

THESIS  
VARIATION IN PERCENT  
OF FAT IN MILK

BY  
S. Frank Yebina. 1895

THESIS

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T.H.S

Analysis + Examination

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VARIATION IN PERCENT  
OF FAT IN MILK.

by

*John*  
S. Frank Yebina,

Michigan Agricultural College,

August 3, 1895.

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THS

1.

VARIATION IN PERCENT  
OF FAT IN MILK.

By the introduction of the Babcock test in 1889, the testing of milk became a simple operation. This gave wider opportunities for the study of the fat content of milk. It having been my privilege to test milk so many times, my attention has been called to numerous circumstances affecting the composition of milk as shown by the variation in the percent of fat. Of these I will treat but three and they will be considered as follows:

1. Sickness and Excitement.
- II. Period of Lactation.
- III. Temperature.

My chief purpose is to find the relation between the temperature and the quality of the milk, so that the first two subjects will be treated very briefly.

Excitement and Sickness.-

Numerous tests have been made of dairy cows at Agricultural fairs with but poor success, those cows having shown good tests at their home on the farm or in the dairy barn, have been so affected by the excitement caused by the change and the strange surroundings that the results were very unsatisfactory. It was a notable fact that the breed test at the World's Fair did not come up to many reliable private tests made with the same animals for this same reason.

Change of milker and manner of milking.- The Wisconsin Station (R. 1889, P. 42) found that change of milker, manner of milking, and change of environment all exert a more or less decided influence, temporarily at least, on the quantity and quality of the milk produced, the fat being, as a general rule, more sensitive to such changes than the other ingredients or the total yield of milk. The excitement attendant upon dehorning also has different effects upon the milk of individual cows.

Table 1 is taken from the regular herd record of the Minnesota College Herd, showing the pounds of milk given by the cows for the three milkings before they were dehorned and the percent of fat.

| Table 1. |               |         |                |         |               |         |
|----------|---------------|---------|----------------|---------|---------------|---------|
|          | First milking |         | Second milking |         | Third milking |         |
|          | Milk          | Percent | Milk           | Percent | Milk          | Percent |
|          | lbs.          | fat     | lbs.           | fat     | lbs.          | fat     |
| Betty    | 11.5          | 4.3     | 11             | 3.8     | 11.5          | 4.1     |
| Clara    | 9.5           | 4.6     | 9              | 3.7     | 7.1           | 4.0     |
| Crassy   | 6.5           | 4.7     | 6.5            | 4.9     | 6.5           | 4.4     |
| Franc    | 13.5          | 3.9     | 13.5           | 4.0     | 15.0          | 3.6     |
| Gran     | 10.0          | 3.8     | 9.25           | 3.4     | 9.5           | 4.3     |
| Patsey   | 10.5          | 3.5     | 11.0           | 3.6     | 11.25         | 4.0     |
| Rossie   | 10.9          | 4.2     | 10.0           | 3.3     | 10.9          | 3.7     |
| Roxy     | 13.9          | 4.1     | 12.75          | 3.5     | 13.5          | 3.9     |
| Sully    | 21.0          | 4.5     | 20.0           | 4.3     | 20.75         | 4.0     |
| Total    | 107.3         |         | 103            |         | 106           |         |
| Average  |               | 4.17    |                | 3.83    |               | 4.0     |

Table 11 shows the pounds of milk and percent of fat given by each cow during the three milkings immediately following dehorning.

Table 11.

| Name of cows | First milking |             | Second milking |             | Third milking. |             |
|--------------|---------------|-------------|----------------|-------------|----------------|-------------|
|              | Milk lbs.     | Percent fat | Milk lbs.      | Percent fat | Milk lbs.      | Percent fat |
| Betty        | 10.6          | 2.9         | 11.5           | 4.3         | 9.25           | 4.6         |
| Clara        | 12.25         | 7.0         | 9.0            | 5.6         | 9.25           | 4.7         |
| Crossy       | 15.5          | 5.5         | 6.0            | 6.1         | 6.5            | 5.9         |
| Franc        | 12.75         | 3.5         | 13.0           | 3.9         | 13.5           | 4.3         |
| Gran         | 9.5           | 2.7         | 7.5            | 3.8         | 8.5            | 4.7         |
| Patsey       | 10.0          | 4.0         | 10.5           | 3.1         | 10.5           | 3.8         |
| Rossie       | 9.0           | 3.2         | 9.75           | 3.8         | 9.25           | 3.7         |
| Roxy         | 11.0          | 4.6         | 11.0           | 4.8         | 11.75          | 4.3         |
| Sully        | 19.0          | 3.1         | 19.75          | 4.0         | 20.0           | 3.6         |
| Total        | 97.6          |             | 98             |             | 98.5           |             |
| Average      |               | 4.05        |                | 4.37        |                | 4.4         |

Conclusion.- Immediately after dehorning--cow give less amount fat and milk.

1. Sickness.- Conn. Exp. 1886, P. 112. Effect of sickness on the yield and composition of milk. "Cow No. 10 for a week previous had been giving on the average 22-1/2 pounds of milk per day. Sixteen ounces of butterfat, while the percent of fat in the morning's and evening's milk ranged from 3.5 to 4.3 percent. On the 22 of February, 1886, it was noticed that she did not eat well. Her yield of milk and butterfat for the next few days were as follows:

| February | Milk lbs. | Fat ounces |
|----------|-----------|------------|
| 24       | 15.5      | 13.2       |
| 25       | 12.0      | 11.3       |
| 26       | 15.0      | 10.4       |
| 27       | 17.33     | 11.4       |

2. Sickness.- Mr. J. B. White made an analysis of the milk of cows suffering from Pleuro Pneumonia. The results obtained were as follows:-



|        | Mat 1   | Lot 11. |
|--------|---------|---------|
| Water  | 89.80 % | 89.18 % |
| Fat    | 1.18 "  | 1.30 "  |
| Sugar  | 4.20 "  | 4.50 "  |
| Casein | 4.16 "  | 4.30 "  |
| Salt   | .66 "   | .64 "   |

## II. The Period of Lactation:

The milk from the first portion of any single milking is relatively poor and increases in richness to the strippings, which are relatively very rich. Thus the New York State Station found that in the case of fine cows the first pint of milk contained only 0.3 percent of fat, while the last pint contained 6.85 percent.

The Jersey cow, Early Morn of the Purdue University gave a test at the end of her period of lactation of 9.2 percent fat. The test was taken October 8, 1891. Early Morn calving November 5, 1891. Her normal amount of fat was 6 percent.

Effect of the period of lactation on the percentage of fat in the milk found by H. H. Dean of Ontario Agricultural College 1891. "The milk of six cows of the college herd was tested for two hundred and seventy four days. All cows had been giving milk for about fifty days when the test began. The time was divided into three periods of ninety days each. The results were as follows:

| Cows | First period<br>91 days | Second period<br>91 days | Third period<br>91 days |
|------|-------------------------|--------------------------|-------------------------|
| 1    | 3.53                    | 3.84                     | 4.29                    |
| 2    | 3.44                    | 3.88                     | 4.35                    |
| 3    | 3.49                    | 3.29                     | 4.01                    |
| 4    | 3.65                    | 3.74                     | 3.88                    |
| 5    | 3.65                    | 3.75                     | 3.58                    |
| 6    | 3.27                    | 3.45                     | 3.58                    |
| Ave. | 3.49                    | 3.66                     | 3.95                    |

The difference between first 91 days and third 91 days is .46 percent.

Morning's and Evening's milk and Fat.- As regards the composition of the milk secreted during the day and that secreted during the night, analyses of a large number of samples at the New York Station ( R. 1890, P. 14) showed very little difference, although the night's milk contained on an average slightly more water. The quantity of milk secreted per hour was practically the same during day and night, but the amount of fat secreted averaged 11.5 percent more during the day than during the night.

| Date     | Average milk secreted per hour |              |             |             |
|----------|--------------------------------|--------------|-------------|-------------|
|          | Morning lbs.                   | Evening lbs. | Morning oz. | Evening oz. |
| April 19 | 9.69                           | 7.16         |             |             |
| " 20     | 10.06                          | 6.75         | 11.58       | 11.51       |
| " 21     | 10.19                          | 7.16         |             |             |
| " 22     | 10.31                          | 7.09         |             |             |
| " 23     | 10.41                          | 7.84         |             |             |
| " 24     | 11.31                          | 5.78         |             |             |
| " 25     | 11.75                          | 5.41         | 11.48       | 10.96       |
| " 26     | 11.38                          | 5.25         |             |             |
| " 27     | 8.94                           | 8.59         | 11.71       | 11.40       |
| " 28     | 8.63                           | 8.50         |             |             |

The same report of New York shows that evening's milk has a higher percent of fat than morning. Average of percent fat in

morning's milk 5.53 percent, evening's milk 6.11 percent.

Comparison of fats in morning's and evening's milk.

| Period  | Average percent of fat in milk. |         | Days |
|---------|---------------------------------|---------|------|
|         | Morning                         | Evening |      |
| 1       | 4.63                            | 5.27    | 6    |
| 2       | 5.15                            | 5.72    | 6    |
| 3       | 5.13                            | 6.01    | 7    |
| 4       | 5.62                            | 6.42    | 6    |
| 5       | 6.09                            | 6.10    | 3    |
| 6       | 5.95                            | 6.56    | 6    |
| 7       | 5.91                            | 6.46    | 6    |
| 8       | 5.80                            | 6.40    | 6    |
| Average | 5.53                            | 6.11    |      |

At M. A. C. in the case of Belle Sarcastic and Houwtje D. the following results were noted. Cows were milked three times a day. It shows that both Belle and Houwtje gave more fat at noon than at morning or evening.



## Belle Sarcastic

| 1894   | Milk  |      | Milk  |      | Milk  |      |
|--------|-------|------|-------|------|-------|------|
|        | lbs.  | Fat  | lbs.  | Fat  | lbs.  | Fat  |
|        | A. M. | %    | M.    | %    | P. M. | %    |
| May 1  | 22.6  | 2.65 | 20.9  | 3.0  | 22.2  | 3.0  |
| " 2    | 25.4  | 3.25 | 20.5  | 3.2  | 23.2  | 3.0  |
| " 3    | 24.5  | 3.25 | 22.9  | 2.85 | 25.1  | 3.6  |
| " 4    | 26.3  | 3.00 | 23.3  | 2.90 | 22.6  | 3.1  |
| " 5    | 25.4  | 2.80 | 23.4  | 2.75 | 25.4  | 2.48 |
| " 6    | 27.4  | 2.55 | 20.7  | 2.90 | 23.2  | 2.65 |
| " 7    | 27.0  | 3.05 | 23.1  | 3.20 | 24.7  | 2.95 |
| June 1 | 23.8  | 2.40 | 23.0  | 3.00 | 24.6  | 3.05 |
| " 2    | 24.5  | 2.55 | 24.5  | 2.90 | 23.0  | 2.55 |
| " 3    | 25.2  | 2.35 | 22.9  | 2.95 | 24.0  | 2.00 |
| " 4    | 26.0  | 2.60 | 24.6  | 3.40 | 23.5  | 2.85 |
| " 5    | 25.0  | 2.40 | 22.6  | 2.94 | 23.5  | 2.95 |
| " 6    | 20.4  | 2.75 | 20.4  | 3.40 | 24.0  | 1.90 |
| " 7    | 24.5  | 2.80 | 22.8  | 3.15 | 24.2  | 2.00 |
| Total  | 348   |      | 315.2 |      | 333.5 |      |
| Ave.   |       | 2.74 |       | 3.03 |       | 2.72 |

## Houwtje D.

| 1894   | Milk  |      | Milk  |      | Milk  |      |
|--------|-------|------|-------|------|-------|------|
|        | lbs.  | Fat  | lbs.  | Fat  | Mlbs. | Fat  |
|        | A. M. | %    | M.    | %    | P. M. | %    |
| May 1  | 16.5  | 3.70 | 17.9  | 3.60 | 17.4  | 3.00 |
| " 2    | 22.2  | 2.75 | 20.7  | 3.80 | 23.2  | 3.60 |
| " 3    | 25.1  | 2.50 | 21.1  | 3.35 | 23.5  | 2.80 |
| " 4    | 27.1  | 2.75 | 25.1  | 3.35 | 27.4  | 3.10 |
| " 5    | 27.8  | 2.55 | 27.3  | 1.80 | 26.1  | 2.75 |
| " 6    | 29.0  | 2.00 | 25.5  | 2.35 | 28.7  | 3.00 |
| " 7    | 29.8  | 2.60 | 27.1  | 3.40 | 29.0  | 2.30 |
| June 1 | 28.4  | 2.90 | 25.7  | 2.55 | 23.2  | 3.45 |
| " 2    | 29.5  | 3.15 | 31.0  | 2.10 | 24.5  | 3.35 |
| " 3    | 28.4  | 2.65 | 28.7  | 2.50 | 28.5  | 2.65 |
| " 4    | 29.0  | 2.40 | 25.4  | 3.40 | 29.4  | 2.20 |
| " 5    | 29.5  | 2.20 | 25.4  | 2.94 | 26.6  | 2.20 |
| " 6    | 34.8  | 3.10 | 28.9  | 3.10 | 25.5  | 2.70 |
| " 7    | 31.6  | 3.20 | 28.3  | 2.40 | 25.0  | 2.80 |
| Total  | 390.7 |      | 358.1 |      | 358   |      |
| Ave.   |       | 2.74 |       | 3.15 |       | 2.85 |

### III. Temperature:

Mr. Hills of the Vermont Experiment Station Report, 1892, stated that when cows are out on pasture the percent of fat in the milk increase as the temperature rises; in other words, the fat in milk varies inversely with the temperature changes. The present test indicates that this is also true of both total solids and solid not fat; that changes in temperature in either direction from normal tend to decrease the quantity of milk.

Nebraska Station Bulletin No. 30, 1893.- The meteorology of the period under consideration was carefully gone over, noted in connection with the milk yielded and amount of fat present.

Table VIII, February 1893.

| Feb. | Temperature<br>Ave. | Snow | Milk, lbs.<br>Ave. | Percent<br>fat | No. of<br>cows |
|------|---------------------|------|--------------------|----------------|----------------|
| 1    | 25.9                |      | 9.00               | 4.40           | 6              |
| 2    | 34.5                |      | 9.06               | 4.47           | 6              |
| 3    | 38.5                |      | 9.42               | 4.61           | 6              |
| 4    | 30.5                | 1.5  | 8.92               | 4.91           | 6              |
| 5    | 32.0                |      | 9.91               | 5.20           | 6              |
| 6    | 31.3                | .55  | 10.00              | 5.31           | 6              |
| 7    | 18.3                | 2.0  | 10.25              |                | 6              |
| 8    | 17.6                |      | 9.50               | 4.97           | 6              |
| 9    | 22.3                |      | 9.58               | 4.39           | 6              |
| 10   | 24.3                |      | 9.17               | 4.62           | 6              |
| 11   | 15.6                |      | 9.75               | 4.77           | 6              |
| 12   | 37.8                |      | 9.42               | 5.08           | 6              |
| 13   | 28.8                |      | 9.50               | 4.85           | 6              |
| 14   | 13.3                |      | 9.08               |                | 6              |
| 15   | 25.3                |      | 8.58               | 5.30           | 6              |
| 16   | 36.3                |      | 9.08               | 4.91           | 6              |
| 17   | 31.5                |      | 9.25               | 4.68           | 6              |
| 18   | 17.0                |      | 9.25               | 4.80           | 6              |
| 19   | 23.8                |      | 9.25               | 4.42           | 6              |
| 20   | 33.5                |      | 9.17               | 5.15           | 6              |
| 21   | 37.5                |      | 8.67               |                | 6              |
| 22   | 41.5                |      | 8.65               | 4.88           | 6              |
| 23   | 44.4                |      | 8.42               | 5.10           | 6              |
| 24   | 38.0                |      | 8.66               | 4.60           | 6              |
| 25   | 39.1                |      | 9.00               | 4.63           | 6              |
| 26   | 41.8                |      | 8.33               | 4.76           | 6              |

In my investigation concerning the influence of temperature upon the percent of butterfat I have used the College herd. The testing was done by H. E. Van Norman and others for 1894,- from January 1, 1895 by myself. The cows used were,

(a) Belle Sarcastic a thorough bred Holstein, four years old that gave in 365 days, 21,096.2 pounds of milk and 634.67 pounds of butterfat.

(b) Houwtje D. a thorough bred Holstein, six years old giving in 365 days 19,180.2 pounds of milk and 655.45 pounds of butterfat.

Time for milking.- Belle was milked regularly three times a day-- 6:00 A. M., 1:00 M., and 7:00 P. M. Houwtje was milked regularly three times a day at the same hours as Belle until March 8, 1895, after that time a day--6:00 A. M. and 5:30 P. M.

The days of each month are divided into three groups according to temperature, and the groups designated accordingly as those of High, Low, and Medium temperatures. The three groups containing nearly equal number of days.

The percents of fat were taken from the College herd.

I have taken for consideration the records of those two cows for two months, May and June, in 1894 and also May and June in 1895. I have also used the record of these cows, by months, for the year 1894.

Temperature was taken from the Meteorological observations at M. A. C. The thermometer was exposed in the open air and temperature taken three times a day, 7:00 A. M., 2:00 P. M.

Table 1. 1894.

| Temp. Percent fat<br>daily at high |    |      |      | Percent fat<br>at low         |    |      |      | Percent fat<br>at medium     |    |      |      |
|------------------------------------|----|------|------|-------------------------------|----|------|------|------------------------------|----|------|------|
| May mean temp.<br>63--73°F.        |    |      |      | Temp. temp.<br>ave. 31--53°F. |    |      |      | Temp temp.<br>ave. 54--62°F. |    |      |      |
| Belle Houwtje                      |    |      |      | Belle Houwtje                 |    |      |      | Belle hou                    |    |      |      |
| 1                                  | 66 | 2.88 | 3.4  | 2                             | 56 | 3.15 | 3.38 | 3                            | 61 | 3.28 | 2.88 |
| 9                                  | 63 | 2.73 | 2.74 | 4                             | 53 | 2.83 | 3.06 | 5                            | 61 | 2.48 | 2.03 |
| 12                                 | 63 | 2.91 | 2.70 | 18                            | 40 | 3.01 | 3.30 | 6                            | 60 | 2.70 | 2.45 |
| 13                                 | 68 | 3.08 | 2.80 | 19                            | 37 | 3.00 | 2.96 | 7                            | 59 | 3.06 | 2.85 |
| 14                                 | 63 | 2.76 | 2.75 | 20                            | 43 | 2.98 | 3.41 | 8                            | 55 | 3.10 | 2.51 |
| 16                                 | 64 | 3.01 | 2.65 | 21                            | 53 | 3.35 | 3.11 | 10                           | 56 | 2.86 | 2.71 |
| 17                                 | 73 | 2.98 | 2.83 | 22                            | 53 | 2.91 | 2.96 | 11                           | 54 | 2.88 | 2.81 |
| 25                                 | 64 | 2.90 | 2.55 | 28                            | 46 | 2.71 | 2.98 | 15                           | 56 | 3.05 | 2.60 |
| 26                                 | 65 | 2.88 | 2.55 | 29                            | 51 | 2.98 | 3.73 | 24                           | 57 | 2.96 | 2.56 |
| 65.4 2.9 2.77                      |    |      |      | 30                            | 31 | 3.01 | 4.30 | 27                           | 57 | 2.80 | 3.18 |
|                                    |    |      |      | 31                            | 51 | 2.71 | 2.96 | 57.6 2.91 2.65               |    |      |      |
|                                    |    |      |      | 46.7 2.96 3.29                |    |      |      |                              |    |      |      |

## Summary.-

|                                       |  |  |  | Belle Houwtje |       |
|---------------------------------------|--|--|--|---------------|-------|
|                                       |  |  |  | % fat         | % fat |
| Average high temperature 65.4° 9 days |  |  |  | 2.90          | 2.77  |
| Average low temperature 46.7 11 days  |  |  |  | 2.96          | 3.29  |
| Ave. medium temperature 57.6 10 days  |  |  |  | 2.91          | 2.65  |

There were nine days of high temperature, ten days of medium and eleven days of low temperature.

Houwtje's average percent of fat for the days of high temperature was 2.77 percent, while on the days of low temperature it was 3.29 percent, a difference of .52 percent in favor of low temperature. Belle shows only a difference of .01 percent in favor of the low temperature.



Belle May '94.

Comparison of Lat and Temperature -

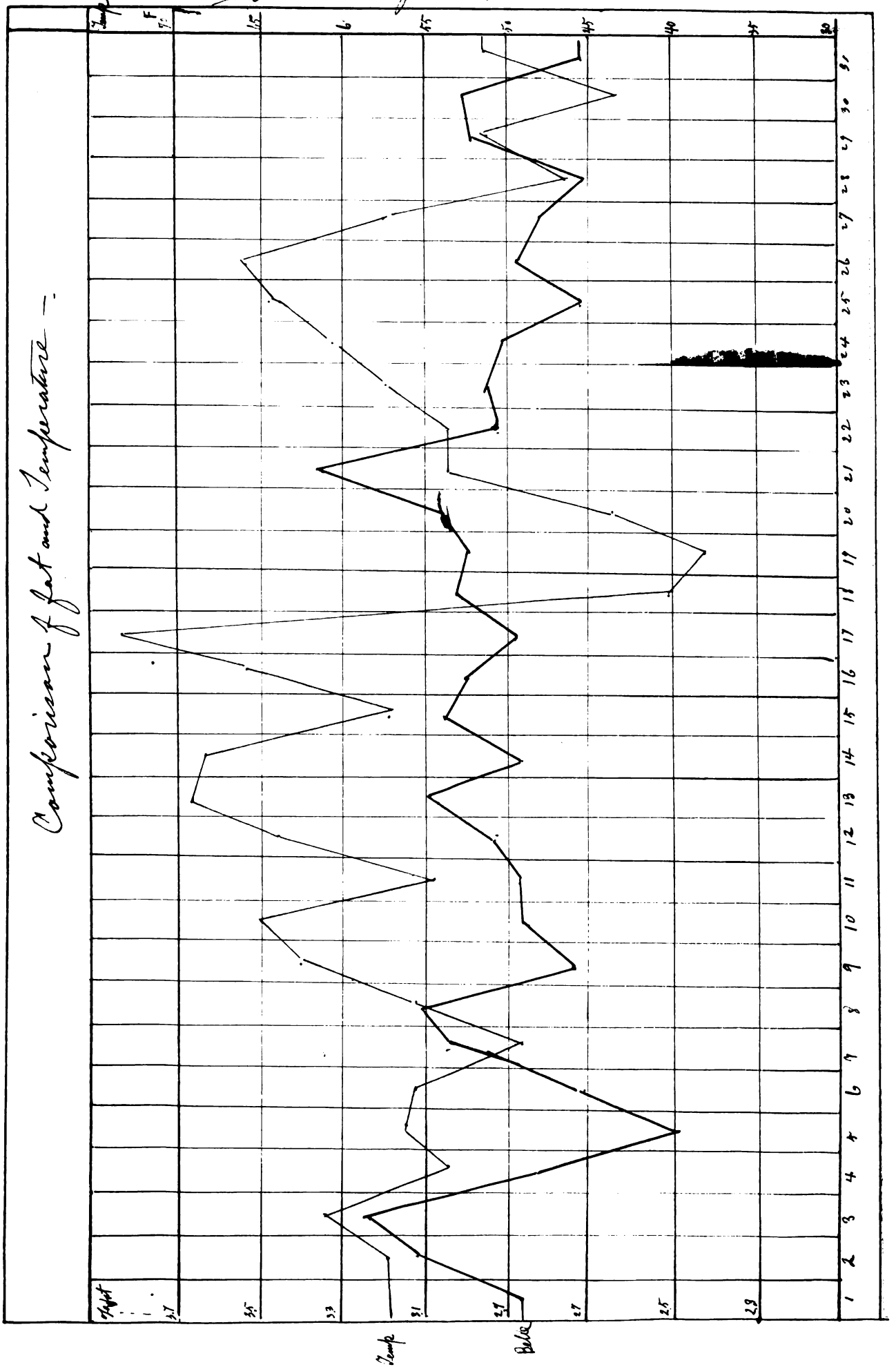


Table 11. 1895

| Temp. daily at high |       |         |      | Percent fat at low |        |       |      | Percent fat at medium |        |      |      |
|---------------------|-------|---------|------|--------------------|--------|-------|------|-----------------------|--------|------|------|
| June mean           | temp. | temp.   |      | Temp               | at low | temp. |      | Temp                  | temp   | temp |      |
|                     |       | 78--81° |      | ave.               | 49--69 |       | ave  |                       | 70--77 |      |      |
| Belle Houwtje       |       |         |      | Belle Houwtje      |        |       |      | Belle Houwtje         |        |      |      |
| 11                  | 78    | 2.61    | 2.01 | 1                  | 60     | 2.81  | 2.96 | 9                     | 70     | 2.92 | 3.40 |
| 13                  | 78    | 2.61    | 2.86 | 2                  | 66     | 2.80  | 2.86 | 10                    | 73     | 2.72 | 3.26 |
| 14                  | 79    | 2.71    | 2.93 | 3                  | 69     | 2.43  | 2.66 | 17                    | 76     | 2.75 | 3.11 |
| 15                  | 80    | 2.41    | 3.15 | 4                  | 58     | 2.28  | 2.66 | 20                    | 71     | 2.53 | 3.18 |
| 16                  | 78    | 3.60    | 3.28 | 5                  | 49     | 2.85  | 2.45 | 25                    | 76     | 2.63 | 2.53 |
| 21                  | 79    | 2.11    | 2.23 | 6                  | 54     | 2.68  | 2.95 | 26                    | 75     | 2.15 | 2.90 |
| 22                  | 81    | 2.51    | 2.50 | 7                  | 60     | 2.87  | 2.80 | 27                    | 74     | 2.36 | 1.98 |
| 23                  | 80    | 2.46    | 3.00 | 8                  | 69     | 2.81  | 2.86 | 29                    | 75     | 2.30 | 2.45 |
| 24                  | 78    | 2.43    | 2.90 | 18                 | 61     | 2.75  | 2.66 | 30                    | 77     | 2.45 | 2.15 |
| 22                  | 79    | 2.55    | 2.55 | 19                 | 66     | 2.35  | 2.85 | 28                    | 73     | 2.51 | 2.61 |
| Ave. 79             |       | 2.60    | 2.74 | 61.2               |        | 2.66  | 2.77 | 74                    |        | 2.53 | 2.75 |

## Summary.-

|                            |      |         |  | Belle | Houwtje |
|----------------------------|------|---------|--|-------|---------|
|                            |      |         |  | % fat | % fat   |
| Average high temperature   | 79°  | 10 days |  | 2.60  | 2.76    |
| Average low temperature    | 61.2 | 10 days |  | 2.66  | 2.77    |
| Average medium temperature | 74   | 10 days |  | 2.53  | 2.75    |

In table 11, Belle shows a very slight difference of .06 percent in favor of low temperature, while Houwtje shows a difference of .01 percent in favor of low temperature.

County D July '94.

Comparison of fat & Temperature

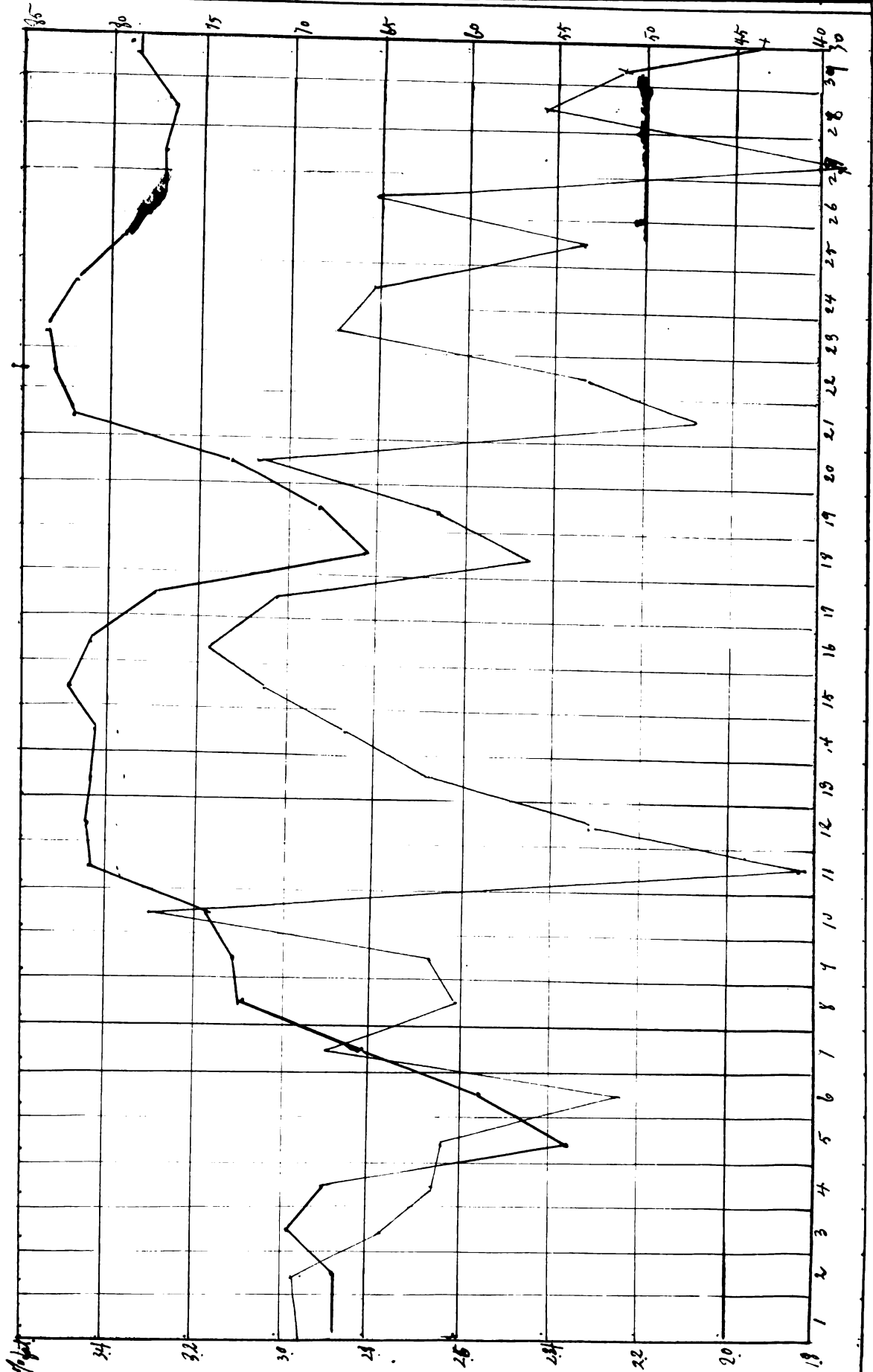


Table 111. 1895

| Temp daily at high<br>May mean temp.<br>72--84 |      |      |      | Temp. Percent fat<br>at low<br>Ave. temp.<br>33--50 |      |      |      | Temp Percent fat<br>ave. at medium<br>temp.<br>55-71 |      |      |      |
|------------------------------------------------|------|------|------|-----------------------------------------------------|------|------|------|------------------------------------------------------|------|------|------|
| May Belle Houwtje                              |      |      |      | Belle Houwtje                                       |      |      |      | Belle Houwtje                                        |      |      |      |
| 3                                              | 73.3 | 3.63 | 4.70 | 11                                                  | 44.3 | 3.13 | 4.70 | 1                                                    | 65.6 | 3.10 | 4.32 |
| 4                                              | 76.3 | 3.75 | 4.10 | 12                                                  | 43.3 | 3.08 | 4.37 | 2                                                    | 67.6 | 3.21 | 4.30 |
| 5                                              | 80.0 | 3.55 | 4.21 | 13                                                  | 45.3 | 3.00 | 3.87 | 7                                                    | 71.0 | 4.47 | 4.00 |
| 6                                              | 72.6 | 3.07 | 3.70 | 14                                                  | 33.3 | 3.06 | 4.25 | 8                                                    | 69.0 | 3.26 | 3.26 |
| 9                                              | 77.6 | 3.10 | 4.50 | 15                                                  | 48.6 | 2.55 | 3.75 | 17                                                   | 56.6 | 2.80 | 4.20 |
| 10                                             | 78.6 | 3.01 | 3.77 | 16                                                  | 46.3 | 2.75 | 4.17 | 18                                                   | 54.0 | 2.51 | 4.00 |
| 29                                             | 77.0 | 2.91 | 3.82 | 19                                                  | 46.3 | 2.56 | 3.90 | 22                                                   | 56.6 | 2.70 | 3.40 |
| 30                                             | 81.0 | 2.71 | 3.10 | 20                                                  | 44.3 | 2.61 | 4.10 | 23                                                   | 62.0 | 2.88 | 4.00 |
| 31                                             | 84.0 | 2.95 | 4.05 | 21                                                  | 48.6 | 2.78 | 4.40 | 24                                                   | 62.3 | 2.60 | 3.00 |
|                                                |      |      |      | 26                                                  | 49.6 | 2.57 | 4.90 | 25                                                   | 68.3 | 2.81 | 3.00 |
|                                                |      |      |      | 27                                                  | 49.0 | 3.16 | 3.37 | 28                                                   | 70.0 | 2.76 | 3.55 |
| Ave. 77.7 3.18 4.01                            |      |      |      | 45.5 2.84 4.16                                      |      |      |      | 63.9 3.00 3.73                                       |      |      |      |

## Summary.-

|                            |       |         | Belle | Houwtje |
|----------------------------|-------|---------|-------|---------|
|                            |       |         | % fat | % fat   |
| Average high temperature   | 77.7° | 9 days  | 3.18  | 4.01    |
| Average low temperature    | 45.5  | 11 days | 2.84  | 4.16    |
| Average medium temperature | 63.9  | 11 days | 3.00  | 3.73    |

Belle favor of difference in high temperature .34 %

Houwtje favor of difference in low temperature .11 %

Mounty D May 95.

Comparison of fat and temperature--

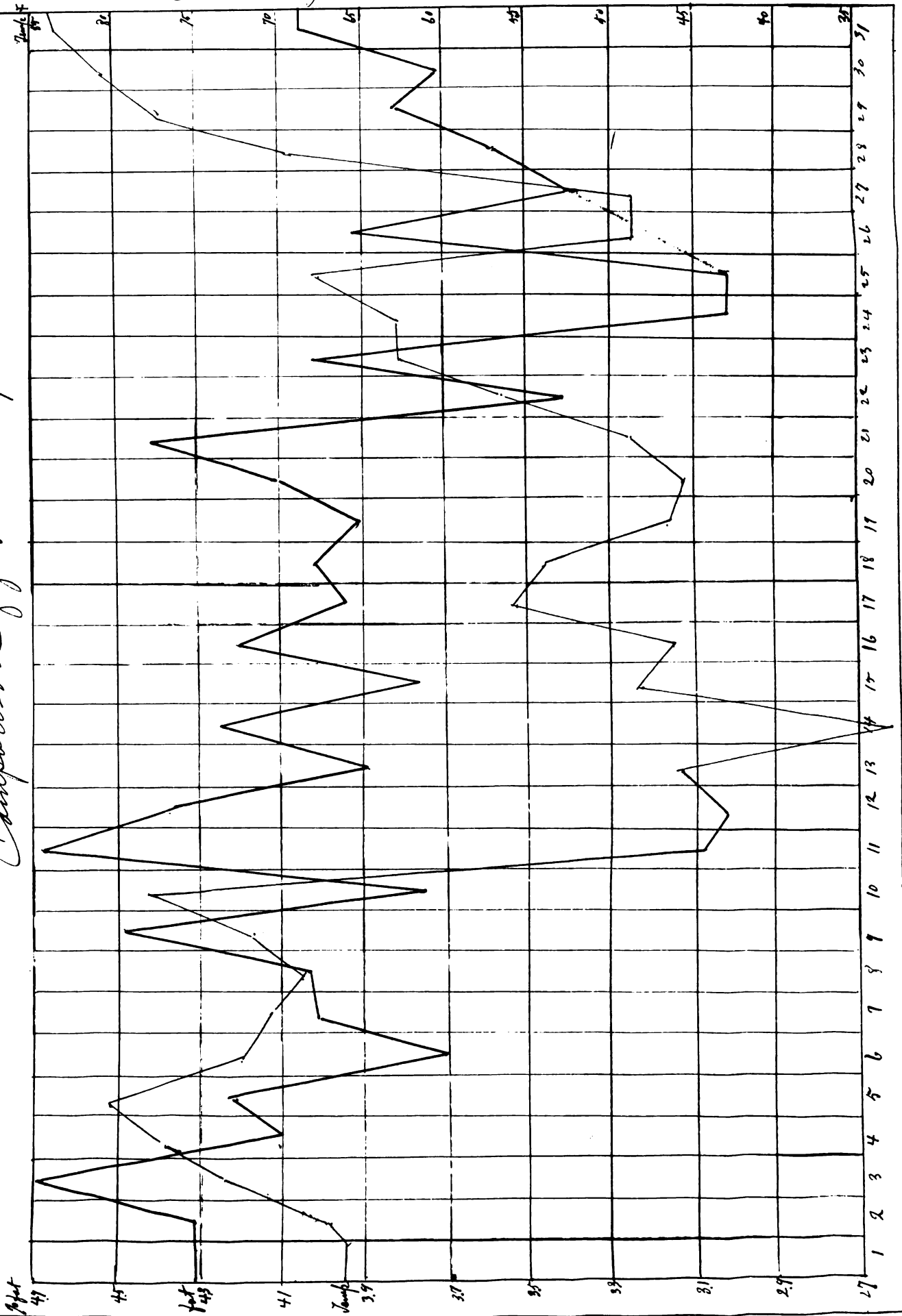


Table IV. 1895.

| June | Temp. Daily mean |      | Percent fat at high temp. 78--81° |    | Temp. av. |      | Percent fat at low temp. 53--68° |    | Temp. av. |      | Percent fat at medium temp. 69--75° |  |
|------|------------------|------|-----------------------------------|----|-----------|------|----------------------------------|----|-----------|------|-------------------------------------|--|
|      |                  |      | Belle Houwtje                     |    |           |      | Belle Houwtje                    |    |           |      | Belle Houwtje                       |  |
|      |                  |      |                                   |    |           |      |                                  |    |           |      |                                     |  |
| 1    | 80               | 3.20 | 4.30                              | 5  | 57        | 2.80 | 3.90                             | 8  | 73        | 3.05 | 3.80                                |  |
| 2    | 80               | 3.15 | 4.55                              | 6  | 56        | 2.95 | 3.70                             | 12 | 74        | 2.76 | 3.50                                |  |
| 3    | 77               | 3.15 | 4.40                              | 7  | 59        | 3.10 | 3.65                             | 14 | 70        | 2.96 | 3.70                                |  |
| 4    | 81               | 2.60 | 4.10                              | 13 | 63        | 2.95 | 3.95                             | 16 | 75        | 2.96 | 3.85                                |  |
| 9    | 76               | 2.76 | 3.92                              | 15 | 67        | 2.83 | 3.57                             | 18 | 75        | 3.15 | 3.60                                |  |
| 10   | 80               | 3.11 | 3.70                              | 19 | 53        | 3.63 | 4.17                             | 21 | 69        | 2.91 | 3.62                                |  |
| 11   | 79               | 3.58 | 4.00                              | 20 | 64        | 2.98 | 3.32                             | 22 | 75        | 3.75 | 3.18                                |  |
| 17   | 77               | 2.80 | 3.37                              | 26 | 65        | 3.00 | 3.50                             | 24 | 74        | 2.90 | 3.65                                |  |
| 23   | 77               | 3.90 | 3.50                              | 27 | 67        | 3.11 | 3.87                             | 30 | 75        | 3.00 | 4.00                                |  |
| 25   | 80               | 3.20 | 3.31                              | 28 | 62        | 2.88 | 3.65                             |    |           |      |                                     |  |
|      |                  |      |                                   | 29 | 61        | 3.10 | 3.85                             |    |           |      |                                     |  |
| Ave. | 78.7             | 3.14 | 3.91                              |    | 61.2      | 3.30 | 3.83                             |    | 73.3      | 3.06 | 3.65                                |  |

## Summary:-

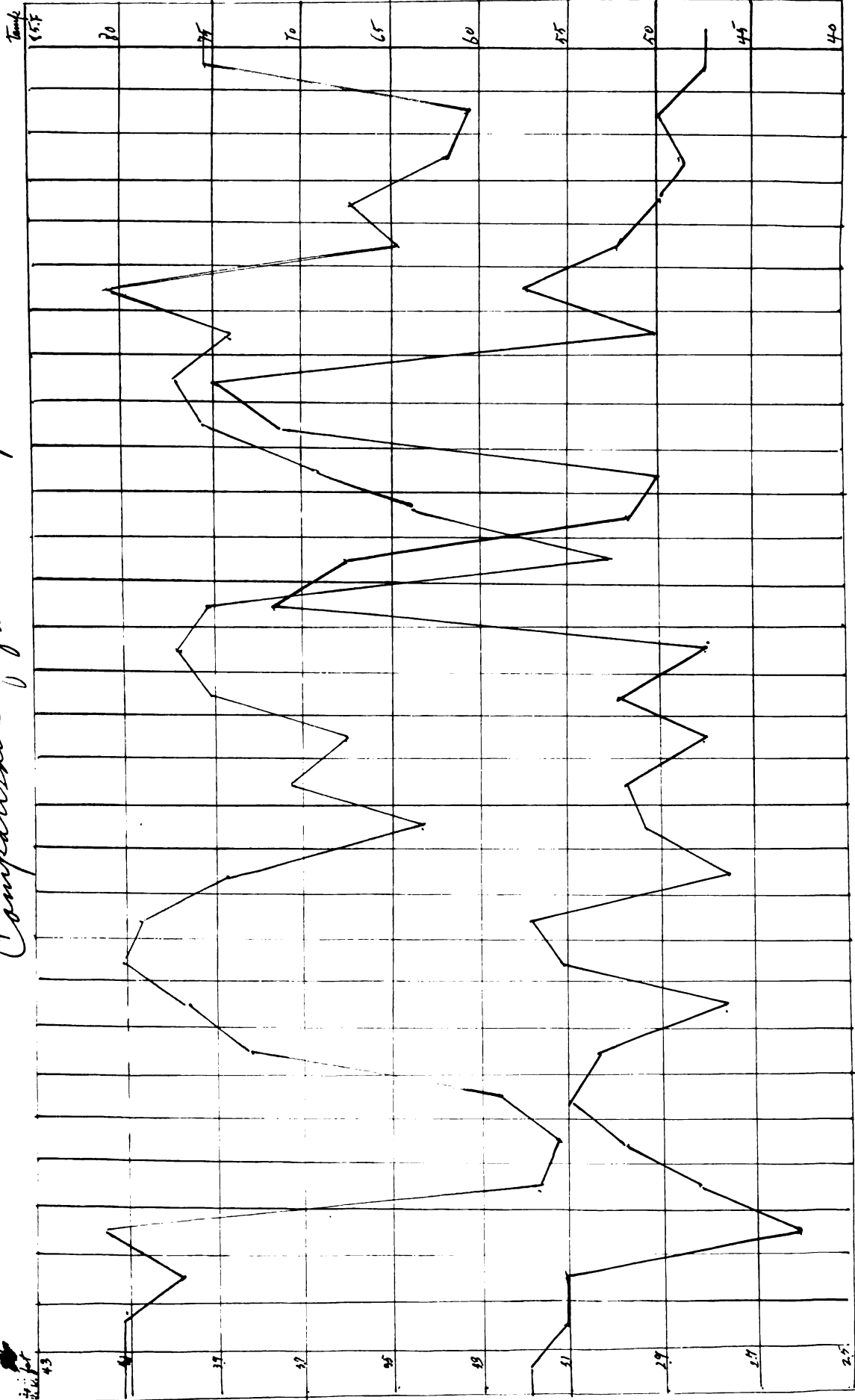
|                            |       |         | Belle | Houwtje |
|----------------------------|-------|---------|-------|---------|
|                            |       |         | % fat | % fat   |
| Average high temperature   | 78.7° | 10 days | 3.14  | 3.91    |
| Average low temperature    | 61.2  | 11 days | 3.30  | 3.83    |
| Average medium temperature | 73.3  | 9 days  | 3.06  | 3.65    |

Belle, difference in favor of low temperature 0.16 %

Houwtje " " " high " 0.08 %

Belle S. June '95.

Comparison of fat and temperature



This table shows the summary of results shown in above four tables.

| Belle Sarcastic. |            |             |           |             |            |           |
|------------------|------------|-------------|-----------|-------------|------------|-----------|
| Date             | High temp. | Percent fat | Low temp. | Percent fat | Favor      |           |
|                  |            |             |           |             | High temp. | Low temp. |
| May 1894         | 65.4       | 2.90        | 46.7      | 2.96        |            | .6        |
| June "           | 79.0       | 2.60        | 61.2      | 2.66        |            | .06       |
| May 1895         | 77.7       | 3.18        | 45.5      | 2.86        |            | .34       |
| June "           | 78.7       | 3.14        | 61.2      | 3.30        |            | .16       |
|                  |            |             |           |             | Favor      | 1.16 %    |

| Houwtje D. |            |             |           |             |            |           |
|------------|------------|-------------|-----------|-------------|------------|-----------|
| Date       | High temp. | Percent fat | Low temp. | Percent fat | Favor      |           |
|            |            |             |           |             | High temp. | Low temp. |
| May 1894   | 65.4       | 2.77        | 46.7      | 3.29        |            | .52       |
| June 1894  | 79.0       | 2.76        | 61.2      | 2.77        | .01        |           |
| May 1895   | 77.7       | 4.01        | 45.5      | 4.16        |            | .15       |
| June 1895  | 78.7       | 3.91        | 61.2      | 3.83        | .08        |           |
|            |            |             |           |             | Favor      | .58 %     |

To more clearly show the effect of temperature on the quality of the milk I have taken four coldest and four hottest days in the four months used above and compared in the following tables.

| Belle, 1894 |       |      |       |       |      |       |
|-------------|-------|------|-------|-------|------|-------|
| Low temp    |       |      | High  |       |      | Favor |
| May temp.   | % fat | Date | temp. | % fat | low  |       |
| 19          | 37    | 2.97 | 17    | 73    | 2.83 | .14   |
| 18          | 43    | 3.30 | 13    | 68    | 2.80 | .55   |
| 20          | 43    | 3.41 | 14    | 63    | 2.75 | .1    |
| 7           | 54    | 2.85 | 26    | 65    | 2.55 | .85   |
| Ave.        | 44.5  | 3.13 |       | 67.2  |      | .4    |

0.4 percent difference in favor of low temperature.

| Houwtje D. |             |      |      |             |                     |       |
|------------|-------------|------|------|-------------|---------------------|-------|
| Low        |             |      | High |             |                     | Favor |
| May temp   | percent fat | May  | temp | Percent fat | High temp Low temp. |       |
| 30         | 31          | 4.30 | 17   | 73          | 2.83                | 1.47  |
| 19         | 37          | 2.96 | 13   | 68          | 3.08                | .12   |
| 20         | 43          | 3.41 | 1    | 66          | 3.40                | .1    |
| 28         | 46          | 2.98 | 6    | 65          | 2.55                | .43   |
| Ave.       | 39.2        | 3.41 |      | 67.2        | 2.96                | 1.47  |

0.47 percent difference in favor of low temperature.



## Belle Sarcastic, 1894.

|      | Low   | Percent |      | High  | Percent | Favor     |
|------|-------|---------|------|-------|---------|-----------|
| June | temp. | fat     | June | temp. | fat     | low temp. |
| 5    | 49    | 2.85    | 15   | 80    | 2.41    | .44       |
| 6    | 54    | 2.68    | 22   | 81    | 2.51    | .17       |
| 7    | 60    | 2.87    | 23   | 80    | 2.46    | .41       |
| 18   | 61    | 2.75    | 21   | 79    | 2.11    | .64       |
| Ave. | 56    | 2.78    |      | 80    | 2.39    | .41       |

0.51 percent difference in favor of low temperature.

## Houwtje D., 1894.

|      | Low   | Percent |      | High  | Percent | Favor    |
|------|-------|---------|------|-------|---------|----------|
| June | temp. | fat     | June | temp. | fat     | low high |
| 5    | 49    | 2.45    | 15   | 80    | 3.15    | .7       |
| 6    | 54    | 2.95    | 22   | 81    | 2.50    | .46      |
| 7    | 60    | 2.80    | 23   | 80    | 3.00    | .2       |
| 18   | 61    | 2.66    | 21   | 79    | 2.23    | .43      |
| Ave. | 56    | 2.71    |      | 80    | 2.72    | .02      |

0.09 percent difference in favor of low temperature.

## Belle Sarcastic, 1895.

|      | Low   | Percent |     | High  | Percent | Favor    |
|------|-------|---------|-----|-------|---------|----------|
| May  | temp. | fat     | May | temp. | fat     | low high |
| 14   | 33.3  | 3.06    | 31  | 84    | 2.95    | .01      |
| 11   | 44.3  | 3.13    | 30  | 81    | 2.75    | .25      |
| 20   | 44.3  | 2.61    | 5   | 80    | 3.55    | .94      |
| 12   | 43.3  | 2.60    | 10  | 78    | 3.01    | .41      |
| Ave. | 41.3  | 2.85    |     | 80.7  | 3.09    | .27      |

0.15 percent difference in favor of high temperature.

## Houwtje D., 1895

|      | Low   | Percent |     | High  | Percent | Favor    |
|------|-------|---------|-----|-------|---------|----------|
| May  | temp. | fat     | May | temp. | fat     | low high |
| 14   | 33.3  | 4.30    | 31  | 84    | 4.00    | .3       |
| 11   | 44.3  | 4.70    | 30  | 81    | 3.70    | 1.0      |
| 20   | 44.3  | 4.10    | 5   | 80    | 4.00    | .1       |
| 12   | 43.3  | 4.37    | 10  | 78    | 3.77    | .6       |
| Ave. | 41.3  | 4.36    |     | 80.7  | 3.85    | .51      |

0.28 percent difference in favor of low temperature.

## Belle Sarcastic, 1895.

|      | Low   | Percent |      | High  | Percent | Favor    |
|------|-------|---------|------|-------|---------|----------|
| June | temp. | fat     | June | temp. | fat     | Low High |
| 5    | 57    | 2.80    | 4    | 81    | 2.60    | .2       |
| 6    | 56    | 2.95    | 1    | 80    | 3.20    | .35      |
| 7    | 59    | 3.10    | 2    | 80    | 3.15    | .05      |
| 19   | 53    | 3.63    | 25   | 80    | 3.20    | .43      |
| Ave. | 50.4  | 3.12    |      | 80.2  | 3.03    | .05      |

0.11 percent difference in favor of low temperature.

## Houwtje D., 1895

|      | Low   | Percent |      | High  | Percent | Favor    |
|------|-------|---------|------|-------|---------|----------|
| June | temp. | fat     | June | temp. | fat     | low high |
| 5    | 57    | 3.90    | 4    | 81    | 4.10    | .2       |
| 6    | 56    | 3.70    | 1    | 80    | 4.30    | .6       |
| 7    | 59    | 3.65    | 2    | 80    | 4.55    | .9       |
| 19   | 53    | 4.17    | 25   | 80    | 3.20    | 2.3      |
| Ave. | 50.4  | 3.80    |      | 80.2  | 4.03    | .36      |

0.23 percent difference in favor of high temperature.

The two following diagrams show graphically the relative changes of temperature and percent of fat in the milk of Belle Sarcastic and Houwtje D. during the year 1894.

This seems to show that the change of temperature has a very remarkable effect on the percent of fat.

During cold weather the percent of fat seems to rise while in hot weather the percent falls.

Summary of results where four days of low and high temperature's were compared.

|          | Belle        |             | Houwtje      |             |
|----------|--------------|-------------|--------------|-------------|
| May      | percent fat  | Percent fat | Percent fat  | Percent fat |
|          | favor of low | favor of    | favor of low | favor of    |
|          | temp.        | high temp.  | temp.        | high temp.  |
| 1894     | .44          |             | .51          |             |
| June '94 | .51          |             |              | .09         |
| May '95  |              | .15         | .28          |             |
| June '95 | .11          |             |              | .23         |

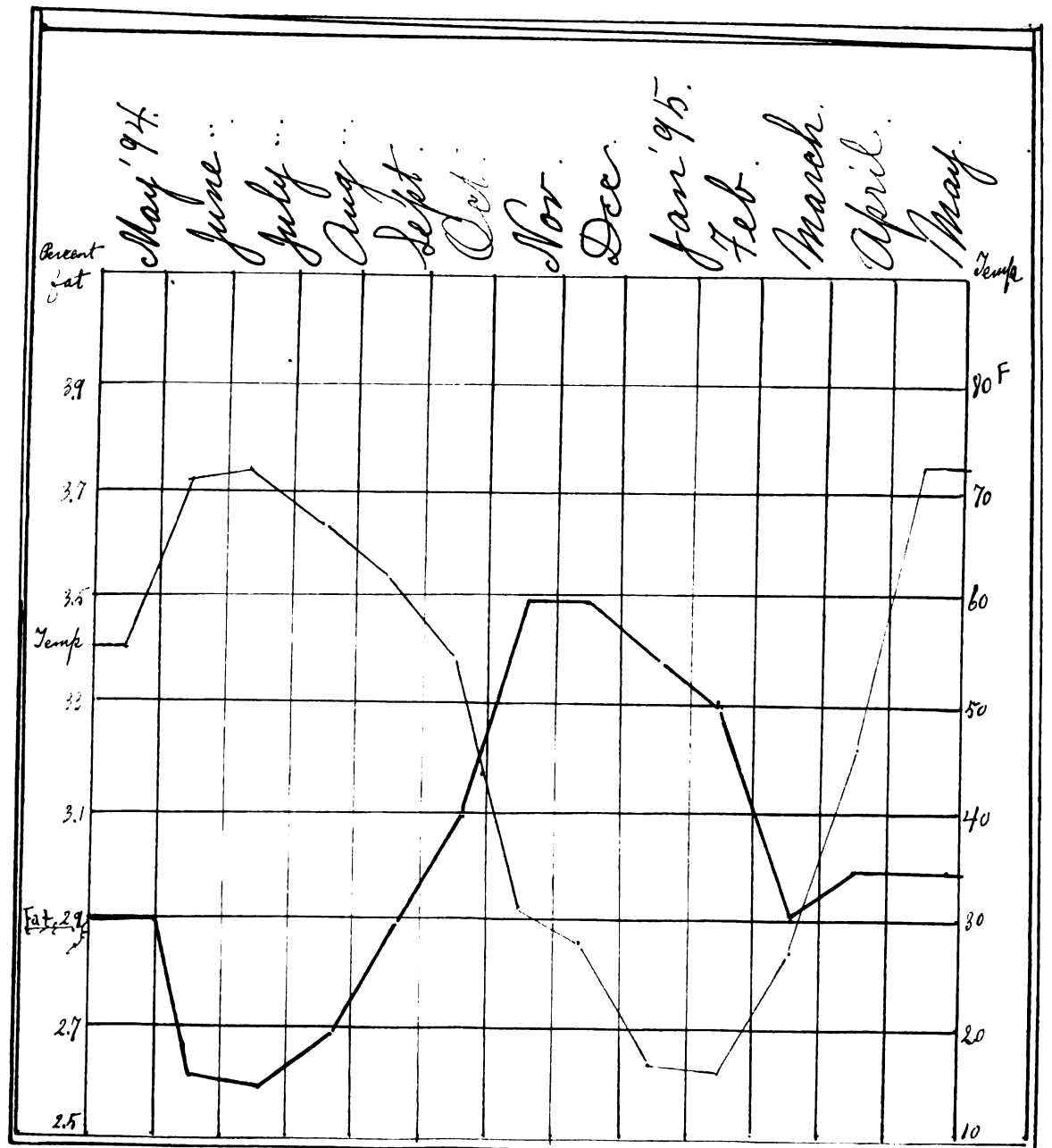
Belle:

0.87 percent difference favor of low temperature.

Houwtje: 0.55 percent difference in favor of low temperature.

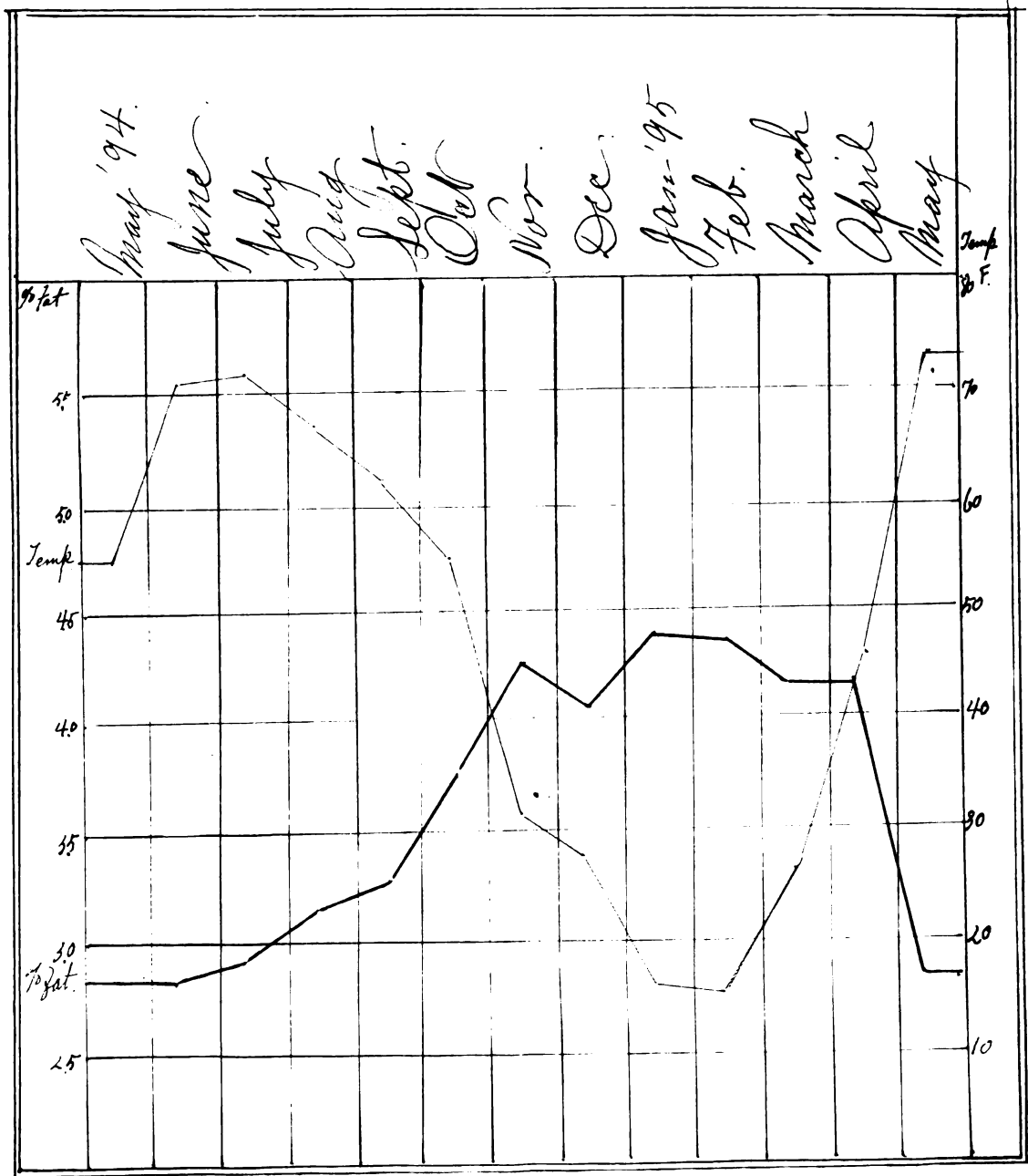
Belle L.

Comparison of fat and Temperature



Mountje D.

Comparison of Fat and Temperature



In regard to the results of this investigation, I give the following summary, though I am not satisfied to draw fixed conclusions.

I. Sickness and Excitement causes a low percent of fat in milk:

II. Period of Lactation:

(a). At the beginning of lactation the milk is poor.

(b). Morning's milk is richer in fat than evening or noons.

III. Temperature:

(a). So far my investigation shows that low temperature gives a high percent of fat.

(b). Effect is different in the different cows.

Belle seems to have given a decidedly higher percent of fat during cold weather, while in the case of Houwtje D. the effect seemed to be the same but in a less degree.



LW 1/2/19

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