6289

Secretion of Crop-Milk in the Castrate Male Pigeon.

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Riddle and Braucher[1] showed that the cyclical extreme enlargement of two areas of the crop wall, and the resulting crop-milk formation—both well known to occur at or near the end of the brooding period in pigeons—are under control of a hormone of the anterior pituitary. Only anterior pituitary tissue or extracts were found capable of initiating these processes, but with such tissue or extracts these phenomena could be produced in birds of both sexes and at all ages. While unaware of the results of Riddle and Braucher a report was later published by Kaufman and Dabrowska[2] in which the conclusion is drawn that the hormone of the testis is necessary for the normal cyclical functioning of the crop-gland in the male pigeon.

Kaufman and Dabrowska castrated a male pigeon which had previously secured a female mate within a group of pigeons. After the male was castrated he ceased to copulate and express ardor, but nevertheless still maintained a special interest in his former mate. This female mate continued to lay fertile eggs—thus showing that another male (or other males) were copulating with her, and was wholly or in part stimulating the growth and ovulation of the eggs which she laid. It would therefore be a matter of much surprise if the castrate male *began* to incubate at the time this female laid eggs; for, even an unmutilated male pigeon who has been solely responsible for stimulating egg production in his mate is sometimes 2 to 5 days out of syncrony[3] with his mate in the impulse to begin to brood or sit; again, apparently normal males sometimes brood for a few days only and fail to complete the cycle. Indeed, it is of much interest that a castrate pigeon will incubate at all, and (though apparently unaware of this) Kaufman and Dabrowska have observed what seems to be the first recorded case. These authors, however, entirely fail to state whether this castrate *began* incubation as soon as eggs were laid by his mate or only 5 or 10 days thereafter; also whether the incubation was consistently and earnestly

[1] Riddle, O., and Braucher, P. F., *Am. J. Physiol.*, 1931, **97**, 617.

[2] Kaufman, L., and Dabrowska, W., *C. R. Assoc. d. Anat.*, Warsaw, 1931, Aug.

[3] Whitman, C. O., Behavior of Pigeons, Carnegie Inst. Publ. 257, 1919, **3**.

done; and whether perhaps he performed this function equally, but quite perfunctorily, *at all times* when eggs were placed in the nest of his mate. All these points have an important bearing on the significance of their finding that, when killed at the time its mate's young were hatched, the crop-glands of this (complete) castrate were entirely inactive. Unless this male had performed true incubation during the 13 or more days immediately preceding autopsy there would be no reason to expect anything other than inactive crop-glands. The fact that this castrate—operated when adult and probably after it had fed young—still showed the instinct to feed young is interesting but of uncertain meaning in relation to the point discussed here.

First Test. We have made 2 tests of the capacity of the crop-glands to enlarge and function in castrate male pigeons at the end of cycles of incubation which we knew were full and normal cycles: A normal mated pair which had produced and incubated earlier eggs was permitted to go through the copulations requisite for the production of a pair of eggs (laid April 24-26). The male was castrated on April 25—the date on which normally he would lightly begin incubation. Except for light sitting during the following 2 days, apparently because of sore wounds, he nested consistently. The 2 young were hatched on May 12. It was then proved (by removing the female) that the castrate could and did *feed* the young (May 12-13). On May 13—*i. e.,* 18 days after castration and beginning incubation—the castrate was killed for the necessary inspections. The castration was found to have been completely accomplished. A considerable part of the left, and a smaller part of the right, epididymis remained *in situ;* these were removed and sectioned. The 2 crop-glands were actively secreting crop-milk. The weight of the right gland was found to be 4.200 gm. Since this area when entirely inactive weighs approximately 0.200 gm. (in this race) it was 20 times its weight in the inactive state. The sectioning of such crop-glands is wholly superfluous; weights (or even appearance) are entirely decisive.

Second Test. Another (larger) male was castrated under conditions entirely similar to the case described above. This castrate also incubated consistently till both young were hatched 18 days later. The castrate fed these young at once, and was killed on this same day. The crop-glands were actively secreting, the weight of the right gland being 5.400 gm. Close examination of the former site of the testes showed no trace of gonad tissue on the left side; on the right side a small nodule (6.6 mg.) of regenerating testis

tissue was found. Even at the date of autopsy the amount of this tissue was only about one-fourth of 1% of the amount of testis tissue removed at castration.

Injection Tests. Further to test the capacity of anterior pituitary extracts to activate the crop-glands in castrate male doves and pigeons 2 additional castrates were treated as follows: A male which had been castrated (completely) 6 months earlier was given 4 daily injections of an alkaline extract of the anterior lobes of cattle. Ninety-six hours after the first injection the right crop-gland, though not actively secreting, had attained almost or quite to the maximum (1.900 gm.) to be expected from the dosage, and would doubtless have begun secretion within the next 24 hours. A second, and wholly similar test was made on a ring dove, also castrated 6 months before the administration of the pituitary extract. Here the crop-glands were actively secreting and the right gland (normal inactive weight=about 0.100 gm.) weighed 0.930 gm. Here again we obtained the maximum enlargement to be expected from dosage during a 4-day period.

Summary. The castration of male pigeons at the beginning of an incubation cycle, to insure true and consistent incubation, does not even slightly interfere with the enlargement and complete functioning of the crop-glands at the end of the incubation cycle 18 days later.

Castration of adult male pigeons and doves 6 months prior to the administration of potent extracts of the anterior pituitary does not lessen or otherwise modify the capacity of these extracts to activate the crop-glands of these birds.

There is no valid evidence that the testes play any direct part in the activation of the crop-glands. The testes do, of course, induce or influence the copulations which normally lead to the males' impulse to incubate; and a completed term of incubation apparently induces the anterior pituitary to release the specific hormone which in turn activates the crop-glands. The presence of this activator in the blood is as effective in the absence as in the presence of the testes.