q_{O_2}, $mm^3/mg/hr$
1	None	Diaphr.	72	162	6.00 ± .05
		Liver		193	7.14 ± .06
		Heart		203	8.54 ± .08
		Kidney		87	18.26 ± .15
2	Cortisone, 5 mg/day for 14 days	Diaphr.	18	58	* 4.73 ± .07
		Liver		64	* 6.07 ± .11
		Heart		46	* 5.76 ± .15
		Kidney		32	*16.35 ± .27
3	Cortisone, 10 mg/day for 14 days	Diaphr.	18	71	* 4.11 ± .06
		Liver		82	* 5.90 ± .07
		Heart		48	* 5.75 ± .09
		Kidney		58	*15.39 ± .14
4	*Idem*, then no treatment for 14 days	Diaphr.	12	39	5.94 ± .09
		Liver		50	6.65 ± .13
		Heart		37	8.60 ± .16
		Kidney		37	17.58 ± .26
5	ENT, 10 mg/day for 14 days	Diaphr.	16	60	* 4.78 ± .07
		Liver		60	* 5.91 ± .09
		Heart		53	* 5.70 ± .13
		Kidney		65	*14.78 ± .19
6	*Idem*, then no treatment for 14 days	Diaphr.	9	23	5.65 ± .08
		Liver		35	7.47 ± .12
		Heart		36	9.44 ± .29
		Kidney		30	18.95 ± .34

* P less than 1%: Tissues of treated rats *vs* comparable tissues of controls.

fluence of cortisone on Q_{O_2} may be related to the anti-anabolic action of this steroid on tissue metabolism. If so, what will be the response of tissue Q_{O_2} to a potent anabolic steroid, which is known to antagonize cortisone? This problem has been investigated here by comparing Q_{O_2} of some tissues in rats treated with cortisone and with 17-ethyl-19-nortestosterone.

Methods. Male Sprague-Dawley rats, weighing 225-272 g, kept in individual cages and fed special grain diet(13), were used for this study. Cortisone Acetate (Merck) was injected intramuscularly. Androgen, 17-ethyl-19-nortestosterone (ENT), (Searle & Co.) was given *per os,* in the form of crushed tablet mixed with food(7). Six groups of rats were treated as follows: 1—Normal controls, no treatment. 2—Given cortisone, 5 mg daily/rat for 14 days. 3—Given cortisone, 10 mg daily/rat for 14 days. 4—Given cortisone, 10 mg daily/rat for 14 days and then the treatment discontinued for another 14 days. 5—Given ENT, 10 mg daily/rat for 14 days. 6—Given ENT, 10 mg daily/rat for 14 days and then the treatment discontinued for another 14 days.

Rats were killed at end of experiment(5). Diaphragm, liver, heart and kidney were immediately excised and placed in cold nutrient medium, identical with the one used for Q_{O_2} study. Tissue slices were then prepared(5) and placed separately in reaction vessels containing 3 ml of oxygenated medium. Oxygen consumption (Q_{O_2}) was measured by the direct Warburg technic(14) using the Krebs-Ringer phosphate buffer with glucose in an atmosphere of 100% O_2 at 37.0°C. Q_{O_2} was expressed in microliters of O_2 consumed per mg of dry tissue, per hour.

Results. The results of determination of Q_{O_2} are summarized in Table I. Treatment of rats with cortisone or with anabolic steroid 17-ethyl-19-nortestosterone significantly depressed the oxygen uptake of tissue slices studied. When, after 14 days of administration of any of these hormones, treatment was discontinued and animals left to recover for 14 days, (Groups 4 and 6) normal values of Q_{O_2} were found. Depression of Q_{O_2} found

in this study is therefore considered reversible.

Discussion. Expected antagonism between anti-anabolic (or catabolic) cortisone and anabolic androgen ENT was not found when the effect of these hormones on Qo_2 of various tissue slices was studied. Both cortisone and ENT depressed Qo_2 in diaphragm, liver, myocardium and kidney slices. These results agree with previous work on post-cortisone Qo_2 in the liver and heart(4) and on Qo_2 in the liver and diaphragm of rats treated with ENT(5). We were, however, unable to confirm the finding of Lacroix(3) who observed increased Qo_2 in the diaphragm of male rats treated with cortisone.

Cortisone and ENT are certainly antagonistic under various clinical and experimental conditions. It results from this study, however, that both these hormones had comparable action on tissue respiration. The depression of Qo_2 in tissues studied is reversible. Interruption of hormonal treatment for 14 days resulted in normalization of Qo_2.

More recent studies have shown that cortisone influenced glucose and pyruvate utilization and that the enzymatic impairment observed in tissues of cortisone treated rats is probably located at the level of the Krebs cycle. Cortisone also produced significant changes in enzymes involved in protein metabolism(4) and inhibited oxidative phosphorylation in liver mitochondria of rats (15). It may be expected that further studies of various enzymes, involved in cellular metabolism, will permit to find a difference between cortisone and anabolic hormones. Such studies are now in progress in this laboratory.

Summary. Treatment of male rats with cortisone or with anabolic steroid 17-ethyl-19-nortestosterone significantly depressed oxygen uptake of diaphragm, liver, myocardium and kidney slices. This depression of Qo_2 in tissues studied was reversible. Interruption of hormonal treatment for 14 days resulted in normalization of Qo_2. Expected antagonism between anti-anabolic and anabolic hormones was not found as far as the effect of these hormones on Qo_2 of tissues is concerned.

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