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Effect of Testosterone Propionate on Behavior of the Female Canary.

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It is well known that marked changes take place in fighting, song, and flocking behavior of birds during the breeding season. In pre-

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vious studies of flock organization the sex of the birds and the state in the reproductive cycle of both sexes played large parts.[1, 2] In canaries males usually dominated females, except their own mates, at all seasons and both sexes became more aggressive during nesting activity. This domination is manifested by pecking, or a threat to peck, after which the other bird retreats. When birds are first brought together there is usually violent fighting, followed by a more peaceful order when each bird "knows its place."

The sex hormones naturally attracted interest as a possible physical basis for social dominance in the flock. Estrone was injected into female canaries without effect. It was subsequently observed, however, by others[3, 4, 5] that the ovary produces androgenic substances as well as estrogenic. It, therefore, seemed possible that the male hormone in both sexes was an important factor in social dominance.

In order to test the effect of male hormone, testosterone propionate was administered to 3 of a flock of 6 female canaries. The 3 lowest ranking females, R, T, and C, received .076 mg of testosterone propionate in oil daily. The other 3, H, D, and W, received the same amount of plain oil. In 32 days after the first injection R, C, and T were in 1st, 2nd, and 3rd places, instead of their former places as 4th, 5th and 6th. Fig. 1 shows this shift in dominance.

A detailed record of the changes in pecking order is given in Fig. 2 by the rise and fall of the solid and broken lines. The number of pecks dealt was observed to increase in most cases at the time of the shifting in dominance. More pecks in return indicating unsettled dominance were also seen at this time. There was a shift in dominance in all contact pairs of which one member received hormone and

TABLE I.
Relative Positions of the 6 Female Canaries in the Social Order.

January			February								March				
22	28	30	3	8	14	18	20	21	23	25	1	5	9	13	18
D	D	D	D	D	D	D	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*
W	W	W	W	W	W	*R*	*T*	*T*	*T*	*T*	H	H	*C*	*C*	*C*
H	H	H	H	H	H	W	D	D	D	H	*T*	*T*	*T*	*T*	*T*
C	*C*	*C*	*C*	*C*	*C*	H	W	W	W	D	*C*	*C*	H	H	H
R	*R*	*R*	*R*	*R*	*R*	*C*	H	H	H	*C*	W	W	D	D	D
T	*T*	*T*	*T*	*T*	*T*	*T*	*C*	*C*	*C*	W	D	D	W	W	W

Those in italics are birds which began receiving hormone Feb. 5; the others received control injections of oil over the same period.

1 Allee, W. C., *Wilson Bull.*, 1936, **48**, 145.

2 Shoemaker, H. H., *Auk*, **56**, in press.

3 Domm, L. V., *Cold Spring Harbor Symposia on Quant. Biol.*, 1937, **5** 251.

4 Witschi, E., and Miller, R. A., *J. Exp. Zool.*, 1938, **79**, 475.

5 Noble, G. K., *Anat. Rec.*, 1938, **72**, 60.

the other did not. These results were in accord with those obtained with hens.[6]

On February 14, nine days after injections began, R and C were singing and T began singing regularly March 1. The song was indistinguishable from that of normal males. Just previous to laying females frequently chatter like young males learning to sing and in one case out of about a hundred in these flocks an untreated female uttered a loud song. This was a continued repetition of only one or 2 shrill notes. R and T not only sang an elaborate song but were seen at times singing at each other at full power with heads about

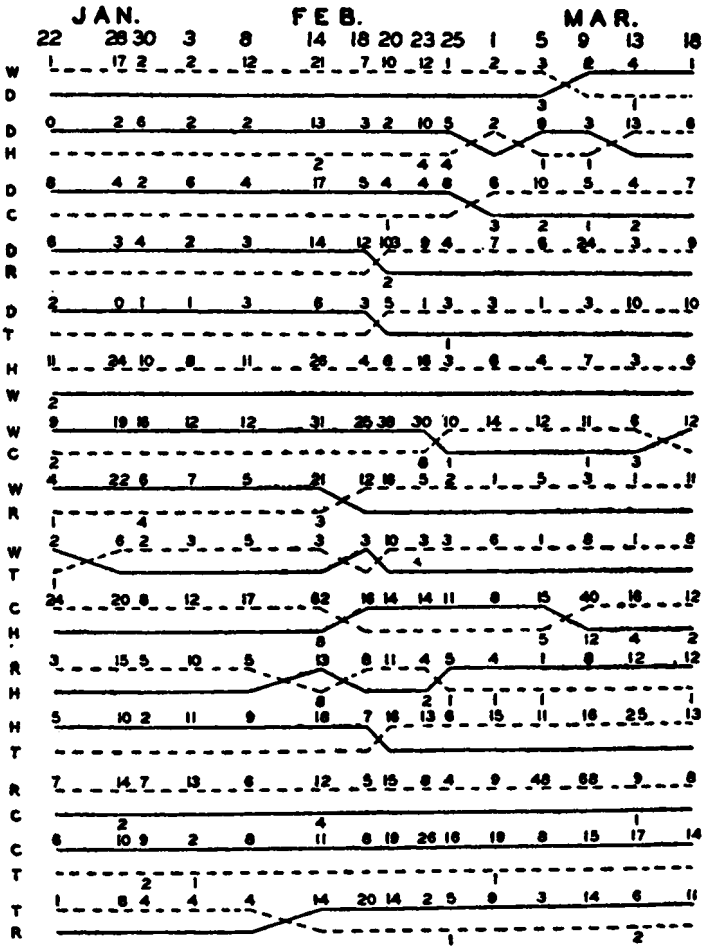

FIG. 1.
Numbers represent pecks delivered on indicated days by birds at left.

[6] Allee, W. C., and Collias, N., *Anat. Rec.*, 1938, **72**, 60.

an inch apart. This is also typically male behavior, never seen among untreated females. In these injected birds females exhibited courtship behavior characteristic of males, which consisted of a very trim bearing of body with neck outstretched. This behavior often is termed posturing. They also frequently dangled a string or a piece of cotton before other females.

Though copulation was not observed, definite pairing behavior existed between the combinations R-H and T-D. Indications of such also were seen for C-W but not confirmed due to the accidental death of C. H, W, and D all built nests, laid, and incubated but the eggs, of course, were infertile. The hormone treated ones, R, C, and T, made no indications of nesting and the ovary of C when examined showed a non-functional state. D and H laid in the same nest and would sit together except for interference by the other's mate. R being the dominant bird kept D driven from the nest but coaxed H to it. When R was removed from the cage, T allowed D to sit but regularly drove H from the nest except when H could slip in under D.

In normally mated pairs when approached or threatened by his mate it is part of the courtship behavior for the male to "posture" away. The potential ability of the male to dominate his mate, however, seems to remain, because occasionally he drives the female all over the cage singing and beating her violently. The latter behavior was observed in the pair R-H.

The failure of the injected females to tread receptive females may reflect the lack in testosterone propionate of the capacity to initiate the complete chain of events caused by the normal testicular hormone. That it is not due to a lack in the nervous system is indicated by two instances in which untreated females have been observed to copulate like males. One of them copulated with females on numerous occasions and the other mounted the male immediately following a normal copulation with the same male.

The anal region of the hormone-treated birds also developed the typical male appearance. This consists of a cylindrical projection of the anal area with a definitely anterior inclination. In females this region is smaller, tapering, and never with a forward tilt.

Since the female canary responds to such small amounts of androgenic substances, its possible use for assay of androgens is suggested.

Summary. Testosterone propionate administered to female canaries caused suppression of the female reproductive functions and initiation of the following male traits: singing, courtship behavior, peck-dominance over untreated females, and appearance of the male type of anal region.