THE GENETIC FACTOR FOR HEN–FEATHERING IN THE SEBRIGHT BANTAM.

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Crosses between Sebrights and Game Bantams had shown that the dominant gene for hen-feathering is inherited as an alternative to cock-feathering, but the number of F_2 and back-cross cocks that were obtained was too few to settle the question whether one or two pairs of genes for hen-feathering were involved. The situation has been recently discussed in my paper on "The Genetic and Operative Evidence Relating to Secondary Sexual Characters," Carnegie Publication, No. 285, 1919. I am now able to add a small amount of new data to that previously recorded, although I regret that even the combined data still do not show clearly whether one or two factors for hen-feathering are involved.

During the summer of 1919, I back-crossed four hens (out of Game by Sebright) to a pure Game Bantam cock bought from the same breeder from whom the other Games had come. The chicks were hatched in June and July, 1919, and the following records were made on March 22, 1920, when the new birds had fully attained their adult plumage.

Five of the cockerels were hen-feathered, and three were cock-feathered. There was no difficulty in separating the cockerels into two classes. Only one bird fell within the group of hen-feathered cocks that in my previous paper I sometimes spoke of as "intermediate." This means only that some of the back and saddle feathers were more pointed than are those of pure Sebright cocks. Their ends may show on each side of the tip a narrow edging lacking barbules. Previously the same back-cross gave two hen-feathered and seven cock-feathered males. The two records together give, therefore, 7 hen-feathered and 10 cock-feathered males.

For a single factor-difference the expectation for 16 birds would be 8 hen-feathered and 8 cock-feathered birds. The num-

bers obtained are in fair agreement with this expectation. If two factors are necessary for hen-feathering, the back-cross expectation would be 4 hen-feathered to 12 cock-feathered birds, which differs so much from the results obtained that the assumption of a single factor-pair seems the more probable.

In former years I have obtained 127 F_2 offspring from the above cross of Sebright by Game Bantam and its reciprocal. These have been recorded in the Carnegie paper (Table I., page 19). There were 55 males in the records. If a single pair of not-sex-linked genes was involved in the cross, the expectation in F_2 would be, three cock-feathered males to one hen-feathered one. If two pairs of genes were involved either one of which is sufficient for the development of hen-feathering the expectation in F_2 would be 9 to 7; if both are necessary the expectation is 15 to 1. There were 29 hen-feathered, and 26 cock-feathered birds. It was pointed out that these data seem in better agreement with a two-factor pair, than with a one-factor pair assumption. But, as pointed out above, the old and the new data combined for the back-cross, appear to fit better the single factor pair assumption.

There is one other possibility that may be considered. If there is one dominant factor, D^1, for hen-feathering in the Sebright, and a modifier that intensifies the action of D^1, but alone or in duplex does not produce hen-feathering, the expectation for F_2 is 12 to 4, and for the back-cross 1 to 1. The former ratio, which is of course the 3 to 1, does not fit the case any better than one factor alone, although it might help to explain the intermediate type of male, as due to the presence of a normal allelomorph of the intensifier.

Color Inheritance in the Cross of Sebright to Game.

It is now possible to add a few more cases to the data for color-inheritance. Four back-cross hens were reared (1919), that fall in the former classes (Carnegie Publication, No. 285, pages 19–20) B, G, A, A. One of the four is almost exactly like the game-hen. The cockerels fall into the classes, B, G (or H), S, S, S, K, E.

Of these 11 back-cross birds two were almost exactly like the game (one female, one male). For two pairs of color factors,

the game type is expected in the back-cross in one fourth of the classes, *i.e.*, in 3 out of 12, which agrees fairly well with the results. For three factors for color, the game type is expected in the back-cross once in eight times. The numbers are too small to be decisive for either case, but as pointed out before, the main color difference between the two races may not be more than 3 or less than 2 factor-pairs.

In the earlier experiments one game appeared in F_2 out of 49 females, which is somewhat favorable to the assumption of three factor-pairs. The new data are not sufficient in amount to settle the question between two or three factors, but the latter is perhaps somewhat more probable.

Proof that the Character for Hen-Feathering is not Sex-Linked.

The proof that the factor (or factors) for hen-feathering involved in this cross is not carried by the sex-chromosome can not be deduced from the evidence of the F_1 males in the cross and its reciprocal, for, both the F_1 males would get a Z chromosome from each parent, and therefore would be alike in both cases. But in the F_2 generation the proof is given, for when the cross is made one way, only hen-feathered males are expected, and when made the other way (reciprocal) one hen-feathered to one cock-feathered male is expected, if the gene concerned is sex-linked. The F_2 results in both crosses show, however, both hen-feathered and cock-feathered males; hence the factor (or factors) involved is shown not to be carried in the sex-chromosomes.