red bull will be red and the other half roan. It appears that the solid red or nearly solid red cows have inherited the red from both parents, as their offspring show no other color than red. The exception to this is the roan calf from a red cow at the beginning of this paper, and that cow is really yellow with a little white. I have not attempted to go into the different shades of color in this paper, but hope in the near future to have the opportunity to tabulate such shades to a certain extent, to see what results can be had.

It may seem strange to some not familiar with cattle breeding that this paper mentions over and over the "eye circle" and "spot on nose." I will say that these two points are especially prominent with grade Hereford cattle, and are, for this reason, easier to follow and draw conclusions from. As I have said, the spot on nose and the eye circle seem to go with the red body color, and are almost entirely absent from the roans. At some future time I hope to have material showing how long this red on the face will continue. With this end in view I am now breeding some cows with eye circles and spots on nose to a purebred Hereford bull.

I believe that at some future time man will be able to control colors in animals as surely as the plant breeder already does. We beef breeders of the South are more than ready to be shown how to wipe out the brindle stripes from native cattle, for it stays unto many generations to mark the scrub blood; even high-grade animals carry this mark of scrub ancestry.

AN IMPORTANT PRINCIPLE IN SELECTING FOR FANCY POINTS.

W. J. SPILLMAN, *Washington, D. C.*

In the improvement of a strain of plants or animals by breeding and selection there are two general classes of characteristics which we strive to attain. One class consists of those things which we ordinarily call fancy points, the other we call utility points, though these two names do not very aptly describe the two classes of characteristics concerned. From the standpoint of the breeder who is working for profit, the so-called fancy points may have high commercial value and hence, as far as the producer of pedigreed animals or plants is concerned, have to him important economic value. Perhaps it would

be more accurate to describe class 1 as consisting of esthetic characteristics, and class 2 as those characteristics relating to production, or simply productive characteristics.

In some cases the ideal of the breeder relates almost exclusively to esthetic characters. This is especially true amongst pigeon fanciers, and to a large extent amongst poultry fanciers, but I shall deal here with the more usual case in which productive characters are of prime importance and esthetic characters more or less incidental—a situation which is always found in the development of those breeds which the ordinary farmer uses almost solely for their productive characters. That is, I shall deal with the work of those who ought to be producing high-class breeding stock for the ordinary farmer, leaving out of consideration the fancier whose object is to take prizes or to produce stock with which others can take prizes, with little or no reference to their utility to the farmer who must make his money from actual products from productive characteristics.

It is comparatively easy to improve a breed with reference to a single characteristic; it is more than twice as difficult to improve it with reference to two characteristics; and as the number of characteristics for which we select increases, the difficulty of securing individuals combining the characteristics sought increases enormously.

Again, for any given variable character in a breed those individuals will be more numerous which present the character in an intermediate form than will the individuals which present it in extreme form. To illustrate my meaning, let us consider the length of ear in corn. Suppose that fully developed ears in a given variety on a given farm in a given season vary from 7 to 14 inches in length and that the mean length is $10\frac{1}{2}$ inches. Ears 7 inches in length will be comparatively few; but as we pass from the extremes to the mean the number of ears increases rapidly, and ears 10 to 11 inches in length will be more numerous than those of any other length. Now it will be much easier to secure uniformity of length if the length selected lies in the mode of our curve, that is, its highest point—that is, the ear length which is most common in the corn selected—than it will be to establish an extreme length. In other words, the nearer the ideal is to the mode of the curve of length the greater the ease with which the characteristic can be fixed, and the population made uniform with reference to it.

Now in productive characteristics we are compelled to work for the extreme of production. In corn we want the highest yielding strain, in poultry we want the greatest egg production, etc., so that, generally speaking, in selecting for productive characters we must work against nature, always a difficult thing to do.

This being the case, in dealing with utility breeds why should we add to the difficulty of breeding by setting extreme standards for esthetic characters? Would it not be better, in the case of esthetic characters, for us to ascertain the tendency of the breed—that is, the norm of each esthetic character—and make that standard? I will illustrate further by the case of ear length.

FIG. 1.—EAR LENGTH, 1909, RED OAK FARM, NEWTON COUNTY, MO.

Figure 1 shows the norm for ear length on the farm of J. F and W. J. Spillman for the present season as determined by measuring the length of 90 ears of corn selected at random over the seed plot. The column of ear lengths was first constructed, and then each ear was measured and a mark was made opposite the length of that ear.

It will be observed that the mode of the curve occurs at about 8 inches, being a little on the side of $8\frac{1}{2}$ inches. It should be stated that the season was very dry and that the mode of the curve is nearly one inch shorter this year than it was last year in the same corn.

Another important point to notice in this method of determining the mode for ear length is that it eliminates the effect of the season. Last year we selected for 9 inch ears because that was the mode of our curve. This year we are selecting for 8 and $8\frac{1}{2}$ inch ears, and believe that by that method we are selecting for identically the same inheritance as we did the previous year. We think that in a normal season the length of the corn we selected this year would be about 9 inches.

By choosing that ear length which our farm is trying to produce we are able to secure uniformity in ear length quickly, and at the same time we have the best chance of finding ears of the proper length with other characteristics desired because there are more ears of this length than of any other.

Of course, in making the actual determination of ear length it would be wise to use several hundred individuals, the figures in the chart being merely meant to be illustrative of the principle rather than as a model to follow in making the determination.

It may be argued that in the case of ear length we can increase the yield by selecting for longer ears, but this is rather doubtful. I am inclined to believe that we can fix type much more rapidly by selecting the modal length and that we can secure yield by proper spacing of the plants. It is probable that if one desired longer ears it would be better to seek for a strain which normally produces longer ears than to try to develop such a strain in which the normal ear length is not what is wanted.

In breeding corn the same principle here outlined may be applied to the length of the grain, and most rapid progress toward securing a type will probably come from selecting that grain length which is most common in the variety with which the breeder is working. I pass here entirely the question of desirability of uniformity in a field of corn, since the difficulties which arise from too great uniformity, as pointed out by Shull, East, Collins, and others, may be overcome by growing two strains and hybridizing them,

Figure 2 is a curve constructed from the data of Figure 1. It is seen that the modal point of the curve is quite distinct and lies just a little beyond 8 inches. This curve is sharper than the corresponding curve last year, presumably as a result of the selection made last year.

Another illustration of the point under consideration is the color of Barred Rock fowls. There is reason to believe that in these fowls the tendency to barring is inherited by males from both parents,

FIG. 2.—LENGTH OF EAR ON FARM OF J. F. AND W. J. SPILLMAN, 1909. (Very dry year.)

while it is inherited in females only from the sire; hence the males have more tendency to barring than the females and are therefore lighter colored; that is, the white bars on black feathers are broader; hence males and females of the same breeding are different in shade of color, the male being lighter. Now the standard set by Barred Rock breeders requires show birds of both sexes to be of the same shade of color. In order to accomplish this it is necessary for the breeder to maintain what is practically two breeds of these fowls, one light and the other dark, selecting his females from the light breed and his males from the dark. If the breeders of Barred Plymouth Rocks would carefully determine the normal difference in shading

between the sexes and establish this as standard it would remove what seems to me to be a wholly unnecessary difficulty in the further improvement of this breed and allow breeders to concentrate on those characteristics which are useful to the ordinary farmer who keeps chickens of this breed. I know of no breed of live stock of which esthetic requirements are not made, and in some cases there can be no question that the effort to secure the standard set for these esthetic characters has greatly militated against the productive characteristics of the breeds. I wish merely to suggest, in closing, that it appears to me to be important for the practical breeder to recognize the point I have attempted here to make and to fix the standard of esthetic characters at the normal for the breed, because of the large number of individuals which will be found meeting the requirements of the standard, in order to be able to put greater stress upon those characteristics which relate to productive values and in which, in order to make progress, we must select extreme forms, which are always comparatively rare.

HEREDITY AND ENVIRONMENT.

WALTER SONNEBERG, *Philadelphia, Pa.*

THE PROPOSITION.

The definite fund of character which is represented by the seed or fertilized egg develops relatively in correspondence with the environmental coincidence—the closer the parental and progenic environments agree the truer will be the offspring to type—subject to the responsiveness or coefficient of variability which regulates the degree of departure from type due to each change of environment.

Prof. T. H. Morgan assures us that “the egg need not contain the characters of the adult nor need the sperm. Each contains a particular material which in the course of the development produces in some unknown way the character of the adult. Tallness, for instance, need not be thought of as represented by that character in the egg; but the material of the egg is such that, placed in a favorable medium, it continues to develop until a tall plant results.”

According to Dr. F. A. Woods, “It is significant that among vertebrates the modifications are largely associated with the integument, where cell-division is active and constant, and in a tissue that