

Recommended  
for acceptance, on behalf  
of Graduate Committee  
W. H. McIntire  
7/3/20

Approved  
L. E. Elmer Kyle

INFLUENCE OF AGE, PERIOD OF LACTATION,  
SEASON, AND TIME OF FRESHENING ON THE PRODUCTION  
OF JERSEY CATTLE IN TENNESSEE.

By

S. C. Collins.

33



SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF M.S. IN AGRICULTURE,  
UNIVERSITY OF TENNESSEE.

TABLE OF CONTENTS.

|                                                    |         |
|----------------------------------------------------|---------|
| Introduction...                                    | page 1. |
| Plan of Project.....                               | 1.      |
| Summary of Literature.....                         | 2.      |
| Influence of Age.....                              | 10.     |
| Variations According to Month of<br>Lactation..... | 12.     |
| Seasonal Variations.....                           | 12.     |
| Influence of Time of Freshening.....               | 21.     |
| Summary.....                                       | 21.     |

9 Jan 25 N.L.B. 1.00

VARIATIONS ACCORDING TO AGE,  
SEASON, AND PERIOD OF LACTATION IN THE PRODUCTION OF  
JERSEY COWS IN TENNESSEE.

INTRODUCTION.

Although a great deal of work has been done on this subject elsewhere, it will be worth while to learn just what variations in the production of dairy cows in Tennessee result from the influence of factors known to have an effect. Complete records for one year for 482 Tennessee Register of Merit Jersey cows are available in the Dairy Office, University of Tennessee for the compilation of the data. These records have been used in arranging the tables found in this work. The range of the production and the percentage of fat of these cows is very wide. The individual cows show considerable irregularities in production from month to month. The aim of this work is to determine how closely these irregularities follow the general laws that have been formulated according to the variations observed at other places.

PLAN OF PROJECT.

A. Review of Literature on the Subject.

B. Arrangement of Data to Show

1. Influence of Age on Production and Percentage of Fat.
2. Variations according to Month of Lactation.
3. Seasonal Variations.
4. Influence of Season of Freshening.

C. Summary.

## SUMMARY OF LITERATURE ON THE SUBJECT

## Effect of Advancing Age.

After the review of the records of a large number of Jersey and Holstein cows, Eckles <sup>6</sup>(X) makes the following statement:

" A dairy cow on the average as a two-year-old may be expected to produce about 70 per cent; as a three-year-old around 80 per cent; and as a four-year-old about 90 per cent of the milk and butter fat she will produce when mature."

"The richness of the milk remains practically constant from year to year, except that after the third milking period there is a slow, gradual decline with advancing years."

In looking for the reasons for the increase in production with the increase in age, Ragsdale at the University of Missouri has made some very interesting observations. It is generally supposed that the principal factor enabling a cow to produce more milk as a five-year-old than as a two-year-old is that she is greater in size. Ragsdale <sup>1</sup>(X) has shown, after arranging a great deal of weight data, that the increase of milk secretion with age follows the same course as the increase of body weight with age, and that while milk secretion and body weight follow the same course, they are largely independent of each other.

Table I contains data presented to show that the growth of a dairy cow follows the course of a monomolecular chemical reaction; that is, the percentage decline in growth in weight with age is constant. These are based on the weights of 14,600 Register of Merit Jersey cows.

TABLE I.

/ (Z)

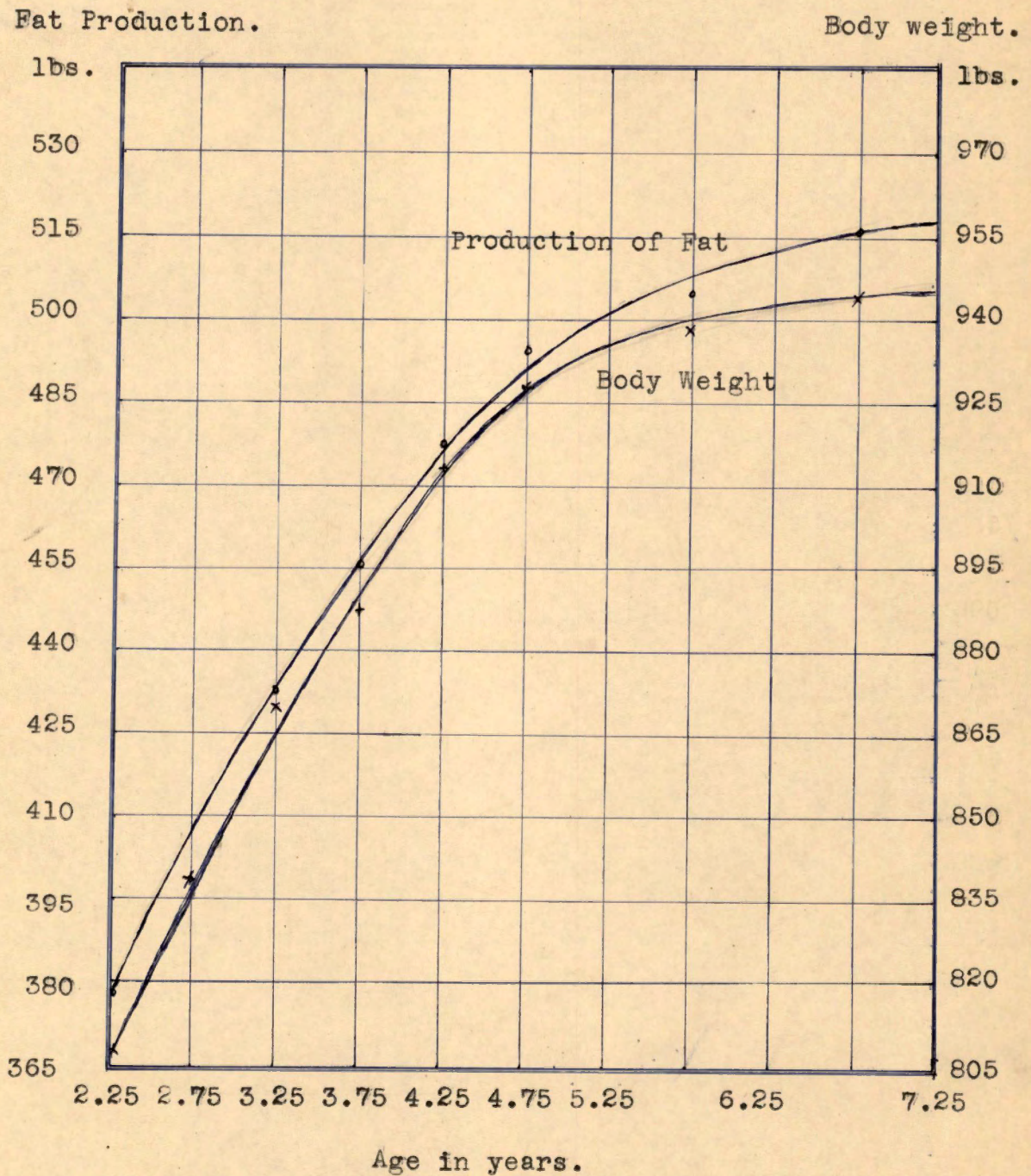
| Age in Years | No. of Cows Included | Average Weight | No. of Cows Included | Average Production. |
|--------------|----------------------|----------------|----------------------|---------------------|
| 2.25         | 3155                 | 808            | 2829                 | 377                 |
| 2.75         | 1449                 | 836            | 1261                 | 398                 |
| 3.25         | 1523                 | 872            | 1271                 | 432                 |
| 3.75         | 1122                 | 888            | 992                  | 456                 |
| 4.25         | 1171                 | 916            | 978                  | 477                 |
| 4.75         | 916                  | 930            | 809                  | 496                 |
| 5.5          | 1692                 | 938            | 1487                 | 502                 |
| 6.5          | 1235                 | 945            | 1067                 | 516                 |
| 7.5          | 965                  | 952            | 837                  | 521                 |
| 8.5          | 621                  | 957            | 565                  | 523                 |

From Table I and Fig. I it can be seen that each 100 pounds gain in body weight was accompanied by a gain of approximately 100 pounds in yearly butter fat production. Further, the rate of growth decreased rapidly with increase in production. That is, the number of pounds of body weight gained and the number of pounds <sup>gain</sup> of butter fat produced in unit time decrease at a constant per cent of themselves.

This decline in the rate of growth is supposed to be due to the using of the growth " limiting substance." It seems to be used at a constant ratio or per cent of itself. Considering the half year periods given in Table I, the amount of the limiting substance at each age is seen to be about 74 per cent of the amount of the substance at the preceding age. The difference between the weight at the given age and at maturity is considered a measure of the substance.

In an attempt to determine what part of the 100 pounds increase in yearly production was due to the 100 pound gain in body weight,

Figure 1. This figure shows the parallelism of the changes in body weight and in fat production with increasing age. (Table 1).



Ragsdale (<sup>1</sup>2) arranged the data in Tables 2 and 3.

This question was answered in a general way by separating the factors of age and body weight. The animals were classified into age groups, Table 2, and into body weight groups, Table 3. A study of Table 2 reveals that on the average only 20 pounds increase in production can be attributed to 100 pounds gain in weight, 80 per cent of the increase, therefore, must be due to other factors accompanying increased maturity.

Ragsdale has also shown (<sup>2</sup>3) that from the age when milk secretion usually begins ( 2 years) to the age when maximum body weight is reached ( about 8 years) increase of milk secretion and increase of body weight with age follow the same exponential course, which is the course of a monomolecular reaction of chemistry. After this age, unlike body weight which remains practically constant, milk secretion declines exponentially, that is the decline follows the course of decline of a monomolecular reaction. (7). *Reference should be given to some physical chemistry text which shows the nature of this reaction*

<sup>8</sup>  
Gowen (<sup>4</sup>), working with records of Guernsey cattle, has come to the same conclusion with regard to production. He adds, " The butter fat percentage shows a slight but significant decline as the age of the cow advances. This decline on the average amounts to three-tenths of one percent in the ten years from two to twelve years of age."

TABLE 2.

The Increase of Milk Secretion with Increasing Body Weight at Constant Age.

| Body Weight                                                     | Age of Cows.      |                            |                   |                                 |                   |                                  |
|-----------------------------------------------------------------|-------------------|----------------------------|-------------------|---------------------------------|-------------------|----------------------------------|
|                                                                 | 2 to 3 yrs.       |                            | 3 to 4 yrs.       |                                 | 4 to 5 yrs.       |                                  |
|                                                                 | No. in-<br>cluded | Yearly<br>fat prod.<br>lbs | No. in-<br>cluded | Yearly fat<br>production<br>lbs | No. in-<br>cluded | Yearly fat<br>production<br>lbs. |
| lbs.                                                            |                   |                            |                   |                                 |                   |                                  |
| 625                                                             | 101               | 342                        | 43                | 389                             | 38                | 423                              |
| 675                                                             | 199               | 351                        | 142               | 392                             | 101               | 439                              |
| 725                                                             | 540               | 360                        | 255               | 396                             | 315               | 438                              |
| 775                                                             | 584               | 367                        | 573               | 407                             | 318               | 448                              |
| 825                                                             | 1043              | 374                        | 508               | 420                             | 445               | 456                              |
| 875                                                             | 576               | 381                        | 605               | 429                             | 262               | 463                              |
| 925                                                             | 496               | 394                        | 220               | 452                             | 240               | 482                              |
| 975                                                             | 155               | 411                        | 185               | 455                             | 82                | 491                              |
| 1025                                                            | 97                | 402                        |                   |                                 | 49                | 508                              |
| 1075                                                            |                   |                            |                   |                                 |                   |                                  |
| 1125                                                            |                   |                            |                   |                                 |                   |                                  |
| 1175                                                            |                   |                            |                   |                                 |                   |                                  |
| 1225                                                            |                   |                            |                   |                                 |                   |                                  |
| Average gain<br>in production<br>per 100 lbs.<br>gain in weight |                   | 17                         |                   | 19                              |                   | 21                               |
|                                                                 |                   |                            |                   |                                 |                   | 25                               |

TABLE 3.

The Increase of Milk Secretion with Age at Constant Body Weight

| Age<br>in<br>years. | Weight of Cows             |                                                |                            |                                |                  |                      |                   |                      |
|---------------------|----------------------------|------------------------------------------------|----------------------------|--------------------------------|------------------|----------------------|-------------------|----------------------|
|                     | 750 to 849 lbs.            |                                                | 850 to 949 lbs.            |                                | 950 to 1049 lbs. |                      | 1050 to 1151 lbs. |                      |
|                     | No. of<br>cows<br>included | Yearly<br>produc-<br>tion in<br>fat in<br>lbs. | No. of<br>cows<br>included | Yearly<br>production<br>in fat | No. of<br>cows   | Yearly<br>production | No. of<br>cows    | Yearly<br>production |
| 2.5                 | 1869                       | 354                                            | 1289                       | 385                            | 259              | 405                  | 23                | 418                  |
| 3.5                 | 799                        | 401                                            | 1241                       | 429                            | 422              | 458                  | 44                | 431                  |
| 4.5                 | 446                        | 433                                            | 1019                       | 458                            | 513              | 474                  | 114               | 496                  |
| 5.5                 | 239                        | 463                                            | 842                        | 483                            | 476              | 496                  | 131               | 519                  |
| 6.5                 | 174                        | 452                                            | 563                        | 475                            | 503              | 503                  | 97                | 524                  |
| 7.5                 | 130                        | 470                                            | 443                        | 487                            | 499              | 499                  | 91                | 529                  |
| 8.5                 | 87                         | 479                                            | 255                        | 487                            | 492              | 492                  | 47                | 533                  |

### Effect of Advancing Lactation Period.

As to the variations according to the month of the lactation period, it is a well known fact that the milk flow rises for some time after calving. This is followed by a steady decline until the animal goes dry, this decline becoming more rapid toward the end of the period. The percentage of fat undergoes just the opposite change.

Brady, Ragsdale, and Turner <sup>3</sup> (~~β~~) regard milk secretion as a chemical or physico-chemical process. Like other chemical reactions the speed of milk secretion is within certain limits dependent on the supply of substances entering the reaction, for example, food, on the removal of the products of the reaction, for example the removal of milk; and probably on certain catalyzers produced by the pregnant uterus. Since milk secretion is a process of limited duration under a plentiful food supply, there must be some factor other than food which limits the process. If the limiting reaction is chemical in nature then these authors believe that the decline of the speed of milk secretion should be expressed by the formula of some chemical reaction. The formula adopted by Ragsdale is as follows:

"  $M_t = M_0 e^{-kt}$  , where  $M_t$  = milk production during any month  $t$ ;  
 $M_0$  = theoretical value of the milk flow at the time of parturition".

The remarkable correlation between the observed values and those calculated by the formula is shown in Table 8. There is only a very slight deviation in the first month and in the last month or two. This latter deviation is found to be due to gestation (~~7~~<sup>4</sup>). The results

for farrow cows, found in Table 4 accord almost perfectly with the formula.

It is a common belief of dairymen that gestation is an important factor in the decline of milk secretion with the advance of the lactation period. Brady, Ragsdale and Turner (<sup>4</sup>/<sub>1</sub>) (<sup>5</sup>/<sub>1</sub>) attack this question by dividing milk records into two groups; a farrow group, in which the cows were not bred during the year under observation, and a pregnant group, in which the animals were bred during the third and fourth months after calving. The averages for these two groups are presented in Table 4.

The results given show that during the first five months of lactation the farrow and the pregnant cows decline in milk production in a similar manner. After the fifth month and until the end of the twelfth month of lactation the pregnant cows decrease in milk flow more rapidly. With the farrow cows each month's production after the second month was about 94.77 per cent of the preceding month's production. The figures indicate that gestation is the cause of a reduction of milk amounting to between 480 and 800 pounds during the latter part of the lactation period.

#### Seasonal Variations in Production.

Turning the cows to pasture in the spring generally causes an increase in both the yield of milk and its richness. After 2 to 4 weeks the percentage of fat falls to normal. The tendency is for cows to yield slightly poorer milk in summer than in winter (<sup>10</sup>/<sub>1</sub>).

TABLE 4.

The relative Decline of Milk Secretion with the Advance of the Period of Lactation of Farrow and Gestating

| Month of<br>Lactation | Cows ( Guernsey Breed) |                          |                 |                 |
|-----------------------|------------------------|--------------------------|-----------------|-----------------|
|                       | Farrow Cows            |                          | Gestating Cows. |                 |
|                       | No. of Animals         | Yield per Mo.            | No. of Animals  | Yield per Month |
|                       |                        | Observed      Calculated |                 |                 |
|                       |                        | lbs.                     | lbs.            | lbs.            |
| 2                     | 920                    | 1052                     | 1049            | 373             |
| 3                     | 912                    | 998                      | 994             | 374             |
| 4                     | 923                    | 938                      | 942             | 373             |
| 5                     | 914                    | 879                      | 874             | 372             |
| 6                     | 917                    | 833                      | 846             | 372             |
| 7                     | 912                    | 792                      | 802             | 374             |
| 8                     | 904                    | 752                      | 760             | 371             |
| 9                     | 905                    | 715                      | 720             | 369             |
| 10                    | 906                    | 676                      | 682             | 369             |
| 11                    | 852                    | 650                      | 641             | 358             |
| 12                    | 653                    | 617                      | 613             | 283             |

## B - Influence of Age on Production and Percentage of Fat.

On the following pages will be found data compiled from the records of 482 Tennessee Register of Merit - Jersey Cows.

In order to study the changes in production with increasing age, the cows were grouped in age classes ranging from senior yearling to 13 year-old.

Table 5 shows the average yearly production according to age. On account of the small number of cows considered, many irregularities occur in a curve drawn to give a graphic representation of the trend of production. But in general the results conform very closely to the statement made by Eckles which was quoted above. It will be noted that a large increase was made in the twelfth year, but since the number of cows is so small, that is not considered significant. The percentage of fat declined very slowly with increasing age.

Weights for these cows were not available. Ragsdale (Z) has shown that about 20 per cent of the increased production with advancing age may be attributed to the increase in body weight. It seems that a large part of the remaining 80 per cent could be accounted for by assuming that the cows ability to consume and digest feed is fixed, increasing only as the body size increases, and that the nutrients which, in the young cow, are divided between milk production and tissue growth, in the mature cow are all available for milk production. In order to produce 1 lb. gain in a growing animal something like 1 lb. of protein and 7 lbs. of carbohydrates are necessary. Allowing 40 percent of this for maintenance, about .6 lb. of protein and 4.2 lbs of carbohydrates would be available for milk production, were the animal not growing.

TABLE 5.

Figures Compiled from Records of 485 Register of Merit  
Jersey Cows in Tennessee.

| Age of Cows  | # Milk  | # Fat  | % Fat | No of Cows. |
|--------------|---------|--------|-------|-------------|
| Sr. Yearling | 6125.5  | 353.52 | 5.77  | 34          |
| Jr. 2 - yr.  | 6376.3  | 358.83 | 5.63  | 67          |
| Sr. 2 - yr.  | 7004.7  | 404.20 | 5.77  | 30          |
| Jr. 3 - yr.  | 7027.6  | 399.68 | 5.69  | 38          |
| Sr. 3 - yr.  | 7675.6  | 427.65 | 5.57  | 32          |
| Jr. 4 - yr.  | 7779.8  | 444.23 | 5.71  | 59          |
| Sr. 4 - yr.  | 8414.0  | 457.08 | 5.43  | 21          |
| Jr. 5 - yr.  | 7983.0  | 435.74 | 5.46  | 34          |
| Sr. 5 - yr.  | 8438.3  | 467.87 | 5.54  | 30          |
| Jr. 6 - yr.  | 8096.7  | 460.11 | 5.68  | 20          |
| Sr. 6 - yr.  | 9181.0  | 491.45 | 5.35  | 12          |
| Jr. 7 - yr.  | 8559.5  | 458.29 | 5.35  | 24          |
| Sr. 7 - yr.  | 8428.0  | 463.72 | 5.50  | 16          |
| Jr. 8 - yr.  | 8320.0  | 459.16 | 5.52  | 17          |
| Sr. 8 - yr.  | 8316.2  | 460.58 | 5.54  | 10          |
| 9 - yr.      | 8782.0  | 481.17 | 5.50  | 16          |
| 10 - yr.     | 8454.3  | 454.78 | 5.40  | 13          |
| 11 - yr.     | 8732.8  | 478.85 | 5.48  | 8           |
| 12 - yr.     | 10662.0 | 588.76 | 5.22  | 3           |
| 13 - yr.     | 9329.6  | 508.87 | 5.45  | 3           |
| Av. of All   | 7693.0  | 428.62 | 5.57  | -           |

TABLE 6.

Variation in Monthly Production and Per Cent of Fat Accord-  
to Month of Lactation Period. (Average of All)

| Month | Daily Milk<br>Yield | #Milk        | #Fat  | Av. per cent fat. |
|-------|---------------------|--------------|-------|-------------------|
| 1.    | 28.0                | 559 ( 20 da) | 28.23 | 5.04              |
| 2.    | 28.4                | 851          | 44.07 | 5.17              |
| 3.    | 27.2                | 815          | 43.00 | 5.28              |
| 4.    | 25.4                | 762          | 41.72 | 5.47              |
| 5.    | 23.6                | 709          | 39.52 | 5.57              |
| 6.    | 21.7                | 650          | 37.40 | 5.63              |
| 7.    | 21.1                | 633          | 35.99 | 5.68              |
| 8.    | 19.6                | 589          | 34.03 | 5.77              |
| 9.    | 18.4                | 551          | 32.30 | 5.86              |
| 10.   | 16.8                | 504          | 28.17 | 5.91              |
| 11.   | 15.1                | 452          | 26.79 | 5.92              |
| 12.   | 15.1                | 451          | 26.44 | 5.86              |

Fig.2. Production and Percentage of Fat with Increasing Age. (Table 5).

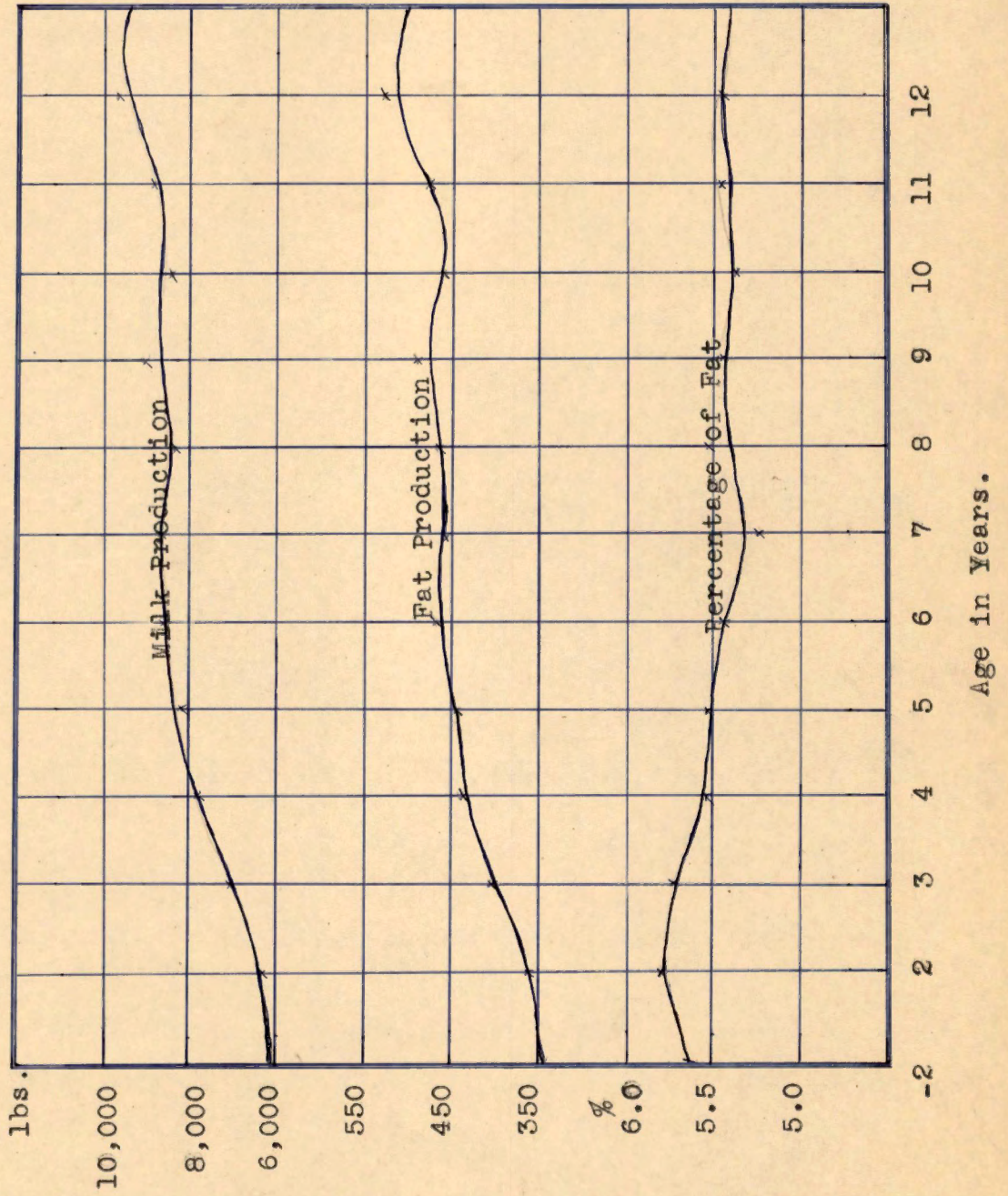
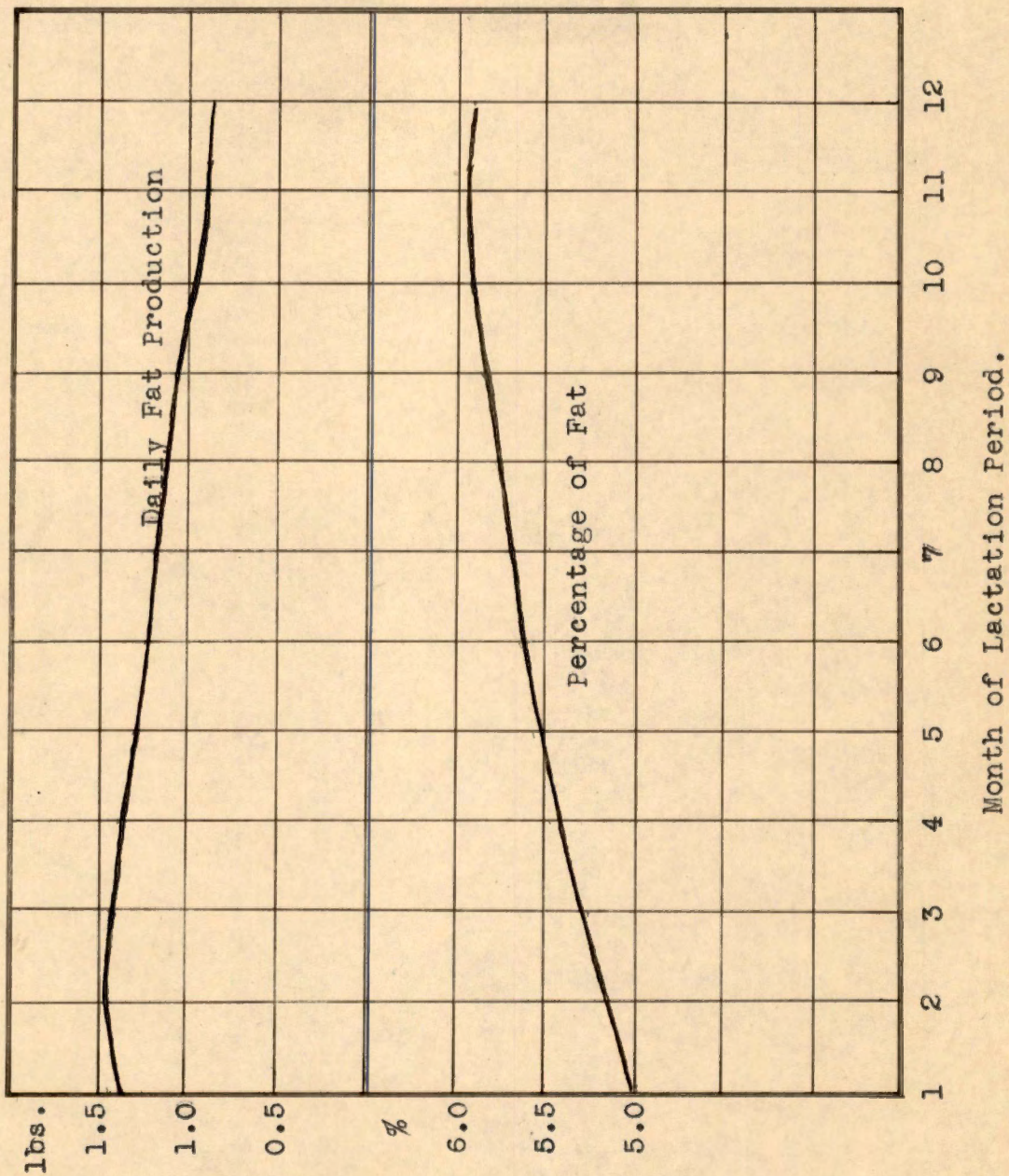


Figure 3. Production According to Month of Lactation Period.  
Average Daily Production (482 cows). (Table 6).



That amount of nutrients would produce enough milk to yield from .5 to .75 lb. of fat. That is, the food which the young cow uses for making 100 lbs. gain in weight would enable her to produce 50 to 75 lbs. more fat when mature.

#### Variations According to the Month of Lactation.

In arranging the data to determine the variations during the lactation period, the cows were divided into twelve groups according to the month in which they freshened and the average monthly production of each group was calculated. In this manner the three factors, period of lactation, time of year, or season, and the time of freshening could be studied <sup>Simultaneously.</sup> ~~(at once).~~

From Table 6 it will be seen that when the average of all the cows was considered the production of milk and butter fat reached the highest mark during the second month of the lactation period, gradually declining thereafter. The percentage of fat rose very steadily from 5.04 the first month to 5.86 the twelfth. This is in accord with the generalizations made heretofore.

#### Seasonal Variation.

From Table 9 it can be seen that the season has a rather marked effect upon the yield and especially upon the per cent of fat. No matter when the cow freshened, the production was always increased at the coming of spring, the average reaching a maximum in May and a minimum in January or February. The reverse was true with the percentage of fat. It was highest in winter and lowest in summer. The variation was large enough to be significant. The accompanying figures plotted from data of cows freshening at different times of the year all show uniform waves corresponding to certain seasons of the year.

TABLE 7.

Variation of Production According to Month of Lactation Period.  
(482 Cows.)

| Month of<br>Freshening | Daily Production in #Fat for Month of Lactation Period. |      |      |      |      |      |      |      |      |      |      |      |
|------------------------|---------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|
|                        | 1                                                       | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   |
| Jan.                   | 1.55                                                    | 1.57 | 1.58 | 1.63 | 1.58 | 1.44 | 1.32 | 1.21 | 1.13 | 1.04 | 0.87 | 0.82 |
| Feb.                   | 1.35                                                    | 1.53 | 1.55 | 1.54 | 1.31 | 1.25 | 1.21 | 1.13 | 1.06 | 0.95 | 0.83 | 0.76 |
| Mar.                   | 1.35                                                    | 1.57 | 1.58 | 1.43 | 1.32 | 1.29 | 1.17 | 1.04 | 0.95 | 0.93 | 0.79 | 0.81 |
| Apr.                   | 1.05                                                    | 1.59 | 1.48 | 1.35 | 1.30 | 1.21 | 1.17 | 1.10 | 1.06 | 0.87 | 0.77 | 0.83 |
| May.                   | 1.44                                                    | 1.41 | 1.28 | 1.28 | 1.21 | 1.14 | 0.96 | 0.96 | 0.84 | 0.82 | 0.80 | 0.86 |
| Jun.                   | 1.57                                                    | 1.39 | 1.38 | 1.29 | 1.26 | 1.15 | 1.19 | 1.12 | 1.05 | 0.98 | 0.89 | 0.91 |
| Jul.                   | 1.30                                                    | 1.04 | 1.34 | 1.28 | 1.20 | 1.12 | 1.08 | 1.04 | 0.99 | 1.02 | 0.98 | 0.98 |
| Aug.                   | 1.31                                                    | 1.29 | 1.25 | 1.18 | 1.11 | 1.14 | 1.08 | 1.07 | 1.10 | 1.09 | 1.09 | 1.04 |
| Sept.                  | 1.36                                                    | 1.39 | 1.34 | 1.35 | 1.27 | 1.17 | 1.16 | 1.19 | 1.20 | 1.08 | 0.87 | 0.77 |
| Oct.                   | 1.41                                                    | 1.43 | 1.35 | 1.37 | 1.29 | 1.28 | 1.30 | 1.31 | 1.17 | 0.90 | 0.80 | 0.83 |
| Nov.                   | 1.43                                                    | 1.46 | 1.40 | 1.37 | 1.28 | 1.29 | 1.37 | 1.14 | 1.09 | 1.02 | 0.98 | 0.99 |
| Dec.                   | 1.40                                                    | 1.44 | 1.42 | 1.38 | 1.40 | 1.32 | 1.22 | 1.10 | 1.10 | 0.99 | 0.79 | 0.82 |
| Average                | 1.41                                                    | 1.47 | 1.43 | 1.39 | 1.32 | 1.25 | 1.20 | 1.13 | 1.08 | 0.94 | 0.89 | 0.88 |

TABLE 9.

Variations in Monthly Production According to Month of the Year.  
(82 Cows)

| Month | Fat    | Milk | Per cent Fat. |
|-------|--------|------|---------------|
| Jan.  | 31.17. | 533  | 6.19          |
| Feb.  | 30.00  | 529  | 5.67          |
| Mar.  | 35.34  | 641  | 5.51          |
| Apr.  | 37.58  | 689  | 5.45          |
| May   | 41.00  | 758  | 5.41          |
| June  | 38.75  | 739  | 5.24          |
| July  | 36.99  | 721  | 5.13          |
| Aug.  | 36.85  | 699  | 5.27          |
| Sept. | 34.50  | 636  | 5.42          |
| Oct.  | 34.08  | 582  | 5.85          |
| Nov.  | 30.95  | 523  | 5.92          |
| Dec.  | 31.69  | 521  | 6.08          |

*Number of Cows.*

TABLE 10.

*number of cows.*

Variations in Monthly Production of Milk According to  
Month of Year. (482 cows)

| Month of<br>Freshening | Jan. | Feb. | Mar. | Apr. | May | # Milk produced in |      | Aug. | Sept. | Oct. | Nov. | Dec. |
|------------------------|------|------|------|------|-----|--------------------|------|------|-------|------|------|------|
|                        |      |      |      |      |     | Jun.               | Jul. |      |       |      |      |      |
| Jan.                   | 624  | 881  | 952  | 912  | 923 | 826                | 777  | 712  | 595   | 531  | 433  | 423  |
| Feb.                   | 374  | 520  | 912  | 896  | 886 | 778                | 740  | 688  | 586   | 531  | 457  | 398  |
| Mar.                   | 386  | 359  | 574  | 891  | 904 | 805                | 767  | 711  | 600   | 525  | 459  | 436  |
| Apr.                   | 445  | 362  | 442  | 621  | 976 | 889                | 837  | 773  | 679   | 622  | 546  | 519  |
| May.                   | 416  | 386  | 430  | 455  | 627 | 844                | 802  | 775  | 665   | 603  | 515  | 482  |
| Jun.                   | 547  | 464  | 491  | 436  | 463 | 633                | 892  | 842  | 719   | 657  | 559  | 586  |
| Jul.                   | 560  | 485  | 523  | 518  | 522 | 522                | 577  | 863  | 759   | 704  | 605  | 576  |
| Aug.                   | 583  | 527  | 597  | 588  | 607 | 637                | 636  | 614  | 773   | 746  | 621  | 599  |
| Sept.                  | 621  | 559  | 621  | 599  | 643 | 572                | 474  | 415  | 548   | 799  | 722  | 700  |
| Oct.                   | 726  | 628  | 701  | 699  | 699 | 626                | 508  | 427  | 439   | 399  | 768  | 744  |
| Nov.                   | 792  | 689  | 730  | 723  | 738 | 661                | 629  | 592  | 521   | 501  | 518  | 812  |
| Dec.                   | 805  | 724  | 765  | 760  | 738 | 668                | 638  | 618  | 507   | 403  | 384  | 456  |
| Average                | 533  | 529  | 641  | 689  | 758 | 739                | 721  | 699  | 636   | 582  | 523  | 521  |

TABLE 11.

Variation According to Month of the Year.

| Month of<br>Freshening | No. of<br>cows. | Jan.  | Feb.  | Mar.  | Apr.  | May   | June  | July  | Aug.  | Sept. | Oct.  | Nov.  | Dec.  |
|------------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Jan.                   | 53              | 29.52 | 43.87 | 49.02 | 48.86 | 49.10 | 43.13 | 40.84 | 37.56 | 33.75 | 32.30 | 26.13 | 25.36 |
| Feb.                   | 56              | 23.46 | 27.83 | 47.33 | 46.64 | 47.82 | 41.06 | 38.79 | 37.53 | 33.98 | 32.83 | 28.45 | 25.75 |
| Mar.                   | 55              | 24.64 | 22.61 | 30.04 | 47.26 | 48.88 | 42.92 | 40.82 | 39.92 | 35.05 | 32.23 | 28.62 | 28.70 |
| Apr.                   | 54              | 26.92 | 21.69 | 25.86 | 31.44 | 49.34 | 44.54 | 41.76 | 40.37 | 36.39 | 36.18 | 33.01 | 32.78 |
| May                    | 65              | 26.04 | 22.86 | 24.84 | 25.83 | 31.72 | 42.27 | 39.86 | 39.73 | 36.47 | 35.27 | 28.96 | 29.89 |
| June                   | 30              | 34.68 | 29.71 | 30.23 | 26.93 | 28.36 | 32.06 | 43.01 | 42.78 | 38.93 | 39.03 | 34.40 | 36.91 |
| July                   | 38              | 33.53 | 29.17 | 30.71 | 30.55 | 30.29 | 29.38 | 26.06 | 41.38 | 40.20 | 39.78 | 35.96 | 34.74 |
| Aug.                   | 27              | 35.32 | 30.37 | 33.09 | 33.06 | 33.80 | 32.73 | 32.33 | 28.75 | 38.60 | 38.75 | 35.56 | 34.31 |
| Sept.                  | 26              | 39.25 | 32.69 | 35.87 | 35.73 | 37.26 | 32.33 | 27.09 | 23.98 | 27.60 | 43.19 | 40.25 | 41.73 |
| Oct.                   | 17              | 42.60 | 36.04 | 39.63 | 39.08 | 40.68 | 35.07 | 27.89 | 24.77 | 24.80 | 21.18 | 42.81 | 41.80 |
| Nov.                   | 25              | 43.51 | 38.30 | 39.81 | 38.71 | 40.93 | 34.39 | 33.65 | 31.79 | 29.31 | 30.61 | 27.14 | 45.16 |
| Dec.                   | 36              | 44.64 | 39.78 | 42.64 | 42.04 | 40.80 | 36.65 | 34.05 | 34.17 | 29.60 | 24.42 | 24.73 | 25.44 |
| Average                |                 | 31.17 | 30.00 | 35.34 | 37.58 | 41.00 | 38.75 | 36.99 | 36.85 | 34.50 | 34.08 | 30.95 | 31.69 |

TABLE 12.

Variation of Percentage of Fat According to Month of Year.  
*482 Cows*

*number of cows*

| Month of<br>Freshening. | Jan. | Feb. | Mar. | Apr. | May. | Jun. | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|-------------------------|------|------|------|------|------|------|------|------|-------|------|------|------|
| Jan.                    | 4.73 | 4.98 | 5.14 | 5.35 | 5.32 | 5.22 | 5.24 | 5.27 | 5.67  | 6.08 | 6.03 | 5.99 |
| Feb.                    | 6.27 | 5.35 | 5.19 | 5.21 | 5.39 | 5.28 | 5.24 | 5.45 | 5.80  | 6.18 | 6.22 | 6.47 |
| Mar.                    | 6.38 | 6.30 | 5.23 | 5.30 | 5.40 | 5.33 | 5.32 | 5.61 | 5.84  | 6.13 | 6.23 | 6.57 |
| Apr.                    | 6.05 | 5.99 | 5.85 | 5.06 | 5.05 | 5.01 | 4.99 | 5.22 | 5.36  | 5.81 | 6.04 | 6.31 |
| May                     | 6.26 | 5.92 | 5.77 | 5.67 | 5.06 | 5.00 | 4.97 | 5.13 | 5.48  | 5.84 | 5.62 | 6.20 |
| June                    | 6.34 | 6.40 | 6.15 | 6.17 | 6.12 | 5.06 | 4.82 | 5.08 | 5.41  | 5.94 | 6.15 | 6.30 |
| July                    | 5.98 | 6.01 | 5.87 | 5.89 | 5.80 | 5.62 | 4.51 | 4.79 | 5.29  | 5.65 | 5.94 | 6.03 |
| Aug.                    | 6.06 | 5.76 | 5.54 | 5.62 | 5.56 | 5.14 | 5.08 | 4.68 | 4.99  | 5.19 | 5.72 | 5.73 |
| Sept.                   | 6.32 | 5.85 | 5.61 | 5.96 | 5.79 | 5.65 | 5.72 | 5.78 | 5.04  | 5.40 | 5.57 | 5.96 |
| Oct.                    | 5.86 | 5.74 | 5.65 | 5.59 | 5.82 | 5.60 | 5.49 | 5.80 | 5.65  | 5.31 | 5.57 | 5.62 |
| Nov.                    | 5.49 | 5.56 | 5.45 | 5.35 | 5.54 | 5.20 | 5.36 | 5.37 | 5.62  | 6.11 | 5.24 | 5.56 |
| Dec.                    | 5.54 | 5.49 | 5.57 | 5.53 | 5.53 | 5.48 | 5.33 | 5.53 | 5.83  | 6.06 | 6.44 | 5.58 |
| Average                 | 6.19 | 5.67 | 5.51 | 5.45 | 5.41 | 5.24 | 5.13 | 5.27 | 5.42  | 5.85 | 5.92 | 6.08 |

number of cows

TABLE 13

Variation of Percentage of Fat According to Month of  
Freshening and Advancing Lactation Period.  
(482 cows).

| Month of<br>Freshening | Month of<br>Period of Lactation . |      |      |      |      |      |      |      |      |      |      |      |
|------------------------|-----------------------------------|------|------|------|------|------|------|------|------|------|------|------|
|                        | 1                                 | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   |
| Jan.                   | 4.73                              | 4.98 | 5.14 | 5.35 | 5.32 | 5.22 | 5.24 | 5.27 | 5.67 | 6.08 | 6.03 | 5.99 |
| Feb.                   | 5.35                              | 5.19 | 5.21 | 5.39 | 5.28 | 5.24 | 5.45 | 5.80 | 6.18 | 6.22 | 6.47 | 6.27 |
| Mar.                   | 5.23                              | 5.30 | 5.40 | 5.33 | 5.32 | 5.61 | 5.84 | 6.13 | 6.23 | 6.57 | 6.38 | 6.30 |
| Apr.                   | 5.06                              | 5.05 | 5.01 | 4.99 | 5.22 | 5.36 | 5.81 | 6.04 | 6.31 | 6.05 | 5.99 | 5.85 |
| May                    | 5.06                              | 5.00 | 4.97 | 5.13 | 5.48 | 5.84 | 5.62 | 6.20 | 6.26 | 5.92 | 5.77 | 5.67 |
| June                   | 5.06                              | 4.82 | 5.08 | 5.41 | 5.94 | 6.15 | 6.30 | 6.34 | 6.40 | 6.15 | 6.17 | 6.12 |
| July                   | 4.51                              | 4.79 | 5.29 | 5.65 | 5.94 | 6.03 | 5.98 | 6.01 | 5.87 | 5.89 | 5.80 | 5.62 |
| Aug.                   | 4.68                              | 4.99 | 5.19 | 5.72 | 5.73 | 6.06 | 5.76 | 5.54 | 5.62 | 5.56 | 5.14 | 5.08 |
| Sept.                  | 5.04                              | 5.40 | 5.57 | 5.96 | 6.32 | 5.85 | 5.61 | 5.96 | 5.79 | 5.65 | 5.72 | 5.78 |
| Oct.                   | 5.31                              | 5.57 | 5.62 | 5.86 | 5.74 | 5.65 | 5.59 | 5.82 | 5.60 | 5.49 | 5.80 | 5.65 |
| Nov.                   | 5.24                              | 5.56 | 5.49 | 5.56 | 5.45 | 5.35 | 5.54 | 5.20 | 5.36 | 5.37 | 5.62 | 6.11 |
| Dec.                   | 5.58                              | 5.54 | 5.49 | 5.57 | 5.53 | 5.53 | 5.48 | 5.33 | 5.53 | 5.83 | 6.06 | 6.44 |
| Average                | 5.04                              | 5.17 | 5.28 | 5.47 | 5.57 | 5.63 | 5.68 | 5.77 | 5.86 | 5.91 | 5.92 | 5.86 |

TABLE 14.

## Influence of the Time of Freshening.

## Yearly Production.

| Month of<br>Freshening. | No. of<br>Cows | # Milk | # Fat  | % Fat |
|-------------------------|----------------|--------|--------|-------|
| Jan.                    | 53.            | 8589   | 459.44 | 5.34  |
| Feb.                    | 56             | 7766   | 431.47 | 5.55  |
| Mar.                    | 55             | 7417   | 421.69 | 5.68  |
| Apr.                    | 54             | 7711   | 420.28 | 5.45  |
| May                     | 65             | 7000   | 383.74 | 5.48  |
| June                    | 30             | 7289   | 417.03 | 5.72  |
| July                    | 38             | 7214   | 407.27 | 5.78  |
| Aug.                    | 27             | 7528   | 406.67 | 5.49  |
| Sept.                   | 26             | 7273   | 416.97 | 5.73  |
| Oct.                    | 17             | 7359   | 416.35 | 5.65  |
| Nov.                    | 25             | 7898   | 433.31 | 5.49  |
| Dec.                    | 36             | 7466   | 418.96 | 5.61  |

Table 15.

Comparison of the Production and Age of Tennessee  
Register of Merit Jerseys with Those of Jerseys from the  
United States as a Whole.

| Time of 482 Tennessee Jerseys |                |      | 2206 U.S. Jerseys (10) |      |
|-------------------------------|----------------|------|------------------------|------|
| Fresh.                        | Av. Production | Age  | Av. Production         | Age  |
| Jan.                          | 459.44         | 5.42 | 470.15                 | 4.32 |
| Feb.                          | 431.47         | 5.14 | 471.13                 | 4.55 |
| Mar.                          | 421.69         | 5.23 | 472.80                 | 4.28 |
| Apr.                          | 420.28         | 4.70 | 462.61                 | 4.22 |
| May                           | 383.74         | 4.16 | 468.97                 | 4.27 |
| June                          | 417.03         | 4.90 | 472.92                 | 4.57 |
| July                          | 407.27         | 4.86 | 489.97                 | 4.25 |
| Aug.                          | 406.67         | 5.35 | 462.08                 | 4.21 |
| Sept.                         | 416.97         | 4.45 | 472.35                 | 3.97 |
| Oct.                          | 416.35         | 5.54 | 481.28                 | 4.34 |
| Nov.                          | 433.31         | 5.46 | 479.40                 | 4.26 |
| Dec.                          | 418.96         | 5.00 | 477.11                 | 4.62 |
| Average                       | 428.62         | 4.93 | 473.89                 | 4.32 |

?

?

593

?

?

582

### Review of Tables 5 to 15.

The material contained in these tables was compiled from the records of the 482 Register of Merit Tennessee Jerseys Used in this work.

For Table 5 the cows were arranged according to age. The junior four-year old was the largest class. The production increased very uniformly up to the age of five years. The average production of the youngest class was 75 pounds less than that of the entire number.

Table 6 shows the variations of production and per cent of fat as the lactation period advances. The highest point was reached in the second month. There was a steady decline thereafter. The per cent of fat climbed steadily from the first to the eleventh month. The total change was 0.88 per cent. This tended to equalize the decrease in the milk flow. The milk flow had decreased nearly 50 per cent by the eleventh month. Because of the increase in the percentage of fat, the production of fat decreased only 38 per cent during the same time.

Tables 7 and 13 also give the variations according to the month of the lactation period, but the cows are classified as to the month in which they freshened. Table 7 and Figure 5 show the trend of produc-

tion. Note that in every case there was a distinct rise in that part of the curve which corresponded to the months of March, April, and May. Table 13 and Figure 4 show the same thing for the percentage of fat. But this time the rise comes not in the spring but in September and October.

Tables 10, 11, and 12 deal with the influence of the season or the month of the year. As far as production is concerned, May is the highest month. This considers the average of all. Ordinarily the cow's highest production comes in the second month of her lactation period. But the cows in the groups freshening in January, February, March, and April have their greatest yield in May. As to the test of the milk, July was the lowest month with June, August and May almost as low.

Table 8 shows how the decline in milk yield follows Ragsdale's formula.

Table 14 is a summary taken from Tables 7 and 13. It gives the average production and the per cent of fat of the groups freshening at different times. January is seen to lead. May is at the bottom.

In Table 15 can be seen a comparison of the yield and age of Tennessee Jerseys freshening in the various months and those of the United States at large. With the larger number of cows both production and age are more uniform. The Tennessee cows are older on the average than the other group.

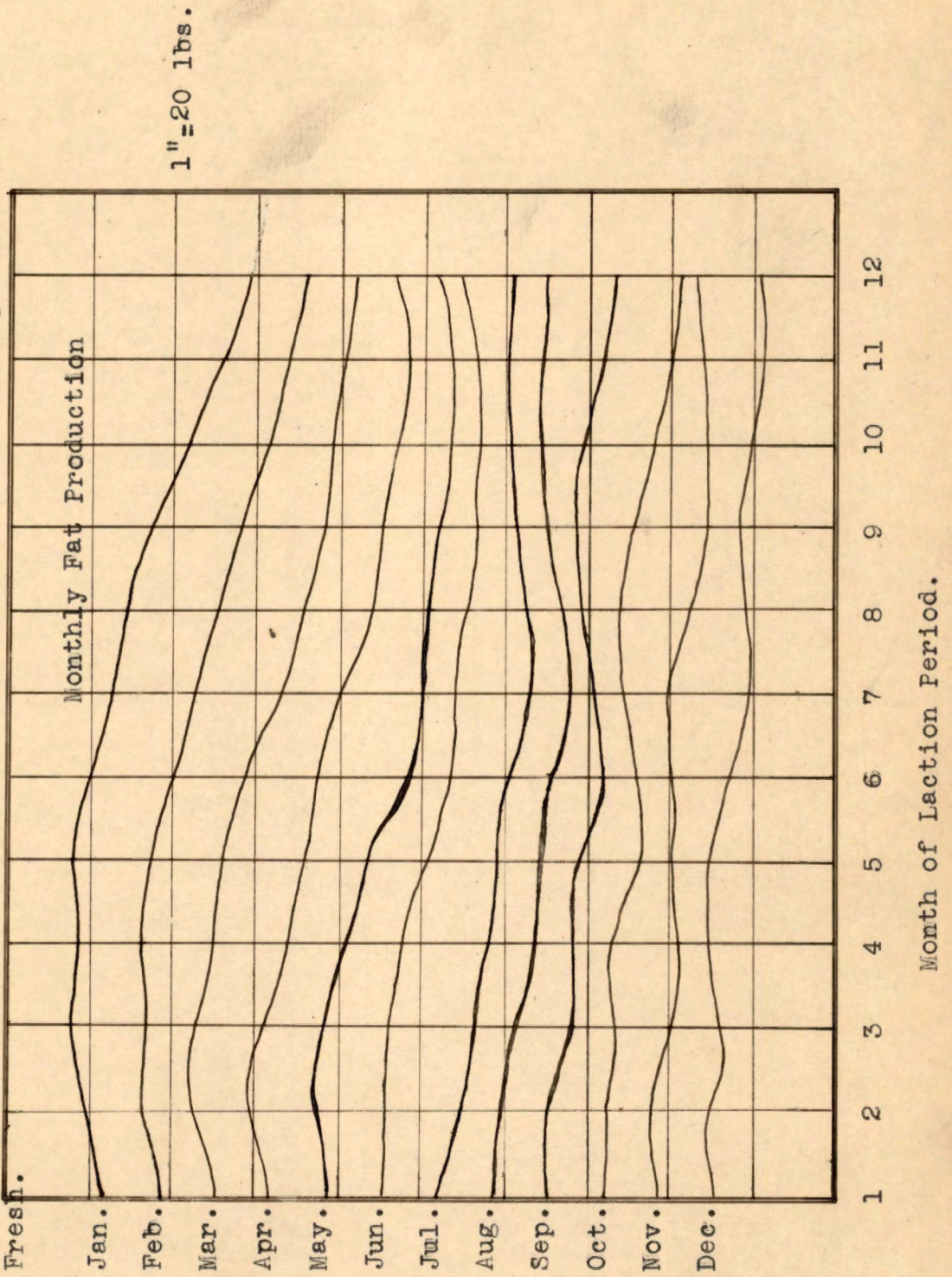
### Influence of Time of Freshening.

Table 14 is especially interesting. It will be noticed that those cows freshening in January produced on the average 75 pounds more fat during the year than those freshening in May. There was a very gradual decline with the groups freshening during the intervening months. The increase in the months following May was perceptible, yet not so uniform. The variations in the percentage of fat seemed to follow no definite rule.

The most significant effect produced by the time of freshening is to be seen in the variations of the percentage of fat from month to month of the lactation period. The plotted curves for the milk and fat yields are affected to a lesser extent. These effects can be seen in Tables 7 and 13 and in Figures 4 and 5.

Considering all the cows, the average percentage of fat rose very gradually from the first to the twelfth month of the lactation period. But when any particular group was considered, for instance the group freshening in January, the percentage of fat did not rise uniformly from the first to the twelfth month. A typical curve of any group is not like the curve of any other group. None of the curves follows the curve representing the average of all, so marked are the superimposed seasonal variations.

Figure 5. Variation of Production According to Month of Lactation  
 Month of Period as Influenced by the Time of Freshening. (Table 7).  
 Fresh.





Hinton and Arnold (10), working with the 1921 register of merit records of Jersey cows (2906 in number ) from all parts of the United States, find little difference between the average production of cows freshening in the various months of the year. The trend of the per cent of fat of any group of these cows is almost identical with that of the corresponding group of Tennessee Jerseys. Yet the production was very uniform. A part of their results is given in table 15. It thus becomes desirable to learn the causes of the marked variations exhibited by classes of Tennessee Jerseys.

It was decided to calculate the mean age of the twelve groups. The age question proved to be a very important factor. Among the Tennessee Jerseys the mean age of the January group was 5.42 years, while that of the May group was only 4.16 years. According to the standard of the American Jersey Cattle Club, a cow should increase her yearly production by one-tenth of a pound of fat for every day that her age exceeds 2 years until she is five years of age. Using these figures as a basis in correcting the average yearly production for the age , the differences are not so large, and because of their irregularity, they lose their significance.

Thus it would seem that in these particular records

the production was hardly affected by the time of freshening. But the fact remains that the trend of the percentage of fat with advancing lactation is distinctly influenced by the month in which the cow freshens.

#### SUMMARY.

*Two-*  
2-year-old cows were found to produce about 75 per cent; 3-year-olds about 85 per cent; and 4-year-olds about 95 per cent of the butter fat that <sup>by</sup> ~~was~~ <sup>produced</sup> ~~by~~ <sup>5-year-old</sup> cows.

The percentage of fat declined slowly with increasing age.

The yield of milk and fat of individuals, as well as the average of all, decreased gradually at first and more rapidly later from the second to the twelfth month of the lactation period. The percentage of fat increased slowly but uniformly from the first to the twelfth month of the lactation period.

Considering the average of all, production was higher in summer than in winter. The opposite was true of the percentage of fat.

Tennessee cows freshening in January produced on the average 75 pounds more fat than those freshening in May. But, when allowance was made for their greater age, the difference was not great. The variations of the percentage of fat from month to month of the lactation period are of a different type for cows freshening at different times of the year. The change from one type to the other is gradual and uniform.

## BIBLIOGRAPHY.

*Should be arranged alphabetically*

- 6 (1) E. H. Eckles. *C.H.* Dairy Cattle and Milk Production. 1911 p. 153.
- 1 (2) Brody, S., Ragsdale, A.C., and Turner, C.W.,  
Journal of Gen. Physiol., Sept. 20, 1923, pp. 21-30.
- 2 (3) Brody, Ragsdale, and Turner, Journal of Gen. Physiology,  
Sept. 20, 1923, pp. 31 - 40.
- 8 (4) Gowen, J. W. Studies in Milk Secretion,  
Maine Agric. Exp't. Station, 1923.
- 9 (5) Gowen, J. W. Studies in Milk Secretion,  
1. Journal of Dairy Science, March, 1923.  
2. Journal of Dairy Science, July, 1923.
- 3 (6) Brody, Ragsdale, and Turner, of Department of Dairy Husbandry,  
University of Mo.  
Journal of Gen. Physiology, Mar. 20, 1923.
- 4 (7) Brody, Ragsdale, and Turner, Journal of Gen. Physiology, July 20, 1923.
- 5 (8) Brody, Ragsdale, and Turner, Journal of Dairy Science, Jan. 1924.
- 10 (9) Henry and Morrison. Feeds and Feeding. 1915. p. 352.
- 11 (10) Hinton and Arnold. Factors Affecting the Per cent  
of Fat in Milk. University of Tennessee. 1924.

7 Getman, Outline of Theoretical Chemistry.