Conclusions. 1. The flicker fusion frequency-intensity relations differ for the light-adapted day- and night-phase eyes. 2. This difference is marked in the high intensity range and decreases as the threshold intensities are approached. 3. In view of data published elsewhere the reversal of sensitivity relationships indicates that the process of light-adaptation is much more pronounced in the night-phase than in the day-phase eye. 4. The flicker response contour and other relationships confirm the conclusion, made elsewhere, that the diurnal rhythm present in the eyes of these beetles results in two physiological states which are so different that they may be considered functionally as separate and distinct photoreceptors.

13420

Sexual Behavior of Intersexual Domestic Fowl.*

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This investigation concerns the behavior of intersexual birds, produced by the injection of estrogens into the egg on or before the fourth day of incubation. The males, as a result of this treatment, develop into intersexes of varying degrees of femininity, as indicated by behavior patterns and plumage.[1] The females are essentially normal except for the occasional occurrence of anomalous oviducts and the greater frequency of right oviducts.[2] The use of intersexual individuals permits the beginning of an analysis of the various components of sexual behavior, which, in this instance, is attempted from a psycho-analytical viewpoint.

The birds were kept in pens measuring 8′ x 17′ and containing from 5 to 9 birds of both sexes. The males were arbitrarily classified on the basis of plumage characters into 4 intergrading classes

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1 Domm, L. V., PROC. SOC. EXP. BIOL. AND MED., 1939, **42**, 310; Domm, L. V., *Anat. Rec.*, 1940, **78** (suppl.), 144.

2 Domm, L. V., *Anat. Rec.*, 1940, **78** (suppl.), 145.

as follows: I. Males which are essentially masculine in general appearance. II. Males which show a prominent scattering of female feathers on hackle, back, and saddle, and a lesser number of scattered female feathers on the breast. III. Males which have a female or nearly female hackle, back, and saddle, while the breast and tail, though predominantly female, still show many scattered male feathers. IV. Males which are practically indistinguishable from the normal female in general appearance.

The experimental technic consisted of introducing the individual to a rooster, to a hen, or to a stuffed dummy, mounted in the squatting copulatory pose. Several procedures were used to isolate the intersexual bird from other birds in order to increase its sexual drive.

The peck order or rank of social dominance was observed in each pen. In general, the most masculine birds were at the top and the most feminine at the bottom of the ranking among the males.

A brief description of the sexual behavior of normal domestic fowl is a prerequisite for an understanding of the behavior of intersexual birds. The sex of a newcomer is determined by behavior. The rooster "waltzes", *i. e.*, lowers one wing and kicks the leg on the side of the lowered wing, thereby inducing the newcomer to either squat or raise the neck hackle feathers. When a bird is introduced to a rooster, he at once pursues, seeking to determine its sex. If it is a receptive female, she squats for copulation. If, on the other hand, it is a male, it raises the neck hackle and thereupon begins a fight which settles its social rank in the group. This fighting, which is initiated by the raising of the hackle, is the alternative to copulation. Two females fight in a similar but less violent manner. The rooster copulates with the stuffed dummy in a behavioristically perfect manner.

The sexual actions of intersexual males showed gradations from essentially perfect masculine behavior patterns to definitely neutral or inactive behavior. A progressively more complicated and cumulative series of behavior patterns coincided with the degree of masculinity of the plumage and of the behavior as a whole. Several stages in behavior preliminary to copulation may be distinguished: (1) The lowered wing. The bird lowers the wing to the ground and bends the head. The action then is ended and the bird may walk away. (2) Waltz and stop. The bird lowers one wing, kicks with one foot, then abruptly rears up and stops. (3) Waltz and circle. The bird lowers one wing, kicks, and then circles around the female. (4) Waltz and grab. The bird waltzes in a perfect manner and

grabs the female by the neck hackle or comb. This last pattern is sometimes followed by: (5) The complete copulatory behavior. In general, birds of Class 4 seldom went beyond Stage 1. Birds of Class 3 seldom went beyond Stage 3. Birds of Class 2 commonly performed Action 4. Birds of Class 1 copulated occasionally. Fertile copulations were found only in some Class 1 individuals. The behavior of the intersexual birds with the dummy showed identical patterns but in general was on a lower level of activity, probably due to the lack of motion on the part of the dummy.

Summary. The behavior of intersexual male domestic fowl shows gradations from essentially normal masculine copulatory patterns to neutral or inactive behavior, coinciding in general with the degree of masculinity of plumage.

13421

The Sexual Behavior of Hormonally Treated Domestic Fowl.*

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The stereotypy of avian behavior patterns makes birds excellent experimental material for a study of the factors influencing behavior. Some of these factors can be segregated by the injection of appropriate hormones into normal and castrate individuals.

In order to analyze the relation of certain endocrines to sexual behavior patterns, a series of experiments was undertaken on domestic fowl of the Brown Leghorn variety. Normal roosters, capons, and sinistrally and bilaterally ovariectomized poulards were used in our experiments. In the present series, capons and bilaterally ovariectomized poulards were injected daily with testosterone propionate and estradiol (progynon-B), sinistrally ovariectomized poulards were injected with testosterone, and normal roosters received stilbestrol. The behavior of these individuals was tested, generally on alternate days, in the following manner: Each experimental bird, alone in his own pen, was introduced at suitable inter-

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