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Responses of Feathers of Male and Female Pheasants to Theelin.*

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Some years ago it was observed[1, 2] that in several species of birds and mammals a number of secondary sex differences, including color, seemed to be dependent on external or hormonal factors and not at all on the genetic sex of the individual. This discovery led to the enunciation of a theory of "equipotentiality" which assumed that male and female tissues are identical in their reactions, particularly to the sex hormones. Among birds the common fowl yielded much in support of this theory, for even in those breeds which show unusual types of reaction, as the Campines,[3] little evidence has been presented to show a difference between the two sexes. Nevertheless minor differences are suggested by the gonadectomy experiments of Finlay[4] and the skin transplantation studies of Masui.[5] In the Reeves pheasant, which belongs in the same family as the domestic fowl, a marked constitutional difference in the behavior of feather follicles of opposite sexes has been found to exist.[6]

An earlier report on these pheasants was concerned only with responses of male and female skin to normal concentrations of sex hormones, which could be tested by the method of skin transplantation. In a further study of Reeves pheasants and also members of the related genus *Phasianus*, it was found that the action of theelin injected intramuscularly is seemingly indistinguishable from that of the normal hormone of the bird's own ovary. Assuming that theelin and the ovarian secretions are essentially identical, the relative responsitivity of male and female feather follicles to the hormone may be compared fairly satisfactorily by means of skin transplantation, gonadectomy and theelin injection. While the

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1 Zawadowsky, M. M., *Trans. Lab. Exp. Biol.*, Zoopark, Moscow, 1928, **4**, 11.

2 Lillie, F. R., *J. Exp. Zool.*, 1927, **48**, 175.

3 Danforth, C. H., *Biologia Generalis*, 1930, **6**, 99.

4 Finlay, G. F., *Brit. J. Exp. Biol.*, 1925, **2**, 439.

5 Masui, K., *Arch. Entwicklungsmech.*, 1933, **128**, 1.

6 Danforth, C. H., PROC. SOC. EXP. BIOL. AND MED., 1935, **33**, 291.

results are rather clear cut, there is little doubt that they are obscured somewhat by the coincident action of other hormones than theelin.[7]

The feathers of Reeves pheasants and those of members of the genus *Phasianus* of course differ greatly in actual appearance, but they show sufficient parallelism in their responses to theelin to justify grouping them together for present purposes. In neither group are the reactions of an all-or-none type. Moreover, the responses in different regions of the body vary considerably. Feathers of the head and throat appear to undergo complete "sex reversal" more readily than those of most other regions. In general there seems to be an irregular gradient extending antero-posteriorly, but this and the possible interrelation of male and female hormones require further analysis.

TABLE I.
Approximate Effects of Various Theelin Levels on Developing Feathers of the Rump.

Group No.	Hormonal Condition	Female Follicles		Male Follicles	
		No. of Examples	Response	No. of Examples	Response
1	Castrated ♂	1	3+	4	1
2	Normal ♂	9	3	7	1
3	Castrated ♂ plus theelin	1	4	2	2±
4	Normal ♂ plus theelin	2	3+	6	2± [3+]
5	Castrated ♀	2	1+		
6	Normal ♀	10	4	7	2
7	Normal ♀ plus theelin	3	4	2	2

(+) indicates a variation upward, (±) a range above and below the value indicated.

Table I is based on reactions of feathers of a single region, the rump, where the threshold is rather high and the range of expression wide. As a scale for measuring responses, 4 primary grades may be recognized and designated as 1, 2, 3 and 4, corresponding to M/M, M/F, F/M, and F/F, where numerators represent genotypes and denominators full normal hormonal concentrations. In groups 3, 4 and 7 of the table, injections of theelin in oil averaged a little over 4500 international units a day and were continued for periods of either 4 days or approximately 2 weeks. The former dosage, affected only a part of each growing feather while the latter, when properly timed, was sufficient to influence feathers throughout their entire extent. In group 4 the figure in brackets refers to a specimen of *Phasianus* which was especially sensitive.

It will be apparent that at all concentrations of theelin, from far

[7] Witschi, E., PROC. SOC. EXP. BIOL. AND MED., 1936, **35**, 484.

below to well above normal, female skin consistently produces feathers of a higher grade than male skin at the same concentrations. Even at the extremes reached in these experiments, only an approximation to sex reversal (1+ and 3+) was attained. This indicates that in these species of pheasants the genetic factor is an important one in the determination of sex differences in plumage, and the results afford no support for the theory of equipotentiality as originally formulated.

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Chilling as an Effective Means of Delousing.

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Louse-borne relapsing fever and typhus fever are prevalent in North China where they often assume epidemic proportions. Since these infections are transmitted by body-lice, delousing will always remain one of the most effective means of controlling them. In China's northern provinces the natural temperature during the months from November to February is stated to fluctuate between −16°C. and −40°C. The problem is to devise an effective, practical, and cheap means of delousing the clothing and other belongings of large numbers of people, especially troops, who are exposed to relapsing fever and typhus fever and live under conditions in which on account of economic and other difficulties, the usual type of delousing by means of moist or dry heat is not available. Hence, a series of experiments has been conducted to test the resistance of body-lice and their eggs to chilling, a natural means which is always available without cost during winter in cold regions.

Altogether 2,922 male and female body-lice varying from 4 days to 32 days old divided into 40 lots, and 2,370 eggs in 9 lots were subjected to chilling at temperatures ranging from −1°C. to −25°C. for various periods of time. Many thousands of lice and their eggs were also subjected to temperatures varying from 5°C. to 8°C. for many days. In most instances the chilling was accomplished by placing the different lots of lice and eggs contained in different cages in a special refrigerator which is adjustable to give any desired temperature from 0°C. to −25°C. In a few instances the lice subjected to chilling were kept in a small test-tube which was closely