RECENT EVOLUTION IN MILK SECRETION OF GUERNSEY CATTLE

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Under the title of evolution much has been written with regard to the development of the morphological characters in the plant and animal. While such studies will undoubtedly remain the foundation on which the theory of evolution must rest for many years to come, it is of interest to view the progress of evolution in some of the characters which surround us and are familiar in everyday life. Furthermore it is important to consider the evolution of those parts which have to do with the everyday physiology of the animal rather than its more nearly structural form.

In the milk production and butter-fat concentration of milk we have an opportunity to make such a study of the progressive effect of the factors contributing to evolution of a given class of animals. These factors may be those which are innate and due to a selection of a better heredity for the animals making successive generations, or they may be due to those sociological causes found in the advance of our scientific knowledge on the effect of environment on the expression of the animal's innate capacities. Ordinarily it is difficult, if not impossible, to separate these two variables in any study. In dairy cattle it is doubly difficult in view of the rapid progress which has taken place recently in our knowledge of their proper feeding and management. For the purpose of this study it is proposed to show the changes which have taken place in Guernsey Advanced Registry
cattle from the time of the inception of the Advanced Registry to the present day.

Milk is, of course, a secretion of one of the complex body glands. The concentration of the fat in the milk represents the variation in the percentage of a product which may be found in such a secretion. Figure 1 shows the progressive changes in the milk production, butter-fat percentage and butter-fat of Guernsey Advanced Registry animals from the time of the establishment of the Advanced Registry to the present day. For this purpose the different periods in the evolution of these cows are indicated by their Herd Book numbers. The first averages represent the results for those cows having 1 to 5000 as their Herd Book numbers. The second group, the averages of those cows from 5000 to 10,000 of Herd Book numbers. In this way a picture of the changes which have taken place in the productivity of Guernsey cattle are indicated against the changes which have taken place in time.

The two upper charts in figure 1 are surprising. They show no increase in either milk yield or butter-fat percentage during the different periods of registration of Guernsey cattle, whether these productions be taken as the highest, the average or the lowest production for the given period. The question, however, is not settled by these charts as from the third chart it will be noted that a marked age change has taken place in the animals entered for Advanced Registry during the different periods. The solid line represents the average age (as given on the right-hand side of the figure) of the cows entering the Advanced Registry for any given period. It will be noted that during the early days of the Advanced Registry only older cows were entered. There has been since this time a progressive change towards testing cattle early in life, making a constant decline in the age of the cows which have been tested for the Advanced Registry within the different periods of time. The dotted line shows the frequency distributions for the number of animals shown at the left for each of the given periods of time within which the Advanced Registry data were divided.

It is known that age materially affects the production of milk in dairy cattle. This effect of age is represented by a marked but ever declining increase in production as the cow advances in years until a maximum is reached, when at about 7 to 9 years the cow's production commences to decline at an ever increasing rate. To a less degree the butter-fat is also affected by age, age resulting in a slight decline in the butter-fat percentage of Guernsey cattle. From these facts it is clear that this decline in the age of production of cows entering Advanced Registry is an important item in considering the interpretation to be given to the data in figure 1. It is, in fact, surprising rather than otherwise that the average production of Guernsey cattle should have remained the same during the different periods of registration as shown in Chart 1 rather than having declined in
Progressive changes in the average age-corrected milk yields and butter-fat percentages of animals making the Guernsey Advanced Registry.

Chart (1) gives the data for milk and butter-fat yield. The cows making the Advanced Registry are divided into periods according to their Herd Book numbers. The age-corrected record of highest producing cow during each period is shown as the solid line; the average uncorrected milk yield as the dotted line; the lowest age-corrected milk yield as the dot and dash line; the average uncorrected butter-fat yield as the dot, dot, dash line.

Chart (2) shows similar data for the butter-fat percentage of these cows. The solid line represents the highest age-corrected butter-fat percentage of these cows for each period; the dotted line the average uncorrected butter-fat percentages for each period; the dot and dash line the lowest age-corrected record for each period.

Chart (3) shows the average ages of the cows within each group of cows as the solid line. The dashed line shows the number of cows in each group. It is clear from these charts that the age of the cows making the Advanced Registry at these different periods has changed markedly. Thus the dotted lines showing the average milk yields and butter-fat percentages of the cows for the different periods does not present a true picture of the events.
production, for, as indicated, younger cows, in general, milk less than do older cows.

This difficulty may be overcome by placing the records on an age corrected basis, or in other words, correcting the production of the cow to what it would have been at mature form, 8 years and 3 months. Figure 2

![Graph of Guernsey Advanced Registry Cows](image)

Progressive changes in Guernsey Advanced Registry Cows from the time the advanced registry was established to the present day.

The dot and solid line represents the age-corrected milk yields for each period in the breed's history. The dot, dot, dash and the dot, dash line represents the age-corrected butter-fat percentages during each period. The heavy lines throughout represent the data to be given most weight. The solid circles give the average age-corrected milk yields of the recorded dams of the cows registered at the given period. The open circles the average age-corrected butter-fat percentages of the recorded dams of the cows registered at the given period.

From figures 1 and 2 the following conclusions may be drawn. (a) Within the significant period, 20,000 to 70,000 of Herd Book numbers, there has been no significant change in the milk yields or butter-fat percentages of the highest and lowest cows. (b) During this time there has been a continuous decrease in the age of the cows tested. (c) There has been a significant increase in the average age-corrected milk yields of these cows during the period. (d) These cows appear to come from the better type of dams. (e) No significant change has taken place in the butter-fat percentage.

shows the result of making these corrections. It will be noted that on a mature form basis there has been a constant increase in the milk production of Guernsey cattle. No such increase is to be noted in the butter-fat percentage. In fact, in general, the butter-fat percentage is practically the
same throughout the whole period. Within these charts the milk yields are shown as the solid and dotted line, the butter-fat percentages as the dot and dash line, the heavy lines represent the data which are significant, the light lines those of doubtful value due to lack of numbers of individuals. Confining our attention to the significant data represented by the heavy lines it will be noted that in milk yield there has been a constant increase in mature form production of Advanced Registry cows, whereas the butter-fat percentages have remained practically the same. In other words the trend has been constantly toward higher milking, younger cows.

It is difficult to distinguish which factors influencing evolution are the most potent in bringing about these changes. On the inheritance side it would be expected that if these changes are brought about by a constantly increasing selection of higher producing cows as dams of those to enter the Advanced Registry, that such an influence of inheritance would be seen by the fact that the dam's production would be higher than the average of the cows for the different periods from which the dams were chosen. The heavy solid dots of figure 2 represent the amounts by which the dams of a given series of cows were higher or lower in their milk production than the average of the cows within their period of life. The open circles represent the butter-fat percentages of these dams for the same period. It is clear that there has been an increasing selection of better producing cows to furnish the offspring for the subsequent generation insofar as milk production is concerned. This better selection has been almost constantly toward the higher side of production. The selection has not been as severe for butter-fat percentage, although, in general, the selection for butter-fat percentage has been somewhat above the average for all cows.

From these facts it is seen that the selection of better cattle as dams to those making the Advanced Registry has probably played a part in increasing the milk production as shown by these Advanced Registry cattle. On the other hand, it is doubtful if this better inheritance is the only factor in bringing about this increase. It seems more probable that the increased knowledge of feeding and the care of dairy animals has also played a large part in the increase of production. In view of the negative relation which exists between amounts of milk yield and the butter-fat percentage of the milk we would expect a decline in the butter-fat percentage. However, the butter-fat percentage has changed but little. The influence of better heredity and the increased knowledge of feeding and care of dairy cattle has been able to nearly maintain the butter-fat percentage constant while the milk yield was increased in amount.

Here, within present day remembrance, is presented a picture of progressive evolution in the secreting power of one of the most important body glands. For that portion of the gland's activity subjected to agencies which are believed to bring about progressive evolution, there is a marked
increase in the average ability of the cows within the Guernsey breed, namely, an increase in the milk producing capacity of these animals. For that portion of the secretion where these agencies of evolution have been less active the original level of activity has been maintained.

ELIMINATION OF CHROMOSOMES DUE TO A MUTANT (MINUTE-N) IN DROSOPHILA MELANOGASTER

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The mutant character Minute-n in Drosophila melanogaster belongs to the general category of Minutes (see Bridges and Morgan, Carnegie Publication, No. 327, page 207), in that (1) the bristles throughout the fly, especially those on the thorax and head, are shorter and slenderer than those of the normal wild-type fly. Likewise the character is (2) a dominant. The gene is (3) lethal when homozygous. And (4) the development to emergence from the pupa takes two or three days longer than that of the wild-type sibs. Besides the above key characteristics of Minutes, Minute-n flies show to a variable extent other characteristics common to Minutes, as, for example, smaller size, abnormal bands on abdomen, reduced aristae, irregular venation, paler body-color, frequent sterility of the females and rather low productivity of some of the females that are fertile, etc. All these characters are inherited as a unit group, and are due either to a single point-mutation, or, more probably, to a section-mutation or "deficiency" (Bridges, Genetics, 2, 445-465). Minute-I, situated near the right end of chromosome II, is known to be a deficiency for the loci of arc and plexus that are about a unit apart, and for the section between them (Carnegie Year Book, No. 23, p. 233). The locus of Minute-n is in the X-chromosome, about six units to the right of forked, or at approximately 62. Since the locus of Minute-n is in the X-chromosome, the character occurs only in females. In the male it is lethal. This agrees with the Notch-deficiencies. The other two Minutes in the X, viz., Minute-k and Minute-o, are likewise dominant in the female and lethal in the male. The termination -n of the name Minute-n designates that this was the fourteenth mutant of the Minute type (found Jan. 11, 1924) to be studied extensively enough to be given a distinctive name. If Minute-n is a deficiency, it nevertheless does not produce changes in crossing-over extensive enough to interfere with its use in linkage studies. Since the locus of Minute-n lies to the right of forked it has provided a means of deter-