Gonadotropin Secretion in Response to External Stimuli of Varying Duration in the Ring Dove (*Streptopelia risoria*).* (26315)

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(Introduced by J. Leathem)
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Gonadotropin secretion in female ring doves may be induced by visual stimuli arising from the presence of male doves, and augmented by stimuli arising from the presence of a nest-site and nesting material(1,2). Female doves placed in cages with males show, over an 8-day period, increasing oviduct weight, increasing incidence of ovulation, and increasing incidence of behavior attributable to ovarian hormones, as compared with isolated controls; all these effects are increased by placing nest-bowls and nesting materials in the cages(2,3).

In all the above experiments, the males (and nesting material) have been continuously present in the cage during the period from the beginning of stimulation to occurrence of ovulation. The purpose of the present experiment is to determine whether the presence of these external stimuli is continuously necessary during the period of ovarian activity, or whether, on the other hand, they may start a process of ovarian development which, once started, can continue without the presence of the initiating stimulus.

Methods. 1. *Subjects.* The subjects were 260 female ring doves, all with previous breeding experience. Each of the birds had successfully reared young to the age of 21 days, after which the adults were placed in individual isolation cages for a period of 3-5 weeks. 2. *Experimental procedure.* All animal rooms were kept on a daily light cycle of 14 hours light (6:00 a.m.-8:00 p.m.) and 10 hours dark. All subjects were taken from the isolation cages at approximately 9:00 a.m. at start of experiment (day 0), and placed in test cages of the same type as the breeding cages. These were wood-and-wire cages 33″ wide, 18″ deep, and 14″ high, furnished with food, water and grit *ad lib.* All subjects were left in these cages for 7 days, then killed for autopsy. Twenty subjects were kept alone in the cages for the whole 7-day period. Each of the remaining 240 birds had a male in the cage with her during the first part of the 7-day period, after which the male was removed and the female left alone in the cage for the rest of the period. In 40 cases, the male was removed after 1 day, in 40 cases after 2 days, etc., up to 6 days. In each of these groups of 40 birds, 20 birds were initially supplied with a nest-bowl and a supply of nesting material, which were withdrawn at the same time as the male. 3. *Collection of data.* The data consist of observations of ovarian condition at autopsy after 7 days in the test cage. The 7-day interval between beginning of stimulation and time of autopsy was selected because previous work(4) has shown that over 90% of birds kept continuously with a mate and nesting material may be expected to have ovulated by that time.

Results. The results are presented in Fig. 1. It is apparent that incidence of ovulation

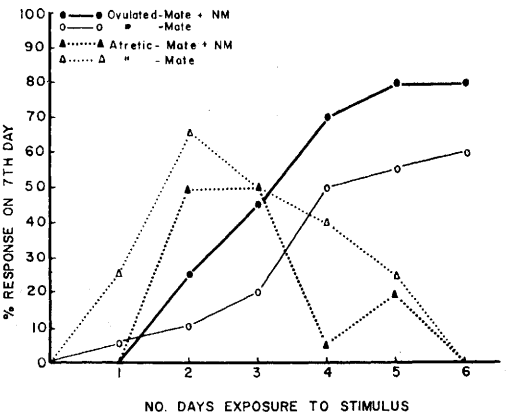

FIG. 1. No. of birds ovulating (solid lines) and No. of birds developing atretic follicles (dotted lines) by the 7th day, as a function of duration of exposure to a male (light lines) or to a male and nesting material (heavy lines) during the first 0-6 days.

* This work was supported by a grant from U. S. Public Health Service.

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by the end of the 7-day period is a gradually increasing function of duration of exposure, at the beginning of the period, to the stimuli which induce secretion of ovulation-inducing hormones. This function is of approximately the same shape for birds stimulated by the male alone as for birds stimulated by the presence of a male and nesting material, except that the effect is augmented by the presence of nesting material from the 2nd day on.

Atretic follicles were noted in many of the ovaries, and incidences of these degenerating ova are plotted, for the various groups, as the dotted lines in Fig. 1.‡ For both types of treatment, the incidence of atretic follicles first rose, then fell, as a function of duration of exposure to the stimulating conditions. It should be noted that the incidence of atretic follicles is *lower* in birds supplied with nesting material than in those having only a mate.

In general, each bird could be characterized as having atretic or ovulated follicles, but not both: there were only 10 birds which had both atretic and ovulated follicles, compared with 66 birds with ovulated but not atretic, and 92 birds with atretic but not ovulated, follicles.

Discussion. These data confirm that stimulation provided by the mate, and by the presence of a nesting situation, induce gonadotropin secretion in female ring doves. When the mate and/or the nesting situation are continuously present, the effects of this stimulation culminate in ovulation, which occurs in almost all birds by the end of 7 days. This indicates, of course, the successive secretion of FSH and of LH by the bird's hypophysis(5).

The presence of atretic follicles under these circumstances probably indicates that the follicles started to develop under the influence of FSH, and degenerated when FSH secretion ceased. The increase in number of atretic follicles with increasing exposure to the stimuli up to 2-3 days of stimulation reflects the fact that increasing duration of stimulation induces development of increasing numbers of follicles which can become atretic when the stimulation is withdrawn. The decrease in incidence of atretic follicles with increasing duration of stimulation, after that point, occurs because increasing duration of stimulation causes increasing numbers of follicles to go on to ovulation even after the external stimulus is withdrawn.§ Somewhat similar considerations apply to the differences between the groups with, and those without, nesting material. The higher incidences of ovulations in the groups provided with nesting material indicate that the presence of nesting material augments the gonadotropin-stimulating effect of the mate; the *lower* incidence of atretic follicles in these groups results from the fact that this augmenting effect causes more of the follicles to go on to ovulation, even after the external stimulation is withdrawn.

We must note that birds of the age and previous experience used in this experiment are already secreting some gonadotropic hormone at the beginning of their exposure to the male; mere exposure to the 14-hour daily photoperiod induces ovarian growth which is augmented by the type of stimuli analyzed in this paper(6,7,8), although female doves never lay eggs when isolated from other birds.

It may be concluded that stimuli provided by the male and by the presence of nesting

‡ Ova in a mature ring dove ovary range in size from something less than 1 mm in diameter to the ovulation size of 15 mm. As in other avian ovaries the ova are clearly visible to the naked eye, suggesting a bunch of (small) white and (large) yellow grapes(10). In contrast to the spherical, bright yellow appearance of normal mature follicles, atretic follicles appear lobate or wrinkled, and vary in color from dark yellow to various shades of reddish and purplish(11,12).

§ That is, the increasing numbers of follicles which go on to ovulation leave decreasing numbers of unovulated mature follicles which *can* become atretic. An additional contribution to the decline in number of atretic follicles on the later days may be that the autopsies occurred too soon after withdrawal of the stimulus for atresia to become apparent. This factor must be relatively small, however, since 75% of the birds kept for 6 days with the mate and nesting material ovulated *both* eggs, and therefore would not have shown atretic follicles even if allowed more time before autopsy.

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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Received November 16, 1960. P.S.E.B.M., 1961, v106.

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-

* Study supported by Nat. Research Council of Canada Grant. Mrs. E. Bekesi is thanked for technical assistance. Cortisone and 17-ethyl-19-nortestosterone were supplied by Merck Co. (Canada) and Searle & Co. (U.S.A.) respectively.