THE ENDOCRINE SYSTEM AND PLUMAGE TYPES

I. SOME EFFECTS OF HYPOTHYROIDISM

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(With Plates IX and X)

The work recorded in these papers is concerned with the relation between plumage types and the endocrine organs, and has the ultimate object of elaborating methods for testing hormone preparations by plumage responses. Recent work, notably that of Danforth (1933), has made it evident that the nature of the response of the plumage of any particular breed of fowl to thyroxine or oestronc depends, primarily, not on the hormone itself, but on the genetic nature of the breed in question. Thus oestrone turns to fawn the black breast feathers of Brown Leghorn cockerels, but darkens nearly to black the fawn breast feathers of the cocks of the Buff Leghorn x Black Minorca cross. Much of the work on plumage up to date has been carried out on the Brown Leghorn, a typical black-red breed, but one by no means ideal for the purpose because the plumage of both sexes possesses only black and red pigment in varying combinations and is sensitive only to large doses of hormones. Thus about 100 mg of oestrone daily is needed to feminize the breast feathers of the Brown Leghorn capon, but 5 mg daily will produce a comparable effect on the saddle of the Sebright Bantam capon (Callow & Parkes, 1936). This greater sensitivity makes the Sebright much more useful than the Leghorn for testing oestrogenic substances. Again, in the Brown Leghorn, the colour change produced in the capon breast feathers by thyroidectomy is similar to that following oestrone injection, while in the Silver Dorking the colour changes produced by these two treatments are different. Since the nature of the response and the sensitivity varies from breed to breed, it may reasonably be expected that among the vast wealth of plumage types available for experiment there may be found particularly sensitive and selective test objects for gonad, thyroid, pituitary and possibly even adrenal hormones.

The first necessity is a thorough examination of all clear-cut and easily available plumage types for their responses to deficiency and excess of the various hormones. Progress along these lines has been made
by Danforth, and to some extent by M. M. & B. M. Zawadowsky, and their co-workers (1928, 1929), but the invaluable pioneer work on feather pattern from Lillie's laboratory in Chicago has mainly been carried out on one breed, viz. the Brown Leghorn. (See Juhn et al. 1931; Lillie & Juhn, 1932, for general accounts.)

PREVIOUS WORK ON HYPOTHYROIDISM

The early work of Torrey & Horning (1922) on the effect of thyroid feeding on the plumage of Rhode Island cocks suggested that the sexual dimorphism existing in either the shape or the colour of the feathers in nearly all breeds of fowl might depend largely on thyroid activity. Much work has now been done on the effect of thyroid feeding or on the injection of thyroxine or of thyroid extract on plumage, and it is now evident that while some of the plumage characters of the hyperthyroidic male are similar to those of the normal female bird, others are quite different.

The effects of hypothyroidism, as shown by removal of the thyroids, have been much less studied, probably on account of the difficulty of complete extirpation. Crew (1926), following up the work of Torrey & Horning, removed the thyroid from hen-feathered Campine cocks and obtained plumage changes similar to those following castration in this breed, i.e. reversion to male-type plumage. Greenwood & Blyth (1929) attempted a complete examination of the effect of thyroidectomy on the Brown Leghorn, but were unfortunate in obtaining only two completely thyroidectomized birds, which died after a short time. Benoit & Aron (1934) have recently described the effects of thyroidectomy on the cock and the drake, mainly with reference to the testis, but they also had difficulty in making the operation complete.

TECHNIQUE

The operation of thyroidectomy was carried out as follows: the bird was put under ether anaesthesia and the feathers over the crop region plucked. The skin was incised in the mid-line and freed from the crop, which was retracted to left or right according to which lobe of the thyroid was being removed. The two lobes are quite separate; the left one lies low on the left jugular, while the right one is down in the anterior thorax on the common carotid. The anterior air sacs on both sides are ruptured while dissecting to expose the thyroids. It is usually possible to ligate the vessels of the left gland, but the right one has to be removed by a process of blunt dissection and traumatization of the