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Cause of Hen-Feathering in Campine and Bantam Males.

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In ordinary breeds of the fowl differences in secondary sexual characteristics of the plumage have been shown[1] to be due to endocrine factors which are largely controllable under experimental conditions. With the type of feather produced serving as a measure of response, evidence from various sources is consistent in indicating that in most breeds the follicles of the male and those of the female react in exactly the same manner to any set of stimuli.[2] In other words, sexual differences in plumage are referable to differences in endocrine stimuli rather than to differences in tissue response. Since this situation obtains in ordinary breeds of fowl, it has been natural to look for an endocrine causation of hen-feathering in those strains where the male has a plumage similar to that of the female. The prompt assumption of male plumage by the castrated Sebright,[3] which is normally hen-feathered, seemed at first to supply definite evidence of an endocrine causation for hen-feathering in the male. But cross-transplantation of testes in Sebright and Leghorn fowls[4] showed that the testes of hen-feathered Sebrights produce no special hormone different from that of cock-feathered Leghorns; and the experiments to be reported at this time indicate that follicles from a

[1] (a) By gonadectomy experiments, H. D. Goodale, *Carnegie Inst. of Wash. Publ.* 243, 1916; L. V. Domm, *J. Exp. Z.*, 1927, xlviii, 31. (b) By thyroid feeding. H. B. Torrey and B. Horning, *Anat. Rec.*, 1923, xxiv, 395. (c) By gonadal transplantation, Pézard, Sand et Caridroit, *Compt. rend. Soc. Biol.*, 1925, xcii, 427. (d) By skin transplantation, Danforth and Foster, PROC. SOC. EXP. BIOL. AND MED., 1927, xxv, 75.

[2] Lillie, F. R., *J. Exp. Zool.*, 1927, xlviii, 175.

[3] Morgan, T. H., PROC. SOC. EXP. BIOL. AND MED., 1915, xiii, 31; *Carnegie Inst. of Wash. Publ. No.* 285, 118 pp., 1919.

[4] Roxas, H. A., *J. Exp. Zool.*, 1926, xlvi, 63.

hen-feathered strain and those from a cock-feathered strain may produce their respective types of feathers when grown side by side and subjected to the same endocrine environment.

The experiments consisted in transferring pieces of skin of the saddle region (where plumage dimorphism, when present, is most marked) from one newly hatched chick to another and later comparing the feathers produced by the donor, the host and the transplant. The following cases may be cited. They should be viewed in the light of the finding that where only ordinary breeds are involved in such transplants the grafts invariably produce feathers corresponding to the sex of the host, irrespective of the sex of the donor.

1. A white Leghorn cock, with good male plumage at maturity, supported a Campine graft which produced numerous feathers of the female type and a few with a narrow marginal fringe such as occasionally appears in normal hen-feathered Campines. The feathers on the graft were comparable to those of control Campine males of the same age. Grafts from Rhode Island Reds and Minorcas on similar Leghorn males have regularly produced a full complement of male feathers.

2. A bantam male with a moderate grade of cock-feathering was grafted with skin from a hen-feathered bantam female. All the feathers produced by this graft were of the female type, with a sharp line of demarcation between them and those of the host.

3 and 4. Exchange grafts were made between 2 bantam males, one of which developed a full male plumage, while the other developed a plumage of a somewhat restricted, intermediate type. In both cases the feathers produced by the graft corresponded very closely to those of the *donor*.

It is evident that in these cases the differential factor was inherent in the skin—presumably in the feather follicles themselves—rather than in circulating fluids of the host, which were distributed alike to his own and to the grafted skin. This points to the conclusion that the difference between the hen-feathered and the cock-feathered male fowl is primarily a difference in reactivity of the skin, the "thresholds" being different in the 2 types. This pecularity of the skin is obviously hereditary. It is possible that there are also hereditary endocrine differences which influence the type of plumage in the fowl, but they have not been apparent in these experiments.