A STUDY OF CERTAIN CHARACTERISTICS OF HOLSTEIN MILK

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INTRODUCTION

The per cent of fat in milk has long been the main criterion used in establishing the value of this product. The markets now seem to be turning away from this one measurement and more emphasis is being placed on the solids-not-fat content of milk, particularly the protein portion. Consequently, we stand in need of more information regarding the characteristics of those traits which we have heretofore overlooked. The relationships between fat and other traits such as daily milk yield, protein, total solids, and solids-not-fat will need to be established before we can sensibly plan a breeding program to bring improvement in the other important constituents of milk. Repeatability and heritability rates for these traits will be needed in order that a breeder may know which traits can be changed by proper emphasis in a breeding program and which, if any, are affected mostly by environmental factors beyond his control.

Very little research has been done on the relationship between weather phenomena and milk production. It would seem likely that weather conditions, except in extremes, could not be controlled efficiently enough in a practical dairy operation to be worthwhile. Nevertheless, it is a subject that merits some consideration and research.

The purpose of this investigation was to determine estimates of the repeatability of and correlations between certain constituents of Holstein milk and also of correlations between these constituents and concurrent weather data.

REVIEW OF LITERATURE

Relationships Between Various Constituents of Milk

Gorrie and Harvey (10) at the University of Idaho have reported on a project in which two-day composite samples were collected each month from all cows in the University milking herd during an eight year period. Each sample was tested for fat percentage and for total solids (hereafter abbreviated TS). A total of 2,370 samples was available for study from 97 Holstein cows.

The influence of cows, yearly and monthly environmental changes, stage of lactation, pregnancy, and age of cow on both fat and solids-not-fat (SNF) percentages was determined by the least squares method of fitting constants. Individual constants were fitted for cows and months. Partial regressions were fitted for the linear, quadratic, and cubic effects of years, stage of lactation and age of cow. Partial regressions were fitted for only the linear and quadratic effects of days pregnant. Standard errors of all constants were calculated from the inverse of the reduced matrix.

Forty-two per cent of the total variation and 20% of the within cow variation in fat percentage was accounted for by the constants fitted. Most of the within cow variation was caused by the stage of lactation and gestation, monthly effects, and factors not being considered. Differences caused by years and age of cow were small and insignificant statistically. Stage of lactation alone caused a decrease in fat percentage of

Holstein milk of about 0.3 during the first 150 days when the curve flattened out and then showed a slight increase at the end of the lactation period. Stage of gestation caused a marked increase in fat percentage, with the effect becoming increasingly important as stage of pregnancy increased. Fat percentage was lower than average from May through September and higher than average for the remaining months. July was the lowest month with 3.43% and December was the highest with 3.77%. The average of all months was 3.60%.

Forty-four per cent of the total variation and 14% of the within cow variation in SNF percentage was accounted for by the constants fitted. Stage of gestation was the most important factor affecting variation in per cent of SNF within cows. An increase in SNF of 0.64% occurred from 100 days to 220 days gestation. The first 100 days of pregnancy showed practically no effect on the per cent of SNF. A significiant increase in SNF of 0.30% occurred from the first to the seventh lactation. The lactation curve, adjusted for pregnancy, showed a linear increase of about 0.01% for each 10 days of lactation. The months of April, November, and December averaged 8.37, 8.62, and 8.31%, respectively, after adjustment was made for other effects studied. These were the only three months in which the monthly average deviated significantly from the average of all months (8.50%).

Grabisch (11) investigated the relationship of butterfat and protein in the milk of 19 cows of Spotted Mountain, Brown Mountain, Hintervald and Jersey breeds for a lactation. For a total of 501 observations, the coefficient of variation was 0.705 and the regression coefficient of protein on butterfat was 0.37. The average differences between the observed protein percentage and that calculated from the butterfat

percentage were: 0.02 for Brown Mountain and Hintervald cows; 0.03 for Jersey cows; and 0.11 for Spotted Mountain cows.

Comburg (6) collected data on 52 complete lactations of Black Pied Lowland cattle kept under two different systems of management. Milk was analyzed for fat, protein, lactose, and ash. Butterfat and protein per cent behave similarly with both being lowest at mid-lactation and increasing thereafter. Ash remained fairly constant throughout. Lactose decreased as lactation advanced. There were indications that grazing increased protein per cent while more lactose was found in milk of cows kept indoors. Positive correlations were found between percentage of: fat and protein; protein and lactose; and ash and lactose. No correlation was found between milk yield and composition of milk. Breeding for high fat milk usually resulted in an increase in protein of about the ratio 3:1.

Work in Belgium by Antoine (1) with 91 milk samples each representing the morning and evening milk from 9 cows and taken between January and June showed there was a significant positive correlation ($r = 0.637$) between the protein and butterfat percentages.

Jack et al. (17) analyzed 20,694 samples of milk selected from all areas of the state of California and at all seasons of the year. Their study indicated that the relationship between per cent of SNF and per cent of milk fat is not strictly linear. However, a linear equation was much easier to use, and seemed to fit the data as well as did more complicated expressions.

The SNF percentage may be estimated from the per cent of fat by use of the formula $Y = 7.07 + 0.444\ X$ (Y = % SNF; X = % fat). The standard error of estimate, 0.36, indicates considerable variability

in the data. Seasonal variations showed higher fat and SNF percentages in the winter months than in summer. Distinct trends through three winter seasons and two summer seasons were observed.

Kublitz (18) reported that in a herd of 20 cows, of all ages and stages of lactation and kept in at night throughout the year, the butterfat and protein content of the milk fell in spring and rose in autumn 2-3 weeks after the transfer from housing to pasture and vice versa.

Overman et al. (26) carried out a study of the composition of herd milk of the Brown Swiss breed. Analyses, of aliquot samples of the mixed herd milk from 39 herds and representing an average of 933 cows each month, showed this Brown Swiss milk to have the following actual mean values: 1) fat - - 3.97% with the standard deviation ± 0.29; 2) SNF - - 9.16%, ± 0.21; 3) total protein - - 3.52%, ± 0.18; 4) lactose - - 4.90%, ± 0.13; and 5) ash - - 0.074% ± 0.018. In these samples of mixed herd milk, the interrelationships between the more important constituents were similar to those previously reported for the milk of individual cows (9, 25). However, the correlation obtained between per cent of fat and per cent of total protein was much lower than in an earlier study (25). Real differences were found among the months of the year in the levels of most of the important constituents of milk. In fat content, for example, the June milk was lowest and the November and December milk highest. Differences from herd to herd for all the important constituents of milk were equally real. The underlying causes of these herd to herd differences, however, could not be determined from these data.

Gaines and Overman (9) in 1938 undertook an experiment to determine the interrelations of milk fat, milk protein, and milk energy

yield. Their data consisted of 305 day partial lactation yields of 130 cows. The yields were determined by continuous milk weights and complete chemical analyses of three-day samples at five week intervals. Where only the milk yield and fat yield were known, milk energy yield could be estimated more accurately ($r = .985$) than could protein yield ($r = .755$). The accuracy of estimate of energy yield from milk and protein yield was intermediate ($r = .832$). These correlations were between actual and estimated yields, at a given yield.

Overman and Gaines (24) in 1948 reported on the linearity of regression of milk energy on fat percentage. Their article considered the contention of Bonnier, et al. (1946) (5) that the regression of kcal/kg. milk (Υ) on fat percentage (f) was significantly not linear, and that the estimation of milk energy in terms of four per cent milk should be made on the basis of their graphically-smoothed regression line, which was concave upward. Three sets of observations on Υ and f were examined from the linearity angle. Two sets agreed with their results in being significantly not linear, but in each set the fitted regression line was concave downward, the opposite of the results of Bonnier. The third set of observations on Υ and f was strictly linear, by statistical test, and yielded the formula FCM = .4005 M + 14.99 F. Overman and Gaines concluded that the evidence indicated no need to modify the estimation of milk energy in terms of four per cent milk by the .4 M + 15 F formula, as a generalization.

Musgrave and Salisbury (23) analyzed the relationships between calories per kilogram and per cent fat, and between per cent total protein and per cent fat. The data were based on detailed analytical determinations of the chemical composition and energy content of 494

samples of Brown Swiss herd milk. A highly significant (1% level) linear relationship existed between calories per kilogram and per cent fat and between per cent total protein and per cent fat of composite samples of cows' milk. Tests of the significance of the departure from linearity indicated that the minor effect of curvilinearity was not statistically significant in either case. From the data available a FCM formula was calculated for Brown Swiss herd milk having the values FCM = 0.45 M + 13.7 F. However, while quantitatively different from the original FCM = 0.4 M + 15 F of Gaines and Davidson, the values obtained from the use of this formula indicated that no important increase in accuracy of estimating the comparative energy equivalents of Brown Swiss market milk of differing fat content would be achieved by its use.

Lonka (21), working in Finland, in a study of records of 54 West Finnish cows from four herds whose milk was tested once a month for butterfat and protein content, found a correlation coefficient between these two variants of 0.60 ± 0.09 and a regression equation Y = 1.534 + 0.39 X (X = per cent fat, Y = per cent protein). The protein content was proved -- to some extent -- to be independent of the fat content.

Moore and Morrow (22) reported in 1940 on a project studying the inheritance of SNF per cent in dairy cattle. Their four year study on abnormal relationship of fat to SNF in milk indicated that the cause of variations in SNF of mixed herd milk from month to month was due largely to the make-up of the milking herd. The influence of the factor of inheritance upon per cent SNF in milk from individual cows was studied, using the method employed by the U.S.D.A. in proving bulls for milk and butterfat production. Using only purebred animals, dam and daughter

comparisons on the progeny of three Holstein and two Jersey bulls had been completed. The results tended to indicate that the three factors, milk production, per cent butterfat and per cent SNF might be inherited separately. A given sire might not affect at all or might decrease or increase per cent SNF, irrespective of changes in per cent butterfat or total milk production.

One sire increased the SNF content 0.16%, although showing a decrease in butterfat content of 0.21%, with no significant change in milk production. Another sire, used in the same herd, increased the content of SNF and butterfat 0.28% and 0.24% respectively, with an accompanying increase in milk production of 242 lbs. A third sire, used in a different herd, lowered the SNF content 0.11% and increased butterfat content 0.06%, and milk yield 428 lbs. Of the other two sires, one increased milk production 938 lbs., and decreased fat content 0.18% without a significant change in per cent SNF. The other decreased milk production 1118 lbs. and at the same time increased both fat and SNF content at about the normal relationship of these constituents of milk.

Bonnier and Hansson (4) in 1946 reported a statistical investigation into the genetical determination of the interdependencies between the percentages of fat, protein, and lactose. The basis of the study was material consisting of 2245 chemically analyzed milk samples from 29 twin pairs of cows. The differencesbetween the first and second lactations' percentages of protein and of lactose in individual cows and at fixed percentages of fat, were studied. It was concluded that the differences in lactose content were due entirely to random variations. The differences in protein were found to be due to a great extent to random variations. By analogy, the same conclusions

were drawn concerning differences between all lactations, and consequently, in the following analysis, the figures from the different lactations of the individual cows were pooled. It was shown that from a statistical point of view, the per cent of protein at fixed values of per cent fat, wase equal for two identical twins, not equal for two paternal twins, and very unequal for two unrelated animals. The same conclusions held good as regards percentages of lactose. It was concluded that the interdependence between the per cent of fat, protein, and lactose was very largely genetically determined. As a consequence it was also concluded that a cow's genetical constitution determines the number of calories in one unit of milk with a given per cent fat.

In 1948, Hansson (12) reported on a summary of the team work at Wiad with identical, uncertain, and fraternal twins and whole and half sisters of cows. The energy content of milk in calories/kilogram (E) varied nearly rectilinearly with the per cent fat (F): $E = 305 - 113.4\ F$. With increasing fat content the sugar content fell off slowly at first but above $F = 5$ the decrease was faster. The protein content increased with increasing fat content and this increase was faster at higher fat values. The fat, protein and sugar content in milk showed clearly heritable variations.

Hansson (13), in 1949 at the International Dairy Congress, reported further on previously reported work. Analysis of 2245 milk samples from 29 pairs of twins--19 identical, 7 fraternal, and 3 doubtful -- and 1306 samples from 47 differently related cows, showed that both protein and lactose content were dependent on fat content; as fat increased protein increased and lactose slowly decreased. The analysis

of variance of the content of protein and lactose within fat classes showed a significant variation in both protein and lactose between twin pairs and within fraternal twin sets, but not within identical twins. It was concluded that variations in the protein and lactose content were determined genetically, partly by the dependence on the genetically determined variation in the fat content and partly by other genetic factors. Thus Hansson concluded that it was possible to vary milk composition by breeding.

Hansson et al. (14), in continuing a study of the influence of heredity on the composition of cows' milk, weighed and analyzed a total of 1306 samples of milk from 67 cows for fat, lactose, casein, albumin, and residual nitrogen once weekly. Variations in the protein constituents in milk were presented graphically to show the effects of stage of lactation, daily milk yield, and fat, lactose, and total protein content. In most cases the residual nitrogen behaved differently from the casein and albumin, confirming the supposition that part of this fraction owed its presence in milk to infiltration from the blood, and not to active secretion. Within stage of lactation groups of ten weeks and protein content groups of 0.2%, the analysis of variance between and within cows showed that the composition of the total milk protein was significantly affected by heredity.

Larsson et al. (20) have reported on the influence of heredity on the relationship between the percentage of fat and protein in milk. Their investigations of the variation in the content of fat and protein in the milk were concerned with 16 cows of the Swedish red and white breed and 26 cows of the Lowland breed. The results showed that besides the hereditary variation of the protein content which was

connected with the variation of the fat content there was a considerable variation of the protein content which was not bound to the variation in the content of fat. Thus, they concluded that it was possible through careful selection to change the relation between fat and protein in the milk.

In a study carried out in the English Midlands, Cranfield et al. (8) determined the percentages of fat, SNF and protein in over 700 samples of mixed milk from 15 herds during 1925-26. Nine herds produced one or more samples below 3% fat with one herd recording 25% of samples below this limit. With regard to SNF, 12 herds produced milk containing less than 8.5% on one or more occasions. Fat per cent fell with the SNF per cent to about the average SNF (8.8%), but below this point there appeared to be a rise in fat content as the SNF fell. There was a "sharp" correlation between protein and SNF, protein content falling with the SNF. With SNF below 8.2% the protein fall appeared to be arrested and even showed a tendency to rise. No definite relationship between protein per cent and season was apparent, but the ratio $\frac{\text{SNF}}{\text{protein}}$ did show a correlation with the months of the year. In summer months this ratio was low but in winter it rose considerably. This appeared to indicate that in summer low SNF per cent was due more to a deficiency in lactose than protein, but that in winter months the protein was more responsible for any SNF deficiency.

Azarme (2) investigated the variations in the protein content of milk during different stages of the lactation period. The total protein nitrogen and the casein nitrogen were determined by approved methods in about 380 weekly samples of milk taken from 27 individual cows of different breeds and at different stages of lactation, from February to

July, 1937. The albumin and globulin nitrogen was calculated in each case by difference. The statistical analysis of the data was made by the methods of "factoral arrangement" and by "pairing" and also by the estimation of the 95% probability range of the mean of the figures available for each week of lactation. It was found that the per cent of total protein nitrogen decreased rapidly from the beginning until the fourth week of lactation, and then rose slowly until the end of the lactation, the rise being more pronounced towards the end. The same was true for casein nitrogen and for albumin + globulin nitrogen, but with the latter only the decrease at the beginning and the rise at the end were sharp. The rise for the rest of the lactation curve, although it did exist, was very slow. The lactation curves for the yield of total protein nitrogen, casein nitrogen and albumin + globulin nitrogen were practically parallel with the lactation curve for the yield of milk. The correlations between the yield of milk and the percentages of total protein nitrogen, casein nitrogen and albumin + globulin nitrogen were studied and the correlations calculated. It was noteworthy that the regression lines were not linear. The correlations between the yield of milk and yield of total protein nitrogen, casein nitrogen and albumin + globulin nitrogen were examined and the correlations calculated. It was shown that there was a close correlation between the yield of milk and its protein content, from which the conclusion was drawn that a very low protein food did not decrease the percentage of protein in milk, but decreased the yield of milk and increased the percentage in milk. On the other hand an increase of adequate protein in the ration might raise the yield of milk if the yield were not at its maximum level.

Bartlett (3) in studying the variations in the SNF content of milk found little variation throughout the milking process, i.e., first and last drawn milk were of similar concentration. Curves were established showing the normal variation in the SNF content of milk throughout a lactation period. SNF content was found to decrease as age of the cow increased. After the first four months of gestation, SNF content increased with pregnancy.

Rowland and Zein-el-dine (28) carried out research on the effect of subclinical mastitis on the SNF content of milk. Their study included SNF determinations on 247 samples of milk from the individual quarters of 62 cows. The samples were also examined bacteriologically for the presence of mastitis streptococci and 121 were found to be infected, 114 uninfected, and 12 doubtful. The SNF content of the uninfected samples varied from 8.24 to 10.28% and of the infected samples from 4.26 to 9.92%. For the uninfected samples of the Shorthorn, Friesian, Ayrshire and Guernsey breeds it averaged 9.36, 9.11, 9.82, and 9.83% respectively, but in the infected samples only 8.44, 8.38, 8.28 and 9.49%. Of the 247 samples, 36% were below 8.80% in SNF content. Of 121 infected samples, 63% were below while of the 114 uninfected samples only 9% were below this standard. Hence 88% of the samples below 8.80% SNF were infected samples, thus showing that subclinical mastitis accounts for a very high percentage of samples low in SNF content.

Larson et al. (19) evaluated the production level of the milk proteins during the entire lactation period of several cows and compared it to the production of total milk and fat. In contrast to the normal attainment of maximum daily production of milk and fat after about the first month, the total amount of protein produced per day tended to be

at a maximum on the day of parturition and either remained constant or decreased the first month. Maximum casein production was reached in but a few days; however, the simultaneous decrease in serum protein output tended to maintain the total protein production in the first few days or to decrease it. Large variations were found to occur during the lactation periods in the ratio of protein to fat production.

The Effect of Weather Conditions

Cranfield (7) in studying the effect of abnormal weather conditions on the quality of milk found a definite correlation between lack of rainfall and decrease in SNF content.

Regan and Richardson (27) noted the effect of environmental temperature on high producing dairy cows in a large psychometric room in which the temperature was increased from 40 to 100° F., while air movement and relative humidity were maintained at the constant values of 50 feet per minute and 60%, respectively. It was found that, as the room temperature was increased, there was a uniform increase in the respiration rate, which approximately doubled for each increment of 18° F.; that there was a decrease in pulse rate; and that at 80 or 85° F., depending upon the breed, a pyrexial point was reached where the animals were no longer able to maintain heat balance. As room temperature was elevated above this pyrexial point, anorexia developed, milk flow declined, and an alteration occured in the characteristics of the milk produced. This alteration included a lowering of the casein and SNF content and an increase in the per cent of butterfat. The pH of the milk was raised, the freezing point depression lowered, and a longer rennet coagulation time was required. The butterfat secreted was lower in volatile acids and higher in unsaturated components.

Houston and Hale (16) reported on an investigation of some of the causes of the variations in the yield and composition of milk. The influence of the season of the year and of climatic conditions on the average yield of a herd were studied. Cross bred Shorthorn cows at the Agricultural Research Institute of Northern Ireland were tested between February, 1929 and February, 1930. Data were obtained for 65 complete or incomplete lactations of 51 cows and 26,000 samples were analyzed. Butterfat content was determined by the Gerber method and specific gravity by the lactometer. The percentages of T.S. and SNF were calculated from the formula $T = 0.25\ G + 1.2\ F + 0.14$. The relationships between the data were studied by means of simple correlation and also by means of partial correlation. The temperatures used were the average temperatures for the periods between the milkings. The influence of the season of the year was measured by correlating temperature with yield and composition, and the correlation coefficients so found were interpreted in terms of the sum difference of all the factors which vary with season. The influence of changes in temperature, as such, on diurnal variations in yield and composition was measured by correlating the changes in temperature between the periods preceding the milkings with the changes in the average yield and composition of the milk at the subsequent milkings. The relationships between the secretion of milk as a whole, the secretion of SNF and the secretion of butterfat were studied. It was shown that butterfat yield is more variable than either milk yield or SNF yield; that variations in the butterfat percentage were due mainly to variations in the milk yield; that the morning butterfat percentage varied more than the evening butterfat percentage; and that butterfat percentage and SNF percentage

do not vary together. It was suggested that day temperature was a better measure of the influence of the season of the year than night temperature. It was found that the season of the year exerted a marked influence on the percentage of SNF. During the summer period the percentage of SNF was depressed. On the other hand, the effect of the season of the year on the butterfat percentage was comparatively small. The morning butterfat percentage was more affected by seasonal influences than the evening butterfat percentage. The diurnal variations in milk yield and SNF were found to be independent of temperature changes.

Contemporary Research

Harvey (15) has underway another project that will run two-four years with an average of 100-150 samples analyzed each month. His objectives are: 1) to determine the influence of breeds (Jersey and Holstein), herds, cows, yearly environmental changes, seasons, stage of lactation, pregnancy, and age of cow on the fat and SNF content of milk; 2) to determine the heritability and repeatability of per cent fat, per cent SNF, and per cent protein on an intraherd and intrabreed basis; 3) to determine the interrelations among per cent fat, per cent SNF and per cent protein, and to determine the influence of factors given in objective 1) on those relationships; 4) to determine the value of the formalin titration test, the lactometer, and Westphal balance for determining the TS content in milk; 5) to develop a selection index for fat and SNF production that will maximize genetic gain.

EXPERIMENTAL PROCEDURE

Sixty three Holstein cows from the Oklahoma A & M College Dairy were selected for this experiment. Twenty of those cows were sampled intensively and all cows were sampled monthly. The intensively sampled cows were tested during three four-day periods in March, in June and in September, 1954. The monthly samples were collected from January, 1954 through October, 1955. The only restriction in selection of the twenty cows to be sampled intensively was that the cow should calve within the months of December, 1953, or January or February, 1954.

In all cases composite night and morning samples were taken at the time of milking in the pipeline milking parlor. Care was taken to insure a representative sample. The same sampling procedure as used by the HIR supervisor was followed.

The total protein in the samples was determined by the Kjeldahl method.[1] This work was under the supervision of Dr. Robert MacVicar of the Agricultural Chemistry Department at Oklahoma A & M College.

The per cent of fat was determined by the Mojonnier method.[2] The TS were determined by the Mojonnier method[2] and also by the Cenco

[1]Assoc. of Official Agr. Chemists. Methods of Analysis. 7th Ed. (Wash., D.C., 1950).

[2]Mojonnier, T. and Troy, H. C. The Technical Control of Dairy Products. 2nd Ed. (Chicago, Ill., 1925).

procedure.[3] The SNF were determined by difference and were also calculated from Jacobson's[4] table based on per cent of fat. The TS data based on the Mojonnier determination and the SNF data based on difference were used in the statistical analyses.

Records of temperature, barometric pressure, and solar radiation were obtained from the routine recordings taken by the Meteorology Department of Oklahoma A & M College. The weather data were collected, in each case, over a 24 hour period immediately following the morning milking (4 A.M.) The sampling day consisted of a 24 hour period beginning at 4 A.M. The average barometric pressure figure represented an average of readings taken at two-hour intervals throughout the sampling day. The temperature readings noted were the maximum and the minimum temperatures during this period. Solar radiation was measured in total Langley units (gram calories/min/cm^2). These data were used to determine whether there was any relationship between the constituents of milk and concurrent weather phenomena.

The objectives of this project were to: 1) determine the within and between cow variation in the production of total milk protein expressed as per cent of total milk units from day to day, period to period, and season to season; 2) determine the within and between cow variation in the production of total milk protein expressed as a per cent of total milk units from month to month, for month of lactation and for month of calving;

[3]Loewenstein, M. Determination of the total solids content of milk with the Cenco moisture tester. Preliminary report. Proc., Assoc. Southern Agr. Workers. 52nd Ann. Convention. 1:81. 1955.

[4]Jacobson, M. S. Butterfat and total solids in New England farmers milk as delivered to processing plants. J. Dairy Sci. 19:171-176. 1936.

3) determine an estimate of repeatability of the total milk yield and of the fat, SNF, TS and protein content of milk from Holstein cows; 4) determine correlations between those constituents of Holstein milk; 5) determine the correlations between those constituents and concurrent weather data; 6) establish at least a preliminary estimate of the effect of sires on the trait of per cent of total protein; and 7) establish records on a group of related animals that may be utilized as a nucleus of a breeding program in the event that such an undertaking becomes feasible.

This thesis deals with the repeatability of and correlations between certain characteristics of Holstein milk (daily yield, fat, SNF, TS and protein); and also with correlations between those characteristics and concurrent weather data.

The basic statistical treatment of the data was done by the Statistical Laboratory at Oklahoma A & M College under the supervision of Dr. F. A. Graybill. An analysis of variance was run on each cow separately. A variance component analysis was run by standard methods (29) and an estimate obtained of the variance of certain characteristics of milk due to: 1) consecutive days; 2) periods within a given season; and 3) seasons.

Repeatability values for the traits were established by two methods. Each method was based on the variances found in the analysis of variance for that trait. The first estimate was based on variances within cow and within month. The second estimate was based on variances within cow between months. The formulae for these computations were 1) $R_1 = \frac{\sigma_e^2}{\sigma_e^2 + \sigma_p^2}$, and 2) $R_2 = \frac{\sigma_e^2 + \sigma_p^2}{\sigma_e^2 + \sigma_p^2 + \sigma_m^2}$ where σ_e^2, σ_p^2 and σ_m^2 represent the variances within days, within periods, and within months, respectively.

Finally the variance components were pooled and an estimate of repeatability obtained over cows by these two methods.

Estimates of coefficients of correlation were established between daily milk yield, per cent of fat, of SNF, OF TS (Moj.), of TS (Cenco), and of protein; and between each of those factors and maximum temperature, minimum temperature, average barometric pressure, and solar radiation. Separate values were established for individual cows between seasons. Twelve cows were sampled throughout the scheduled testing period and five other cows included in this report were sampled only during the March and June periods. The correlations were pooled over periods within months and over months for the two groups of cows, and finally over groups over months to give an estimate of the coefficient of correlation that would be more applicable as a lactation estimate. In some cases the variance of the pooled coefficients of correlation exceeded the Chi-square value (0.05). Such coefficients of correlation are marked with an asterisk and were included to give an indication of the correlation of the traits in question even though the values obtained in such cases are not to be considered as reliable because of their extreme variability.

The correlations were pooled using Lush's method described in Snedecor (p. 151) (29) and also by arithmetic average which served as a check on the first method. As can be seen, very similar values were obtained by the two methods in most cases. The values obtained from Lush's method of combining the coefficients of correlation will be used in this discussion.

RESULTS AND DISCUSSION

Coefficients of Correlation for All Cows Over All Periods

In Tables 1 - 6, coefficients of correlation are presented between 1) per cent of fat, 2) per cent of SNF, 3) per cent of TS (Moj.), 4) per cent of TS (Cenco), 5) per cent of protein, and 6) daily milk yield in lbs.; and between each of those traits and 7) barometric pressure, 8) maximum temperature, 9) minimum temperature, and 0) solar radiation. The data from which these values were calculated are found in appendix tables I-IV. There is some repetition in Tables 2 - 6 since the factor being correlated with the nine other factors will have appeared in a preceding table. However, it was felt that it would be easier to assimilate the information concerning each factor if it were presented in a separate table.

Positive coefficients of correlation were found between:

1) per cent of fat and per cent of TS (Moj.), of TS (Cenco), of protein, barometric pressure, and solar radiation;

2) per cent of SNF and per cent of TS (Moj.), of TS (Cenco), of protein, daily milk yield, maximum temperature, minimum temperature, and solar radiation;

3) per cent of TS (Moj.) and per cent of fat, of SNF, of TS (Cenco), of protein, daily milk yield, barometric pressure, minimum temperature, and solar radiation;

4) per cent of TS (Cenco) and per cent of fat, of SNF, of TS (Moj.), and

TABLE 1

Per cent of Fat Correlated with Nine Other Factors **

Constituents Related[a]	Methods of Combining Correlations[b]	Period 3 (12 cows)	Period 3 (5 cows)	Period 3 (All cows)	Period 6 (12 cows)	Period 6 (5 cows)	Period 6 (All cows	Period 9 (12 cows)	Periods 3, 6, & 9 (12 cows)	Periods 3 & 6 (5 cows)	All cows Over all Periods
		r	r	r	r	r	r	r	r	r	r
1 2[k]	1[l]	-.094	.175	-.015*	-.284	-.233	-.269	-.112	-.167	-.030	-.135
1 2	2	-.083	.169	-.009	-.281	-.241	-.269	-.109	-.158	-.036	-.131
1 3[c]	1	.444*	.658	.515*	.271	.312	.284	.585	.438*	.505	.453*
1 3	2	.391	.637	.463	.267	.309	.280	.559	.406	.473	.421
1 4[d]	1	.145	.396	.232	.288	.369	.312	.389	.281	.380	.304
1 4	2	.125	.339	.188	.290	.354	.309	.368	.261	.347	.280
1 5[e]	1	.067*	.133	.086*	.132	.055	.097	-.118	.036	.094	.049
1 5	2	.044	.131	.070	.104	.059	.091	-.122	.008	.095	.028
1 6[f]	1	-.043*	.023*	-.024*	.012	-.240	-.063	-.049	.004*	-.110*	-.022*
1 6	2	-.029	.015	-.016	.008	-.240	-.065	-.048	-.023	-.113	-.042
1 7[g]	1	.183	.139	.165	.130	.197	.149	.312	.204	.168	.197
1 7	2	.175	.144	.166	.122	.191	.142	.304	.200	.168	.193
1 8[h]	1	-.287	-.464	-.342	-.036	.157	.022	-.153	-.159	-.168*	-.161
1 8	2	-.274	-.447	-.325	-.035	.153	.020	-.166	-.158	-.147	-.156
1 9[i]	1	-.119*	-.274*	-.165*	-.194	.054	-.121	-.067	-.129*	-.113	-.125
1 9	2	-.102	-.269	-.151	-.178	.057	-.109	-.070	-.117	-.106	-.114
1 0[j]	1	.239	.257	.243	.060	.184	.096	-.069	.081	.219	.114
1 0	2	.239	.249	.242	.056	.166	.088	-.066	.076	.028	.105

** Footnotes Following Table 6

TABLE 2

Per Cent of SNF Correlated with Nine Other Factors **

Constituents Related	Methods of Combining Correlations	Period 3 (12 cows) r	Period 3 (5 cows) r	Period 3 (All cows) r	Period 6 (12 cows) r	Period 6 (5 cows) r	Period 6 (All cows) r	Period 9 (12 cows) r	Periods 3, 6, & 9 (12 cows) r	Periods 3 & 6 (5 cows) r	All cows Over all Periods r
2 1[a]	1[k]	-.094	.175	-.015*	-.284	-.233	-.269	-.112	-.167	-.030	-.135
2 1	2	-.083	.169	-.009	-.281	-.241	-.269	-.109	-.158	-.036	-.131
2 3[c]	1	.860	.854	.858	.837	.771	.820	.710*	.813*	.816	.814*
2 3	2	.852	.845	.850	.829	.754	.807	.654	.778	.800	.783
2 4[d]	1	.129	-.060	.069	.649*	.628	.642*	-.098	.321*	.364*	.326*
2 4	2	.128	-.068	.070	.605	.608	.606	-.117	.205	.270	.220
2 5[e]	1	.083	.103	.089	.202	-.103	.113	.216	.164	.001	.129
2 5	2	.082	.107	.089	.187	-.103	.102	.210	.160	.002	.125
2 6[f]	1	.033	-.069	.003	.125	-.103	.058*	.351	.168	-.085	.111
2 6	2	.035	-.071	.002	.114	-.097	.052	.342	.164	-.084	.109
2 7[g]	1	-.200	-.230	-.212	-.007	-.210	-.068	-.120	-.110	-.219	-.134
2 7	2	-.196	-.230	-.206	-.003	-.208	-.064	-.123	-.107	-.219	-.132
2 8[h]	1	.034	-.276	-.059	-.083	-.137	-.098	.338	.092	-.209	.025
2 8	2	.036	-.279	-.057	-.084	-.137	-.100	.325	.092	-.208	.027
2 9[i]	1	.208	.162	.196	-.063	-.039	-.054	.185	.110	.063	.098
2 9	2	.203	.149	.187	-.061	-.040	-.055	.175	.106	.055	.094
2 0[j]	1	.066	.151	.091	.097	-.036	.056	.141	.100	.058	.091
2 0	2	.065	.157	.092	.099	-.036	.059	.139	.101	.061	.092

** Footnotes Following Table 6

TABLE 3

Per Cent of TS Moj. Correlated with Nine Other Factors **

Constituents Related	Methods of Combining Correlations	Period 3 (12 cows)	Period 3 (5 cows)	Period 3 (All cows)	Period 6 (12 cows)	Period 6 (5 cows)	Period 6 (All cows)	Period 9 (12 cows)	Periods 3, 6, & 9 (12 cows)	Periods 3 & 6 (5 cows)	All cows Over All Periods
		r	r	r	r	r	r	r	r	r	r
3 1[a]	1[k]	.444*	.658	.515*	.271	.312	.284	.585	.438*	.505	.453*
3 1	2[k]	.391	.637	.463	.267	.309	.280	.559	.406	.473	.421
3 2[b]	1	.860	.854	.858	.837	.771	.820	.710*	.813*	.816	.814*
3 2	2	.852	.845	.850	.829	.754	.807	.654	.778	.800	.783
3 4[d]	1	.230	.207	.222	.844*	.907	.866*	.191	.561*	.729*	.607*
3 4	2	.225	.189	.215	.802	.899	.830	.172	.400	.544	.431
3 5[e]	1	.105	.159	.121	.231	-.085	.139	.095	.146	.038	.122
3 5	2	.099	.166	.118	.227	-.089	.134	.094	.140	.039	.118
3 6[f]	1	-.007	-.070	-.026	.105*	-.284	-.011*	.303	.130*	-.179	.062*
3 6	2	-.010	-.066	-.026	.116	-.268	-.003	.296	.134	-.167	.066
3 7[g]	1	-.089	-.087	-.088	.044	-.148	-.013	.161	.035	-.118	.001
3 7	2	-.088	-.091	-.088	.043	-.150	-.014	.162	.039	-.121	.005
3 8[h]	1	-.116	-.473	-.234	-.101	-.004	-.072	.220	.008	-.252	-.063
3 8	2	-.121	-.470	-.223	-.100	-.002	-.071	.222	.000	-.236	-.051
3 9[i]	1	.135	-.046	.081	-.143	.088	-.075	.137	.040	.021	.036
3 9	2	.124	-.050	.073	-.140	.086	-.073	.136	.040	.018	.035
3 0[j]	1	.170	.249	.194	.122	-.033	.074	.141	.144	.110	.135
3 0	2	.171	.255	.196	.118	-.032	.074	.124	.138	.112	.132

** Footnotes following Table 6

TABLE 4

Per Cent of TS Cenco Correlated With Nine Other Factors **

Constituents Related	Method of Combining Correlations	Period 3 (12 cows) r	Period 3 (5 cows) r	Period 3 (All cows) r	Period 6 (12 cows) r	Period 6 (5 cows) r	Period 6 (All cows) r	Period 9 (12 cows) r	Periods 3, 6, & 9 (12 cows) r	Periods 3 & 6 (5 cows) r	All cows Over All Periods r
4 d 1 [a]	1 [k]	.145	.396	.232	.288	.369	.312	.389	.281	.380	.304
4 1	2	.125	.339	.188	.290	.354	.309	.368	.261	.347	.280
4 2 [b]	1	.129	-.060	.069	.649*	.628	.642*	-.098	.321*	.364*	.326
4 2	2	.128	-.068	.070	.605	.608	.606	-.117	.205	.270	.220
4 3 [c]	1	.230	.207	.222	.844*	.907	.866*	.191	.561*	.729*	
4 3	2	.225	.189	.215	.802	.899	.830	.172	.400	.544	.431
4 5 [e]	1	.117	.217	.150	.265	-.040	.179	.320	.245	.077	.206
4 5	2	.122	.227	.153	.254	-.041	.167	.307	.228	.093	.198
4 6 [f]	1	.029	.069*	.043	.058*	-.220	-.025*	-.244	-.051*	-.092*	-.060*
4 6	2	.056	.054	.056	.082	-.185	.003	-.213	-.025	-.066	-.034
4 7 [g]	1	.080	.107	.089	-.012	-.091	-.035	-.056	-.002	-.003	-.002
4 7	2	.075	.135	.093	-.015	-.095	-.038	-.050	.003	.020	.007
4 8 [h]	1	.034*	-.094	-.009*	-.123	-.050	-.101	-.263	-.129*	-.070	-.114
4 8	2	.034	-.110	-.008	-.121	-.050	-.071	-.276	-.121	-.080	-.101
4 9 [i]	1	.101*	-.037	.056*	-.140	.017	-.094	-.228	-.096*	-.007	-.075
4 9	2	.086	-.079	.037	-.137	.017	-.092	-.197	-.083	-.036	-.072
4 0 [j]	1	.013	-.076	-.034	-.010	.054	.010	-.401	-.140	.064	-.094
4 0	2	.039	.095	.056	-.016	.047	.003	-.404	-.127	.071	-.085

** Footnotes following Table 6

TABLE 5

Per Cent of Protein Correlated With Nine Other Factors **

Constituents Related	Method of Combining Correlations	Period 3 (12 cows) r	Period 3 (5 cows) r	Period 3 (All cows) r	Period 6 (12 cows) r	Period 6 (5 cows) r	Period 6 (All cows) r	Period 9 (12 cows) r	Periods 3, 6, & 9 (12 cows) r	Periods 3 & 6 (5 cows) r	All cows Over All Periods r
5[e]1[a]	1[k]	.067*	.133	.086*	.132	.055	.097	-.118	.036	.094	.149
5 1	2[l]	.044	.131	.070	.104	.059	.091	-.122	.008	.095	.028
5 2[b]	1	.083	.103	.089	.202	-.103	.113	.216	.164	.001	.129
5 2	2	.082	.107	.089	.187	-.103	.102	.210	.160	.002	.125
5 3[c]	1	.104	.159	.121	.231	-.085	.139	.095	.146	.038	.122
5 3	2	.099	.166	.118	.227	-.089	.134	.094	.140	.039	.118
5 4[d]	1	.117	.217	.150	.265	-.040	.179	.320	.245	.077	.206
5 4	2	.122	.227	.153	.254	-.041	.167	.307	.228	.093	.198
5 6[f]	1	.151*	-.054	.091*	.452*	-.307	.247*	-.159*	.168*	-.182	.089*
5 6	2	.151	-.054	.091	.401	-.308	.192	-.145	.136	-.181	.067
5 7[g]	1	-.255	.196	-.123*	-.184	.282	-.048	-.458	-.300	.239	-.183*
5 7	2	-.250	.187	-.122	-.179	.289	-.041	-.445	-.291	.238	-.176
5 8[h]	1	-.034	-.048	-.038	-.431	.236	-.250*	-.302	-.260*	.094	-.184*
5 8	2	-.023	-.052	-.032	-.406	.231	-.218	-.285	-.238	.090	-.167
5 9[i]	1	-.238	.098	-.139	-.329	-.019	-.233	-.274*	-.281*	.060	-.211*
5 9	2	-.229	.097	-.133	-.304	.023	-.208	-.262	-.265	.060	-.194
5 0[j]	1	.116	.264	.161	-.081	.338*	.045	-.406	-.122	.302	-.026*
5 0	2	.111	.257	.154	-.085	.283	.023	-.397	-.124	.270	-.038

** Footnotes following Table 6

TABLE 6

Daily Milk Yield (lbs.) Correlated With Nine Other Factors **

Constituents Related	Method of Combining Correlations	Period 3 (12 cows) r	Period 3 (5 cows) r	Period 3 (All cows) r	Period 6 (12 cows) r	Period 6 (5 cows) r	Period 6 (All cows) r	Period 9 (12 cows) r	Periods 3, 6, & 9 (12 cows) r	Periods 3 & 6 (5 cows) r	All cows Over All Periods r
6 f_1 [a]	1_1 [k]	-.043*	.023*	-.024*	.012	-.240	-.063	-.049	.004*	-.110*	-.022*
6 1 [b]	2	-.029	.015	-.016	.008	-.240	-.065	-.048	-.023	-.113	-.042
6 2 [c]	1	.033	-.069	.003	.125	-.103	.058*	.351	.168	-.085	.111
6 2 [d]	2	.035	-.071	.002	.114	-.097	.052	.342	.164	-.084	.109
6 3 [e]	1	-.007	-.070	-.026	.105*	-.284	-.011*	.303	.130*	-.179	.062*
6 3 [g]	2	-.010	-.066	-.026	.116	-.268	-.003	.296	.134	-.167	.066
6 4 [h]	1	.029	.069*	.043	.058*	-.220	-.025*	-.244	-.051*	-.092*	-.060*
6 4 [i]	2	.056	.054	.056	.082	-.185	.003	-.213	-.025	-.066	-.034
6 5 [j]	1	.151*	-.054	.091*	.452*	-.307	.247*	-.159*	.168*	-.182	.089*
6 5	2	.151	-.054	.091	.401	-.308	.192	-.145	.136	-.181	.067
6 7	1	-.177*	-.310*	-.217*	-.359	-.292	-.339	.299	-.081*	-.301*	-.130*
6 7	2	-.147	-.288	-.189	-.347	-.260	-.322	.289	-.068	-.274	-.113
6 8	1	.218	-.066	.134	-.524*	-.611	-.552*	.215*	-.051*	-.370*	-.122*
6 8	2	.196	-.054	.123	-.474	-.573	-.503	.187	-.030	-.314	-.092
6 9	1	.158*	.024	.119*	-.376	-.447	-.396	-.041*	-.090*	-.224	-.119*
6 9	2	.125	.024	.160	-.349	-.458	-.381	-.035	-.086	-.217	-.091
6 0	1	-.132	-.020	-.099	-.100	-.081	-.094	.376	.052	-.051	.031
6 0	2	-.135	-.021	-.101	-.100	-.087	-.096	.363	.043	-.054	.022

** Footnotes following Table 6

Footnotes for Tables 1 to 6

[a]. butterfat per cent

[b]. SNF per cent

[c]. T.S. (Moj) per cent

[d]. T.S. (Cenco) per cent

[e]. Protein per cent

[f]. Daily milk yield (lbs)

[g]. Av. Barometric pressure

[h]. Max. temp. (F.)

[i]. Min. temp. (F.)

[j]. Solar radiation ($gm/cal/min/cm^2$)

[k]. Snedecor, p. 151 (29)

[l]. Arithmetic average

* Exceeded Chi-square value at 0.05

of protein;

5) per cent of protein and per cent of fat, of SNF, of TS (Moj.), of TS (Cenco) and daily milk yield;

6) daily milk yield and per cent of SNF, of TS (Moj.), of protein, and solar radiation.

Negative coefficients of correlation were found between:

1) per cent of fat and per cent of SNF, daily milk yield, maximum temperature, and minimum temperature;

2) per cent of SNF and per cent of fat and barometric pressure;

3) per cent of TS (Moj.) and maximum temperature;

4) per cent of TS (Cenco) and daily milk yield, barometric pressure, maximum temperature, minimum temperature, and solar radiation;

5) per cent of protein and barometric pressure, maximum temperature, minimum temperature, and solar radiation;

6) daily milk yield and per cent of fat, of TS (Cenco), barometric pressure, maximum temperature, and minimum temperature.

The correlation between per cent of fat and of SNF attained its highest absolute value during June, or just past mid-lactation for most of the cows. The negative correlation found between the two traits showed a divergence from the results of Cranfield et al. (8) but agreed with the conclusion of Houston and Hale (16) that per cent of fat and SNF do not vary together.

The correlation between per cent of fat and of protein fluctuated very closely about zero and had a value of 0.049 over cows and over periods. This value was much lower than reported by Antoine (1), Grabisch (11), and Lonka (21). One explanation of this difference may be that in the present experiment the animals were tested more intensively

than had been the case in previous experiments. Also it should be noted that different breeds of cattle were being tested under different conditions and a real difference may exist in the populations.

The small negative correlation found between per cent of fat and daily milk yield might have been expected. The variability of the correlations exceeded Chi-square (0.05) and thus lessened the reliability of the correlation obtained. This negative correlation lends support to the conclusion of Moore and Morrow (22) that yield and per cent of fat may be inherited separately.

The small positive correlation detected between per cent of protein and of SNF was in general agreement with the results of Cranfield et al. (8) although he reported a "sharp" correlation between the two traits which might be taken to indicate a correlation higher than that obtained in the present study.

It is of interest to note that only three negative correlations were found in those correlations between the traits of milk. The negative correlations were between fat and SNF, fat and daily milk yield, and TS (Cenco) and daily milk yield. None of these three correlations exceeded 0.135 in absolute value. The positive correlations that equalled or exceeded a value of 0.300 were between fat and TS (Moj.), fat and TS (Cenco), SNF and TS (Moj.), SNF and TS (Cenco), and TS (Moj.) and TS (Cenco). The correlation between TS (Cenco) and protein was 0.206 while all other positive correlations were less than 0.200.

A study of the results of the two methods of TS determination was made in conjunction with this project and will be covered in more detail in another report.[5]

[5]Unpublished data. S. D. Musgrave.

In correlations between weather data and the six traits of milk that were studied, solar radiation more often showed positive rather than negative relationships. Barometric pressure, maximum temperature, and minimum temperature more often tended to have negative correlations with traits associated with milk. The trends are as expected except for barometric pressure. It would seem that an increase in barometric pressure, and therefore a tendency for more favorable weather conditions, would show a positive correlation with traits associated with milk composition. However, concrete conclusions cannot be drawn from so few data on such a variable phenomena.

Repeatability Values

The results of the tabulations on repeatability values are presented in Table 7 for the group of 12 cows and in Table 8 for the group containing 5 cows. From the estimated mean square of the analysis of variance for per cent of fat and also for per cent of SNF it was evident that period and day were more important as causes of variance than month (or season). From Table 9, in which the variances were pooled for the two groups of cows and an overall repeatability value calculated, it can be seen that the values were 0.84 and 0.99 for per cent of fat and 0.96 and 0.92 for per cent of SNF as calculated by methods (1) and (2), respectively.

Per cent of TS (Moj.) and TS (Cenco) showed generally the same sources of greatest variation as did per cent of fat and of SNF although season seemed to be increasing in importance, especially in per cent of TS (Cenco). Day to day variances were much greater in TS (Moj.) than in TS (Cenco).

TABLE 7

Repeatability Values on 6 Traits of Milk of 12 Holstein Cows Sampled During Three Four-Day Periods in March, in June and in September, 1954

Cow No.	Method of Calculation	Fat %	SNF %	TS Moj. %	TS Cenco %	Protein %	Daily Milk Yield
47	1[a]	.851	.764	.955	.479	.594	.825
	2[b]	.558	.478	.403	.465	.152	.117
53	1	.747	1.160	.937	.627	.179	.348
	2	.888	.550	.510	.575	.529	.065
55	1	1.029	.710	.895	1.000	.338	.288
	2	.473	1.177	.813	1.003	.252	.166
69	1	.819	.994	1.056	.842	.906	.574
	2	.864	.661	.529	.444	1.003	.203
74	1	.718	.646	.956	.759	.278	.322
	2	1.041	.822	.711	.659	.252	.092
77	1	.875	1.195	1.117	1.106	.436	.879
	2	1.096	.936	.918	.862	.532	.083
83	1	1.107	.783	.852	.613	.365	.346
	2	.532	.822	.382	.403	.221	.097
84	1	1.230	.701	.810	.842	.469	.162
	2	.270	1.188	.484	.480	.259	.059
88	1	.698	.948	.929	.581	.351	.392
	2	1.036	.684	.772	.436	.340	.183
89	1	.574	.963	.580	.538	.833	.313
	2	1.102	.750	.861	.928	.320	.241
93	1	.508	1.008	.695	.523	.593	.331
	2	1.216	.580	.659	.604	.160	.551
96	1	1.189	1.070	.975	.941	.580	.890
	2	.910	.984	1.087	.814	.450	.223

$$a_{R_1} = \frac{\sigma_e^2}{\sigma_p^2 + \sigma_e^2}$$

$$b_{R_2} = \frac{\sigma_p^2 + \sigma_e^2}{\sigma_m^2 + \sigma_p^2 + \sigma_e^2}$$

TABLE 8

Repeatability Values on 6 Traits of Milk of 5 Holstein Cows Sampled During Three Four-Day Periods in March and in June, 1954

Cow No.	Method of Calculation	Fat %	SNF %	TS Moj. %	TS Cenco %	Protein %	Daily Milk Yield
42	1[a]	.671	.848	1.037	1.102	.852	.085
	2[b]	1.075	1.070	.907	.764	.894	.153
45	1	1.120	1.136	1.113	.931	1.025	.477
	2	.929	1.034	.980	1.112	1.064	.055
52	1	1.234	1.157	1.056	.945	.378	.199
	2	.976	.893	.847	.579	.489	.308
72	1	1.114	.989	.914	.885	.946	.809
	2	1.055	.945	.941	1.105	.092	.051
75	1	.880	.830	1.056	1.253	1.227	.279
	2	1.121	.988	.911	1.020	.534	.491

$$a_{R_1} = \frac{\sigma_e^2}{\sigma_p^2 + \sigma_e^2}$$

$$b_{R_2} = \frac{\sigma_p^2 + \sigma_e^2}{\sigma_m^2 + \sigma_p^2 + \sigma_e^2}$$

TABLE 9

Repeatability Values on 6 Traits of Milk of 17 Holstein Cows with Variance Components Pooled Over Cows and Over Months

	R_1^a	R_2^b
Fat %	.84	.99
SNF %	.96	.92
TS Moj. %	.99	.88
TS Cenco %	.89	.80
Protein %	.75	.60
Daily Milk yield	.33	.17

$$ {}^{a}R_1 = \frac{\sigma_e^2}{\sigma_p^2 + \sigma_e^2} $$

$$ {}^{b}R_2 = \frac{\sigma_p^2 + \sigma_e^2}{\sigma_m^2 + \sigma_p^2 + \sigma_e^2} $$

Variation between seasons was the greatest source of variation for most of the cows with regard to per cent of protein. The repeatability values of 0.75 and 0.60 from Table 9 are of great enough magnitude to be useful.

The greatest source of variation in daily milk yield was month, followed by period, with day to day variances of least importance. This is reflected in the low repeatability values of 0.33 and 0.17 obtained for this trait (Table 9).

Substantiating research will be necessary before such high values of repeatability for the components of milk can fully be trusted, but they are nevertheless encouraging. It is hoped to establish heritability values for these traits, also, from these data.

An unbiased selection of 6 of the 12 cows intensively sampled throughout the scheduled period was made and graphs were drawn to compare per cent of fat and of protein of the milk of these cows. The graphs for each cow followed patterns for per cent of fat and per cent of protein similar to those for cow no. 74, as shown in figures 1 and 2.

In Figure 1 is presented a graph of the values for per cent of fat obtained on cow no. 74 during her sampling period. The day to day variation in per cent of fat is quite apparent and illustrates the lack of accuracy that enters into one day a month sampling as compared with daily samples taken over a 2 - 4 day period.

Figure 2 is a graph of the values of per cent of protein for the same cow during the same period. The day to day variations are much smaller than was the case with per cent of fat. This would tend to

Figure 1 Per Cent of Fat in Milk of Cow No. 74 in Three Four-Day Periods in March, in June and in September, 1954

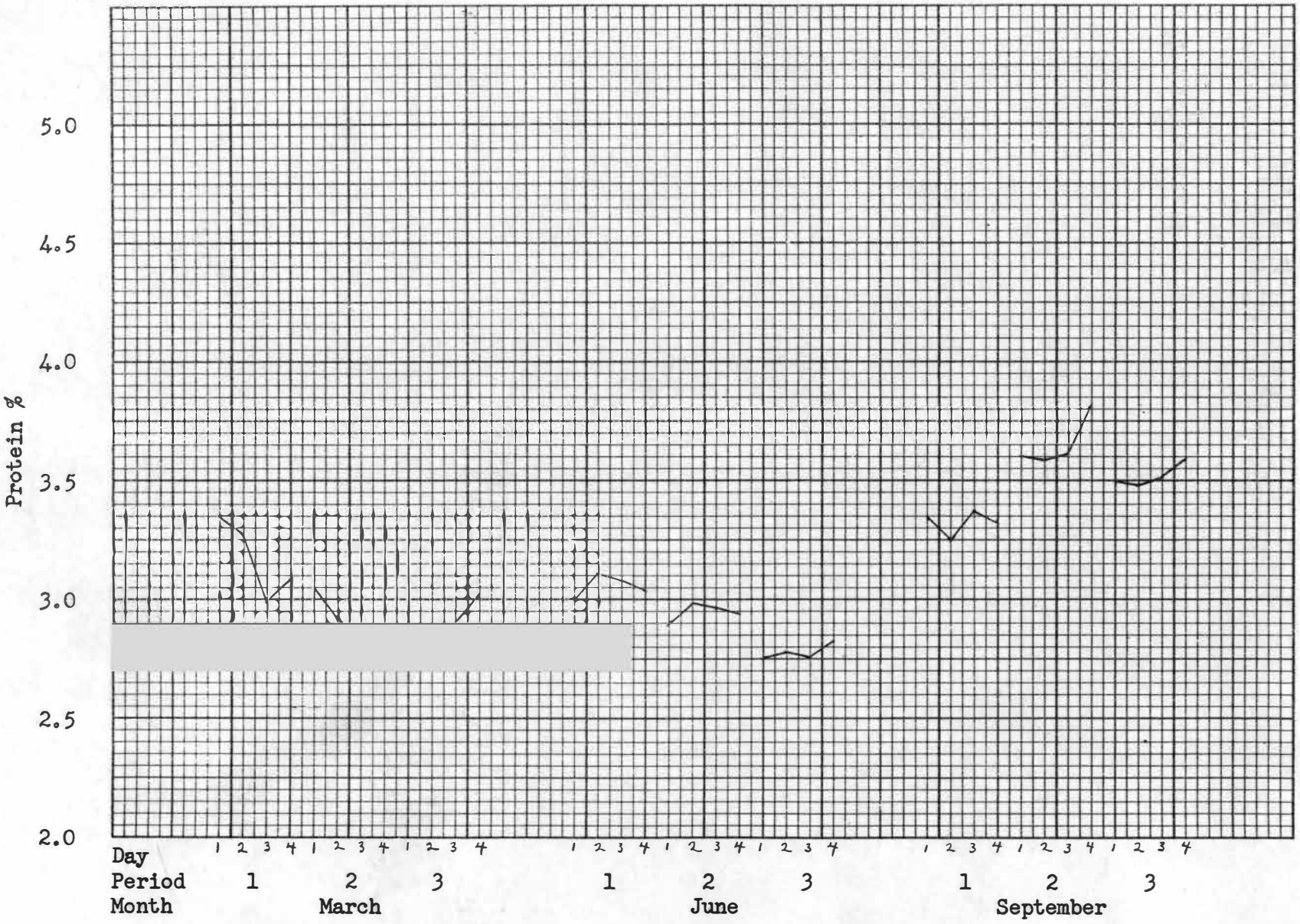

Figure 2 Per Cent of Protein in Milk of Cow No. 74 in Three Four-Day Periods in March, in June and in September, 1954

indicate that per cent of protein was much less affected by fluctuating environmental factors than was per cent of fat. The general trend of the graph followed closely the results of Azarme (2) including the rapid decrease in per cent of protein during the first weeks of lactation and the pronounced rise toward the end of the lactation.

SUMMARY

A study involving 17 Holstein cows of the Oklahoma A & M College dairy herd has been made to determine the repeatability values of and correlations between six characteristics of the milk of those cows. In addition, the correlations between those six characteristics and concurrent weather data were investigated. The daily milk yield was recorded and the samples were analyzed for protein, fat, SNF and TS (by two methods) content.

Standard procedures of statistical analysis were used in establishing repeatability and correlation values. In comparison of the characteristics of milk only three negative correlations were found, those being between fat and SNF, fat and daily milk yield, and TS (Cenco) and daily milk yield. Positive correlation exceeding 0.200 were observed between fat and TS (Moj.), fat and TS (Cenco), SNF and TS (Moj.), SNF and TS (Cenco), TS (Moj.) and TS (Cenco), and TS (Cenco) and protein.

In studies between characteristics of milk and weather data, solar radiation usually tended to have positive correlations while barometric pressure and maximum and minimum temperature more often showed negative correlations.

Repeatability values exceeding 0.60 were found for all characteristics of milk studied with the exception of daily yield, which was in the area of 0.20 to 0.30. Sources of variation were studied and discussed.

Graphs were presented illustrating the high day to day variation of per cent of fat as contrasted to the smaller variations of per cent of protein.

REFERENCES CITED

1. Antoine, A. Relationship between protein and butterfat in milk. Bull. Inst. Agron. et sta. Recherches Gembloux. 20: 5-8. 1952.

2. Azarme, E. Variations in the protein content of milk during lactation. J. Dairy Research. 9:121-146. 1938.

3. Bartlett, S. Variations in the SNF content of milk. J. Dairy Research. 5:113-123. 1934.

4. Bonnier, G. and Hansson, A. Studies on monozygous cattle twins; VII. On the genetical determination of the interdependency between the percentages of fat, protein, and lactose in milk. Acta Agr. Suecana. 2:171-184. 1946.

5. Bonnier, G., Hansson, A., and Jarl, F. Studies in the variations of the calory content of milk. Acta. Agr. Suecana. 2:159-169. 1946.

6. Comburg, G. The constituents of the milk of Black Pied Lowland cows and their relationship to each other in the course of lactation. Kühn Arch. 64:301-364. 1951.

7. Cranfield, H. T. Effect of abnormal weather conditions on the quality of milk. J. Ministry Agr. (Eng.). 37:347-350. 1930.

8. Cranfield, H T., Griffiths, D. G., and Ling, E. R. Variation in the SNF, fat and protein content of cow's milk and their relationship. J. Agr. Sci. 17:62-71. 1927.

9. Gaines, W. L., and Overman, O. R. Interrelations of milk fat, milk protein, and milk energy yield. J. Dairy Sci. 21: 261-271. 1938.

10. Gorrie, C., and Harvey, W. R. Some causes of variation and covariation in fat and SNF per cent of milk from Holstein cows. Proc., Western Div., Am. Dairy Sci. Assoc. 34th Ann. Meeting. 34:71. 1953.

11. Grabisch, W. Investigations into the relationship of butterfat and protein in the milk of different breeds of cows. Züchtungskunde. 24:121-131. 1953.

12. Hansson, A. The importance of inheritance for the composition of milk. Svenska Mejeritidn. 40:147-152. 1948

13. Hansson, A. The genetical determination of the composition of cows' milk, with regard to fat, protein and lactose. Intern. Dairy Congr., Proc., 12th Congr., Stockholm. 1:386-391. 1949.

14. Hansson, A., Skjerwold, H., and Carli, B. The genetical determination of the composition of lacto-protein. Acta Agr. Scand. 1:112-122. 1950.

15. Harvey, W. R. Personal correspondence with S. D. Musgrave. Oct. 14, 1953.

16. Houston, J., and Hale, R. W. The yield and composition of milk with special reference to the influence of climatic conditions and other factors. J. Dairy Research. 3:294-309. 1932.

17. Jack, E. L., Roessler, E. B., Abbott, E. H., and Irwin, A. W. Relationship of solids-not-fat to fat in California milk. Calif. Agr. Exp. Sta. Bul. No. 726:1-12. 1951.

18. Kublitz, M. Variations in the composition of milk during the grazing and stall feeding periods. Milchwissenschaft. 7:197-201. 1952.

19. Larson, B. L., Rolleri, G. D., and Kendall, K. A. Protein production in the bovine. Comparison of daily protein, fat, and milk production during the entire lactation period. J. Dairy Sci. 39:204-214. 1956.

20. Larsson, E. L., Platon, J. B., Thome, K. E., and Hansson, A. The influence of heredity on the connection between the percentage of fat and protein in milk. Intern Dairy Congr., Proc., 12th Congr., Stockholm. 1:377-385. 1949.

21. Lonka, T. Can the relation between fat and protein in milk be changed by selective breeding? Maataloustieteellinen Aikakauskirja. 19:8-21. 1947.

22. Moore, H. C., and Morrow, K. S. The inheritance of solids-not-fat percentage in dairy cattle. J. Dairy Sci. 23:548-549. 1940.

23. Musgrave, S. D., and Salisbury, G. W. The relationship of milk energy and total protein to per cent fat in Brown Swiss herd milk. J. Dairy Sci. 35:174-178. 1952.

24. Overman, O. R., and Gaines, W. L. Linearity of regression of milk energy on fat percentage. J. Animal Sci. 7:55-59. 1948.

25. Overman, O. R., Garrett, O. F., Wright, K. E., and Sammann, F. P. Composition of milk of Brown Swiss cows. Ill. Agr. Exp. Sta. Bul. No. 457. 1939.

26. Overman, O. R., Keirs, R. J., and Craine, E. M. Composition of herd milk of the Brown Swiss breed. Ill. Agr. Exp. Sta. Bul. No. 567. 1953.

27. Regan, W. M., and Richardson, G. A. Reactions of the dairy cow to changes in environmental temperature. J. Dairy Sci. 21:73-79. 1938.

28. Rowland, S. J., and Zein-El-Dine, M. The effect of subclinical mastitis on the SNF content of milk. J. Dairy Research. 9:182-184. 1939.

29. Snedecor, W. Statistical Methods. The Iowa State College Press, Ames. Iowa. 1946.

APPENDIX

APPENDIX

CODE FOR APPENDIX TABLES I AND II

Intensive
- 0 = intensively sampled
- 1 = extensively sampled (once/month)

Complete
- 0 = completed sampling periods in March and in June, 1954
- 1 = completed sampling periods in March, in June, and in September, 1954

Date of calving

1 = January	7 = July
2 = February	8 = August
3 = March	9 = September
4 = April	0 = October
5 = May	X = November
6 = June	Y = December

Date of sample
- 3 = March
- 6 = June
- 9 = September

Period
- 1 = Calendar days 3, 4, 5, 6 of month
- 2 = Calendar days 15, 16, 17, 18 of month
- 3 = Calendar days 24, 25, 26, 27, of month

Day

1, 2, 3, 4 equal 1st, 2nd, 3rd, and 4th days within each period, respectively.

Solar radiation

Measured in total Langley units (gram calories/ min/cm^2)

* Indicates value calculated for missing data

TABLE I

Original Data on 12 Cows that Completed Three Four-Day Periods of Intensive Sampling in March, in June and in September of 1954

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	3	1	1	474	0950	1424	117	375	376	2949	043	031	540
12	00	0	53	0	1	X	3	1	1	366	0856	1222	114	319	299	2949	043	031	540
01	71	0	55	0	1	Y	3	1	1	427	0854	1281	119	299*	437	2949	043	031	540
07	02	0	69	0	1	1	3	1	1	403	0862	1265	129	346	349	2949	043	031	540
01	65	0	74	0	1	2	3	1	1	392	0893	1285	108	336	638	2949	043	031	540
17	00	0	77	0	1	Y	3	1	1	351	0935	1286	125	327	386	2949	043	031	540
08	00	0	83	0	1	1	3	1	1	397	0839	1236	124	327	408	2949	043	031	540
15	00	0	84	0	1	X	3	1	1	323	0787	1110	114	278	401	2949	043	031	540
01	54	0	88	0	1	2	3	1	1	379	0933	1312	131	359	336	2949	043	031	540
01	02	0	93	0	1	Y	3	1	1	336	0886	1222	123	316	381	2949	043	031	540
06	00	0	96	0	1	1	3	1	1	364	0921	1285	098	365	371	2949	043	031	540
01	00	0	89	0	1	1	3	1	1	299	0916	1215	123	360	486	2949	043	031	540
03	52	0	47	0	1	Y	3	1	2	328	0845	1173	118	387	343	2939	056	030	345
12	00	0	53	0	1	X	3	1	2	323	0909	1232	119	314	311	2939	056	030	345
01	71	0	55	0	1	Y	3	1	2	365	0836	1201	121	300	416	2939	056	030	345
07	02	0	69	0	1	1	3	1	2	423	0928	1351	124*	318	367	2939	056	030	345
01	65	0	74	0	1	2	3	1	2	412	0901	1313	113	332	630	2939	056	030	345
17	00	0	77	0	1	Y	3	1	2	364	0809	1173	127	332	353	2939	056	030	345
08	00	0	83	0	1	1	3	1	2	333	0888	1221	124	334	429	2939	056	030	345
15	00	0	84	0	1	X	3	1	2	302	0831	1133	112	273	400	2939	056	030	345
01	54	0	88	0	1	2	3	1	2	347	0838	1185	123	350	315	2939	056	030	345
01	02	0	93	0	1	Y	3	1	2	344	0933	1277	124	322	382	2939	056	030	345
06	00	0	96	0	1	1	3	1	2	343	0936	1279	120	366	385	2939	056	030	345
01	00	0	89	0	1	1	3	1	2	312	0911	1223	123*	360	506	2939	056	030	345

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	3	1	3	424	0927	1351	128	373	344	2928	064	040	128
12	00	0	53	0	1	X	3	1	3	323	0790	1113	110	313	305	2928	064	040	128
01	71	0	55	0	1	Y	3	1	3	314	0850	1164	115	288	405	2928	064	040	128
07	02	0	69	0	1	1	3	1	3	319	0897	1216	118	310	434	2928	064	040	128
01	65	0	74	0	1	2	3	1	3	323	0853	1176	112	297	663	2928	064	040	128
17	00	0	77	0	1	Y	3	1	3	312	0845	1157	136	318	389	2928	064	040	128
08	00	0	83	0	1	1	3	1	3	321	0903	1224	115	333	393	2928	064	040	128
15	00	0	84	0	1	X	3	1	3	329	0830	1159	116	271	425	2928	064	040	128
01	54	0	88	0	1	2	3	1	3	323	0887	1210	122	345	315	2928	064	040	128
01	02	0	93	0	1	Y	3	1	3	342	0851	1193	117	308	359	2928	064	040	128
06	00	0	96	0	1	1	3	1	3	349	0988	1337	137	352	352	2928	064	040	128
01	00	0	89	0	1	1	3	1	3	352	0901	1253	127	345	508	2928	064	040	128
03	52	0	47	0	1	Y	3	1	4	417	0933	1350	117	380	386	2918	067	041	548
12	00	0	53	0	1	X	3	1	4	356	0873	1229	114*	320	293	2918	067	041	548
01	71	0	55	0	1	Y	3	1	4	343	0857	1200	123	309	464	2918	067	041	548
07	02	0	69	0	1	1	3	1	4	326	0945	1271	126	327	441	2918	067	041	548
01	65	0	74	0	1	2	3	1	4	328	0833	1161	126	306	680	2918	067	041	548
17	00	0	77	0	1	Y	3	1	4	340	0933	1273	116	305	423	2918	067	041	548
08	00	0	83	0	1	1	3	1	4	334	0792	1126	114	333	399	2918	067	041	548
15	00	0	84	0	1	X	3	1	4	341	0821	1162	110	273	424	2918	067	041	548
01	54	0	88	0	1	2	3	1	4	337	0887	1224	125	337	337	2918	067	041	548
01	02	0	93	0	1	Y	3	1	4	343	0864	1207	122	303	360	2918	067	041	548
06	00	0	96	0	1	1	3	1	4	397	0917	1314	117	357	353	2918	067	041	548
01	00	0	89	0	1	1	3	1	4	314	0878	1192	118	337	506	2918	067	041	548

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Genco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	3	2	1	407	0951	1358	129	375	355	2954	059	041	548
12	00	0	53	0	1	X	3	2	1	348	0873	1221	119	329	305	2954	059	041	548
01	71	0	55	0	1	Y	3	2	1	315	0851	1166	116	279	355	2954	059	041	548
07	02	0	69	0	1	1	3	2	1	360	1002	1362	124	341	374	2954	059	041	548
01	65	0	74	0	1	2	3	2	1	360	0884	1244	120	304	663	2954	059	041	548
17	00	0	77	0	1	Y	3	2	1	390	0923	1313	124	311	360	2954	059	041	548
08	00	0	83	0	1	1	3	2	1	362	0870	1232	121*	323	358	2954	059	041	548
15	00	0	84	0	1	X	3	2	1	333	0779	1112	105	265	403	2954	059	041	548
01	54	0	88	0	1	2	3	2	1	354	0913	1267	116	339	350	2954	059	041	548
01	02	0	93	0	1	Y	3	2	1	346	0931	1277	118	309	257	2954	059	041	548
06	00	0	96	0	1	1	3	2	1	395	0905	1300	126	351	351	2954	059	041	548
01	00	0	89	0	1	1	3	2	1	364	0907	1271	132	366	545	2954	059	041	548
03	52	0	47	0	1	Y	3	2	2	453	0943	1396	139	366	372	2943	067	045	397
12	00	0	53	0	1	X	3	2	2	344	0880	1224	127	311	299	2943	067	045	397
01	71	0	55	0	1	Y	3	2	2	360	0792	1152	105	280	396	2943	067	045	397
07	02	0	69	0	1	1	3	2	2	317	0838	1155	115	328	444	2943	067	045	397
01	65	0	74	0	1	2	3	2	2	286	0903	1189	118	292	710	2943	067	045	397
17	00	0	77	0	1	Y	3	2	2	332	0833	1165	125	325	383	2943	067	045	397
08	00	0	83	0	1	1	3	2	2	312	0973	1285	121	329	405	2943	067	045	397
15	00	0	84	0	1	X	3	2	2	320	0879	1199	117	279	395	2943	067	045	397
01	54	0	88	0	1	2	3	2	2	280	1005	1285	112	355	363	2943	067	045	397
01	02	0	93	0	1	Y	3	2	2	317	0882	1199	120	290	276	2943	067	045	397
06	00	0	96	0	1	1	3	2	2	311	0971	1282	124	356	378	2943	067	045	397
01	00	0	89	0	1	1	3	2	2	353	0908	1261	131	371	560	2943	067	045	397

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	3	2	3	463	0989	1452	135	375	400	2907	060	053	473
12	00	0	53	0	1	X	3	2	3	352	0893	1245	115	306	273	2907	060	053	473
01	71	0	55	0	1	Y	3	2	3	371	0935	1306	127	286	366	2907	060	053	473
07	02	0	69	0	1	1	3	2	3	327	0933	1260	121	337	414	2907	060	053	473
01	65	0	74	0	1	2	3	2	3	274	0916	1190	120*	285	698	2907	060	053	473
17	00	0	77	0	1	Y	3	2	3	331	1121	1452	123*	310	383	2907	060	053	473
08	00	0	83	0	1	1	3	2	3	315	0909	1224	121*	320	360	2907	060	053	473
15	00	0	84	0	1	X	3	2	3	319	0907	1226	111*	264	402	2907	060	053	473
01	54	0	88	0	1	2	3	2	3	374	0941	1315	117*	352	373	2907	060	053	473
01	02	0	93	0	1	Y	3	2	3	336	0907	1243	118*	292	301	2907	060	053	473
06	00	0	96	0	1	1	3	2	3	383	0951	1344	125*	348	359	2907	060	053	473
01	00	0	89	0	1	1	3	2	3	365	0959	1324	129*	369	546	2907	060	053	473
03	52	0	47	0	1	Y	3	2	4	386	1005	1391	133	387	366	2865	064	043	419
12	00	0	53	0	1	X	3	2	4	336	0921	1257	118	324	268	2865	064	043	419
01	71	0	55	0	1	Y	3	2	4	311	0930	1241	114	304	366	2865	064	043	419
07	02	0	69	0	1	1	3	2	4	347	0956	1303	114	327	410	2865	064	043	419
01	65	0	74	0	1	2	3	2	4	264	0791	1055	121	282	679	2865	064	043	419
17	00	0	77	0	1	Y	3	2	4	330	0873	1203	120	332	436	2865	064	043	419
08	00	0	83	0	1	1	3	2	4	370	0822	1192	121	339	363	2865	064	043	419
15	00	0	84	0	1	X	3	2	4	312	0858	1170	112	291	400	2865	064	043	419
01	54	0	88	0	1	2	3	2	4	328	0898	1226	122	360	370	2865	064	043	419
01	02	0	93	0	1	Y	3	2	4	350	0891	1241	116	318	311	2865	064	043	419
06	00	0	96	0	1	1	3	2	4	333	1077	1410	126	358	378	2865	064	043	419
01	00	0	89	0	1	1	3	2	4	317	0976	1293	123	373	536	2865	064	043	419

table 1 continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF % X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (x 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	3	3	1	401	0962	1363	135*	379	388	2858	061	038	222
12	00	0	53	0	1	X	3	3	1	346	0866	1212	123*	316	305	2858	061	038	222
01	71	0	55	0	1	Y	3	3	1	353	0881	1234	113	314	488	2858	061	038	222
07	02	0	69	0	1	1	3	3	1	352	0896	1248	119	333	463	2858	061	038	222
01	65	0	74	0	1	2	3	3	1	372	0912	1284	112	290	720	2858	061	038	222
17	00	0	77	0	1	Y	3	3	1	334	0908	1242	123*	333	425	2858	061	038	222
08	00	0	83	0	1	1	3	3	1	312	0936	1248	128	345	397	2858	061	038	222
15	00	0	84	0	1	X	3	3	1	312	0813	1125	106	262	390	2858	061	038	222
01	54	0	88	0	1	2	3	3	1	361	0950	1311	115	343	315	2858	061	038	222
01	02	0	93	0	1	Y	3	3	1	334	0878	1212	122*	316	379	2858	061	038	222
06	00	0	96	0	1	1	3	3	1	346	0931	1277	126	390	370	2858	061	038	222
01	00	0	89	0	1	1	3	3	1	327	0937	1264	135*	374	532	2858	061	038	222
03	52	0	47	0	1	Y	3	3	2	426	1005	1431	135*	389	363	2889	060	034	612
12	00	0	53	0	1	X	3	3	2	296	0892	1188	123*	304	259	2889	060	034	612
01	71	0	55	0	1	Y	3	3	2	401	0864	1265	114	323	435	2889	060	034	612
07	02	0	69	0	1	1	3	3	2	347	0954	1301	114	336	424	2889	060	034	612
01	65	0	74	0	1	2	3	3	2	284	0891	1175	115*	284	685	2889	060	034	612
17	00	0	77	0	1	Y	3	3	2	322	0900	1222	123	348	431	2889	060	034	612
08	00	0	83	0	1	1	3	3	2	313	0938	1251	121	345	381	3889	060	034	612
15	00	0	84	0	1	X	3	3	2	313	0838	1151	108	282	376	2889	060	034	612
01	54	0	88	0	1	2	3	3	2	347	0937	1284	117*	355	328	2889	060	034	612
01	02	0	93	0	1	Y	3	3	2	329	0905	1234	122*	334	361	2889	060	034	612
06	00	0	96	0	1	1	3	3	2	378	0989	1347	127*	381	315	2889	060	034	612
01	00	0	89	0	1	1	3	3	2	366	0998	1364	135*	357	514	2889	060	034	612

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Mój. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	3	3	3	411	0961	1372	135*	390	356	2911	075	045	285
12	00	0	53	0	1	X	3	3	3	325	0889	1214	123*	318	310	2911	075	045	285
01	71	0	55	0	1	Y	3	3	3	307	0885	1192	113*	323	430	2911	075	045	285
07	02	0	69	0	1	1	3	3	3	363	0916	1279	119*	333	417	2911	075	045	285
01	65	0	74	0	1	2	3	3	3	304	0901	1205	115*	290	713	2911	075	045	285
17	00	0	77	0	1	Y	3	3	3	334	0908	1242	123*	336	407	2911	075	045	285
08	00	0	83	0	1	1	3	3	3	312	0910	1222	124*	337	399	2911	075	045	285
15	00	0	84	0	1	X	3	3	3	316	0843	1159	109*	273	403	2911	075	045	285
01	54	0	88	0	1	2	3	3	3	348	0942	1290	117*	356	388	2911	075	045	285
01	02	0	93	0	1	Y	3	3	3	331	0880	1211	122*	323	403	2911	075	045	285
06	00	0	96	0	1	1	3	3	3	366	0932	1298	127*	366	322	2911	075	045	285
01	00	0	89	0	1	1	3	3	3	355	0967	1322	135*	366	537	2911	075	045	285
03	52	0	47	0	1	Y	3	3	4	394	0949	1343	135	387	364	2896	068	045	594
12	00	0	53	0	1	X	3	3	4	370	0854	1224	123	323	296	3896	068	045	594
01	71	0	55	0	1	Y	3	3	4	394	0742	1136	112	320	426	2896	068	045	594
07	02	0	69	0	1	1	3	3	4	363	0902	1265	123	334	424	2896	068	045	594
01	65	0	74	0	1	2	3	3	4	320	0873	1193	118	302	704	2896	068	045	594
17	00	0	77	0	1	Y	3	3	4	311	0937	1248	122	342	417	2896	068	045	594
08	00	0	83	0	1	1	3	3	4	323	0920	1243	124	334	376	2896	068	045	594
15	00	0	84	0	1	X	3	3	4	323	0809	1132	113	282	402	2896	068	045	594
01	54	0	88	0	1	2	3	3	4	340	0870	1210	118	348	360	2896	068	045	594
01	02	0	93	0	1	Y	3	3	4	339	0859	1198	122	328	373	2896	068	045	594
06	00	0	96	0	1	1	3	3	4	387	0920	1307	128	350	309	2896	068	045	594
01	00	0	89	0	1	1	3	3	4	402	0951	1353	135	366	550	2896	068	045	594

table I continued:

Sire No.	Dam. No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	6	1	1	376	0885	1261	126	349	344	2902	078	050	770
12	00	0	53	0	1	X	6	1	1	324	0860	1184	118	326	298	2902	078	050	770
01	71	0	55	0	1	Y	6	1	1	265	0876	1141	114	331	408	2902	078	050	770
07	02	0	69	0	1	1	6	1	1	309	0878	1187	118	335	400	2902	078	050	770
01	65	0	74	0	1	2	6	1	1	343	0852	1195	120	300	568	2902	078	050	770
17	00	0	77	0	1	Y	6	1	1	287	0927	1214	118	325	367	2902	078	050	770
08	00	0	83	0	1	1	6	1	1	347	0928	1275	122	318	344	2902	078	050	770
15	00	0	84	0	1	X	6	1	1	367	0897	1264	124	314	323	2902	078	050	770
01	54	0	88	0	1	2	6	1	1	353	0951	1304	126	350	323	2902	078	050	770
01	02	0	93	0	1	Y	6	1	1	342	0884	1226	120	312	334	2902	078	050	770
06	00	0	96	0	1	1	6	1	1	380	0941	1321	128	332	339	2902	078	050	770
01	00	0	89	0	1	1	6	1	1	363	0945	1308	128	323	481	2902	078	050	770
03	52	0	47	0	1	Y	6	1	2	362	0892	1254	124	353	349	2897	084	048	712
12	00	0	53	0	1	X	6	1	2	343	0863	1206	120	335	304	2897	084	048	712
01	71	0	55	0	1	Y	6	1	2	366	0916	1282	118	329	403	2897	084	048	712
07	02	0	69	0	1	1	6	1	2	361	0808	1169	116	466	417	2897	084	048	712
01	65	0	74	0	1	2	6	1	2	323	0883	1206	120	312	617	2897	084	048	712
17	00	0	77	0	1	Y	6	1	2	338	0916	1254	124	317	396	2897	084	048	712
08	00	0	83	0	1	1	6	1	2	358	0853	1211	122	323	330	2897	084	048	712
15	00	0	84	0	1	X	6	1	2	354	0808	1162	116	230	338	2897	084	048	712
01	54	0	88	0	1	2	6	1	2	352	0903	1255	126	344	338	2897	084	048	712
01	02	0	93	0	1	Y	6	1	2	313	0876	1189	116	320	328	2897	084	048	712
06	00	0	96	0	1	1	6	1	2	403	0865	1268	130	341	292	2897	084	048	712
01	00	0	89	0	1	1	6	1	2	412	0792	1204	124	327	473	2897	084	048	712

table 1 continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Genco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	6	1	3	362	0891	1253	124	348	368	2875	086	070	688
12	00	0	53	0	1	X	6	1	3	344	0775	1119	111	330	319	2875	086	070	688
01	71	0	55	0	1	Y	6	1	3	303	0799	1102	110	317	391	2875	086	070	688
07	02	0	69	0	1	1	6	1	3	337	0887	1224	122	334	397	2875	086	070	688
01	65	0	74	0	1	2	6	1	3	323	0883	1206	120	307	584	2875	086	070	688
17	00	0	77	0	1	Y	6	1	3	309	0914	1223	122	326	390	2875	086	070	688
08	00	0	83	0	1	1	6	1	3	332	0891	1223	122	325	324	2875	086	070	688
15	00	0	84	0	1	X	6	1	3	319	0945	1264	126	290	332	2875	086	070	688
01	54	0	88	0	1	2	6	1	3	356	0793	1149	114	349	331	2875	086	070	688
01	02	0	93	0	1	Y	6	1	3	325	0886	1211	121	315	342	2875	086	070	688
06	00	0	96	0	1	1	6	1	3	368	0962	1330	142	343	207	2875	086	070	688
01	00	0	89	0	1	1	6	1	3	349	0943	1292	129	334	549	2875	086	070	688
03	52	0	47	0	1	Y	6	1	4	325	0978	1303	130	349	336	2870	082	070	411
12	00	0	53	0	1	X	6	1	4	339	0858	1197	120	329	295	2870	082	070	411
01	71	0	55	0	1	Y	6	1	4	357	0811	1168	118	316	411	2870	082	070	411
07	02	0	69	0	1	1	6	1	4	322	0839	1161	118	331	405	2870	082	070	411
01	65	0	74	0	1	2	6	1	4	317	0804	1121	118	302	531	2870	082	070	411
17	00	0	77	0	1	Y	6	1	4	294	0875	1169	114	329	373	2870	082	070	411
08	00	0	83	0	1	1	6	1	4	355	0853	1208	120	321	317	2870	082	070	411
15	00	0	84	0	1	X	6	1	4	299	0846	1145	110	289	333	2870	082	070	411
01	54	0	88	0	1	2	6	1	4	316	0902	1218	124	352	354	2870	082	070	411
01	02	0	93	0	1	Y	6	1	4	357	0862	1219	124	308	314	2870	082	070	411
06	00	0	96	0	1	1	6	1	4	412	0867	1279	126	325	291	2870	082	070	411
01	00	0	89	0	1	1	6	1	4	351	0908	1259	130	332	572	2870	082	070	411

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	6	2	1	364	0902	1266	126	346	354	2875	080	065	524
12	00	0	53	0	1	X	6	2	1	325	0831	1156	115	323	276	2875	080	065	524
01	71	0	55	0	1	Y	6	2	1	305	0814	1119	112	321	360	2875	080	065	524
07	02	0	69	0	1	1	6	2	1	346	0814	1160	116	322	381	2875	080	065	524
01	65	0	74	0	1	2	6	2	1	342	0870	1212	115	290	585	2875	080	065	524
17	00	0	77	0	1	Y	6	2	1	302	0851	1153	115	326	391	2875	080	065	524
08	00	0	83	0	1	1	6	2	1	391	0837	1228	124	327	328	2875	080	065	524
15	00	0	84	0	1	X	6	2	1	329	0795	1124	112	283	281	2875	080	065	524
01	54	0	88	0	1	2	6	2	1	325	0885	1210	120	332	308	2875	080	065	524
01	02	0	93	0	1	Y	6	2	1	320	0955	1275	128	332	340	2875	080	065	524
06	00	0	96	0	1	1	6	2	1	369	0906	1275	128	367	313	2875	080	065	524
01	00	0	89	0	1	1	6	2	1	309	0900	1209	120	341	505	2875	080	065	524
03	52	0	47	0	1	Y	6	2	2	322	0928	1250	122	334	360	2872	088	072	710
12	00	0	53	0	1	X	6	2	2	316	0881	1197	116	312	272	2872	088	072	710
01	71	0	55	0	1	Y	6	2	2	279	0866	1145	110	307	426	2872	088	072	710
07	02	0	69	0	1	1	6	2	2	321	0910	1231	123	326	400	2872	088	072	710
01	65	0	74	0	1	2	6	2	2	329	0823	1152	112	298	619	2872	088	072	710
17	00	0	77	0	1	Y	6	2	2	411	0798	1209	118	323	394	2872	088	072	710
08	00	0	83	0	1	1	6	2	2	294	0956	1250	117	325	323	2872	088	072	710
15	00	0	84	0	1	X	6	2	2	359	0827	1186	116	281	302	2872	088	072	710
01	54	0	88	0	1	2	6	2	2	325	0931	1256	120	335	315	2872	088	072	710
01	02	0	93	0	1	Y	6	2	2	327	0865	1192	119	320	353	2872	088	072	710
06	00	0	96	0	1	1	6	2	2	360	0885	1245	124	357	293	2872	088	072	710
01	00	0	89	0	1	1	6	2	2	327	0885	1212	121	340	533	2872	088	072	710

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	6	2	3	342	0950	1292	129	347	365	2880	092	074	722
12	00	0	53	0	1	X	6	2	3	294	0855	1149	114	305	255	2880	092	074	722
01	71	0	55	0	1	Y	6	2	3	296	0928	1224	122	350	423	2880	092	074	722
07	02	0	69	0	1	1	6	2	3	313	0903	1216	121	323	383	2880	092	074	722
01	65	0	74	0	1	2	6	2	3	322	0911	1243	124	296	576	2880	092	074	722
17	00	0	77	0	1	Y	6	2	3	348	1015	1363	136	319	381	2880	092	074	722
08	00	0	83	0	1	1	6	2	3	363	0848	1211	120	319	294	2880	092	074	722
15	00	0	84	0	1	X	6	2	3	326	0944	1270	127	285	283	2880	092	074	722
01	54	0	88	0	1	2	6	2	3	320	0882	1202	120	327	321	2880	092	074	722
01	02	0	93	0	1	Y	6	2	3	326	0885	1211	121	313	332	2880	092	074	722
06	00	0	96	0	1	1	6	2	3	570	0905	1475	147	392	166	2880	092	074	722
01	00	0	89	0	1	1	6	2	3	320	0799	1119	106	290	533	2880	092	074	722
03	52	0	47	0	1	Y	6	2	4	336	0930	1266	126	366	340	2891	093	075	691
12	00	0	53	0	1	X	6	2	4	310	0768	1078	108	311	261	2891	093	075	691
01	71	0	55	0	1	Y	6	2	4	274	0905	1179	112	319	424	2891	093	075	691
07	02	0	69	0	1	1	6	2	4	336	0929	1265	122	325	376	2891	093	075	691
01	65	0	74	0	1	2	6	2	4	308	0883	1191	117	295	598	2891	093	075	691
17	00	0	77	0	1	Y	6	2	4	363	0918	1281	124	296	354	2891	093	075	691
08	00	0	83	0	1	1	6	2	4	312	0923	1235	118	316	290	2891	093	075	691
15	00	0	84	0	1	X	6	2	4	342	0848	1190	118	279	276	2891	093	075	691
01	54	0	88	0	1	2	6	2	4	318	0929	1247	122	338	294	2891	093	075	691
01	02	0	93	0	1	Y	6	2	4	330	0902	1232	110	316	356	2891	093	075	691
06	00	0	96	0	1	1	6	2	4	350	1090	1440	136	332	168	2891	093	075	691
01	00	0	89	0	1	1	6	2	4	300	0824	1124	126	313	536	2891	093	075	691

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	6	3	1	372	0883	1255	126	333	368	2893	097	076	721
12	00	0	53	0	1	X	6	3	1	336	0820	1156	115	297	235	2893	097	076	721
01	71	0	55	0	1	Y	6	3	1	313	0806	1119	110	292	343	2895	097	076	721
07	02	0	69	0	1	1	6	3	1	310	0901	1211	121	315	353	2893	097	076	721
01	65	0	74	0	1	2	6	3	1	341	0825	1166	116	276	516	2893	097	076	721
17	00	0	77	0	1	Y	6	3	1	325	0933	1258	120	310	376	2893	097	076	721
08	00	0	83	0	1	1	6	3	1	355	0802	1157	115	305	306	2893	097	076	721
15	00	0	84	0	1	X	6	3	1	401	0763	1164	116	269	249	2893	097	076	721
01	54	0	88	0	1	2	6	3	1	294	0894	1188	119	334	286	2893	097	076	721
01	02	0	93	0	1	Y	6	3	1	361	0902	1263	126	314	343	2893	097	076	721
06	00	0	96	0	1	1	6	3	1	350	0895	1245	125	355	276	2893	097	076	721
01	00	0	89	0	1	1	6	3	1	357	0866	1223	123	336	489	2893	097	076	721
03	52	0	47	0	1	Y	6	3	2	388	0924	1312	131	290	340	2892	096	075	721
12	00	0	53	0	1	X	6	3	2	343	0843	1186	118	309	234	2892	096	075	721
01	71	0	55	0	1	Y	6	3	2	324	0821	1145	114	297	368	2892	096	075	721
07	02	0	69	0	1	1	6	3	2	332	0739	1071	108	323	327	2892	096	075	721
01	65	0	74	0	1	2	6	3	2	313	0822	1135	113	278	480	2892	096	075	721
17	00	0	77	0	1	Y	6	3	2	321	0864	1185	118	329	360	2892	096	075	721
08	00	0	83	0	1	1	6	3	2	347	0859	1206	120	311	286	2892	096	075	721
15	00	0	84	0	1	X	6	3	2	345	0815	1160	116	272	229	2892	096	075	721
01	54	0	88	0	1	2	6	3	2	347	0907	1254	125	339	316	2892	096	075	721
01	02	0	93	0	1	Y	6	3	2	379	0883	1262	126	328	358	2892	096	075	721
06	00	0	96	0	1	1	6	3	2	372	0908	1280	128	357	287	2892	096	075	721
01	00	0	89	0	1	1	6	3	2	324	0885	1209	120	324	490	2892	096	075	721

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Genco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	6	3	3	364	0846	1210	121	339	338	2898	095	075	654
12	00	0	53	0	1	X	6	3	3	321	0859	1180	120	313	228	2898	095	075	654
01	71	0	55	0	1	Y	6	3	3	315	0821	1136	112	306	331	2898	095	075	654
07	02	0	69	0	1	1	6	3	3	347	0875	1222	120	315	338	2898	095	075	654
01	65	0	74	0	1	2	6	3	3	301	0842	1143	115	276	492	2898	095	075	654
17	00	0	77	0	1	Y	6	3	3	314	0895	1209	121	329	276	2898	095	075	654
08	00	0	83	0	1	1	6	3	3	381	0856	1237	123	304	298	2898	095	075	654
15	00	0	84	0	1	X	6	3	3	358	0720	1078	108	267	238	2898	095	075	654
01	54	0	88	0	1	2	6	3	3	312	0933	1245	124	327	270	2898	095	075	654
01	02	0	93	0	1	Y	6	3	3	348	0908	1256	124	313	292	2898	095	075	654
06	00	0	96	0	1	1	6	3	3	375	0900	1275	126	348	279	2898	095	075	654
01	00	0	89	0	1	1	6	3	3	317	0946	1263	126	337	495	2898	095	075	654
03	52	0	47	0	1	Y	6	3	4	368	0925	1293	128	341	357	2898	094	074	707
12	00	0	53	0	1	X	6	3	4	319	0805	1124	111	318	251	2898	094	074	707
01	71	0	55	0	1	Y	6	3	4	311	0817	1128	111	315	377	2898	094	074	707
07	02	0	69	0	1	1	6	3	4	338	0860	1198	123	320	342	2898	094	074	707
01	65	0	74	0	1	2	6	3	4	329	0846	1175	108	282	529	2898	094	074	707
17	00	0	77	0	1	Y	6	3	4	337	0895	1232	121	333	365	2898	094	074	707
08	00	0	83	0	1	1	6	3	4	317	0857	1174	117	305	280	2898	094	074	707
15	00	0	84	0	1	X	6	3	4	325	0793	1118	112	231	239	2898	094	074	707
01	54	0	88	0	1	2	6	3	4	306	0880	1186	117	322	287	2898	094	074	707
01	02	0	93	0	1	Y	6	3	4	365	0872	1237	122	317	289	2898	094	074	707
06	00	0	96	0	1	1	6	3	4	385	0930	1315	131	366	298	2898	094	074	707
01	00	0	89	0	1	1	6	3	4	311	0906	1217	120	332*	491	2898	094	074	707

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	9	1	1	430*	1019*	1449*	142	399	295	2906	096	074	565
12	00	0	53	0	1	X	9	1	1	373*	0885*	1259*	121	317	145	2906	096	074	565
01	71	0	55	0	1	Y	9	1	1	291*	0913*	1205*	118	344	300	2906	096	074	565
07	02	0	69	0	1	1	9	1	1	381*	0944*	1325*	129	343	307	2906	096	074	565
01	65	0	74	0	1	2	9	1	1	369*	0898*	1267*	123	334	423	2906	096	074	565
17	00	0	77	0	1	Y	9	1	1	334	0919	1253	123*	343	282	2906	096	074	565
08	00	0	83	0	1	1	9	1	1	378*	0925*	1304*	126	349	252	2906	096	074	565
15	00	0	84	0	1	X	9	1	1	425*	0805*	1231*	122	302	150	2906	096	074	565
01	54	0	88	0	1	2	9	1	1	352*	0963*	1314*	129	358	265	2906	096	074	565
01	02	0	93	0	1	Y	9	1	1	386*	0928*	1314*	131	354	306	2906	096	074	565
06	00	0	96	0	1	1	9	1	1	364*	0961*	1325*	128	357	229	2906	096	074	565
01	00	0	89	0	1	1	9	1	1	323	0972	1295	124	353	473	2906	096	074	565
03	52	0	47	0	1	Y	9	1	2	412	0979	1391	139	392	295	2911	094	069	547
12	00	0	53	0	1	X	9	1	2	361	0845	1206	118	324	127	2911	094	069	547
01	71	0	55	0	1	Y	9	1	2	266	0872	1138	111	345	275	2911	094	069	547
07	02	0	69	0	1	1	9	1	2	370	0939	1309	128	344	295	2911	094	069	547
01	65	0	74	0	1	2	9	1	2	369	0906	1275	123	325	411	2911	094	069	547
17	00	0	77	0	1	Y	9	1	2	340	0945	1285	122	316	272	2911	094	069	547
08	00	0	83	0	1	1	9	1	2	391	0945	1336	126	341	250	2911	094	069	547
15	00	0	84	0	1	X	9	1	2	415	0796	1211	119	317	150	2911	094	069	547
01	54	0	88	0	1	2	9	1	2	357	0946	1303	128	353	252	2911	094	069	547
01	02	0	93	0	1	Y	9	1	2	365	0910	1275	126	346	281	2911	094	069	547
06	00	0	96	0	1	1	9	1	2	355	0899	1254	126	375	228	2911	094	069	547
01	00	0	89	0	1	1	9	1	2	316	0838	1254	123	343	463	2911	094	069	547

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	9	1	3	408	1002	1410	135	398	272	2906	097	073	555
12	00	0	53	0	1	X	9	1	3	393	0884	1277	126	328	105	2906	097	073	555
01	71	0	55	0	1	Y	9	1	3	329	0944	1273	117	342	293	2906	097	073	555
07	02	0	69	0	1	1	9	1	3	396	0939	1335	131	348	302	2906	097	073	555
01	65	0	74	0	1	2	9	1	3	353	0920	1273	125	337	419	2906	097	073	555
17	00	0	77	0	1	Y	9	1	3	336	0951	1287	124	335	274	2906	097	073	555
08	00	0	83	0	1	1	9	1	3	377	0907	1284	126	349	261	2906	097	073	555
15	00	0	84	0	1	X	9	1	3	410	0802	1212	121*	315	110	2906	097	073	555
01	54	0	88	0	1	2	9	1	3	355	0990	1345	126	356	247	2906	097	073	555
01	02	0	93	0	1	Y	9	1	3	402	0933	1335	130	361	281	2906	097	073	555
06	00	0	96	0	1	1	9	1	3	357	0989	1346	130	389	219	2906	097	073	555
01	00	0	89	0	1	1	9	1	3	326	1019	1345	127	358	447	2906	097	073	555
03	52	0	47	0	1	Y	9	1	4	470	1077	1547	141	396*	284	2907	092	073	258
12	00	0	53	0	1	X	9	1	4	366	0927	1293	121	323*	127	2907	092	073	258
01	71	0	55	0	1	Y	9	1	4	279	0924	1203	115	344*	270	2907	092	073	258
07	02	0	69	0	1	1	9	1	4	376	0955	1331	128	345*	292	2907	092	073	258
01	65	0	74	0	1	2	9	1	4	384	0869	1253	124*	332*	412	2907	092	073	258
17	00	0	77	0	1	Y	9	1	4	343	0923	1266	123*	331*	277	2907	092	073	258
08	00	0	83	0	1	1	9	1	4	367	0924	1291	126*	346*	244	2907	092	073	258
15	00	0	84	0	1	X	9	1	4	451	0818	1269	121*	311*	150	2907	092	073	258
01	54	0	88	0	1	2	9	1	4	343	0952	1295	128*	356*	258	2907	092	073	258
01	02	0	93	0	1	Y	9	1	4	391	0941	1332	129*	354*	283	2907	092	073	258
06	00	0	96	0	1	1	9	1	4	380	0995	1375	128*	374*	229	2907	092	073	258
01	00	0	89	0	1	1	9	1	4	300	0938	1238	125*	372	448	2907	092	073	258

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	9	2	1	365	0988	1353	144	416	285	2893	095	065	475
12	00	0	53	0	1	X	9	2	1	313	0869	1182	126	356	130	2893	095	065	475
01	71	0	55	0	1	Y	9	2	1	275	0856	1131	119	358	255	2893	095	065	475
07	02	0	69	0	1	1	9	2	1	331	1033	1364	128	364	320	2893	095	065	475
01	65	0	74	0	1	2	9	2	1	309	0990	1299	124	360	467	2893	095	065	475
17	00	0	77	0	1	Y	9	2	1	331	1049	1380	127	372	290	2893	095	065	475
08	00	0	83	0	1	1	9	2	1	367	1004	1371	127	371	251	2893	095	065	475
15	00	0	84	0	1	X	9	2	1	407	0764	1271	124	360	132	2893	095	065	475
01	54	0	88	0	1	2	9	2	1	282	0970	1252	129	379	237	2893	095	065	475
01	02	0	93	0	1	Y	9	2	1	311	0952	1263	125	388	287	2893	095	065	475
06	00	0	96	0	1	1	9	2	1	335	0964	1299	128*	422	210	2893	095	065	475
01	00	0	89	0	1	1	9	2	1	333	0923	1256	127	353	366	2893	095	065	475
03	52	0	47	0	1	Y	9	2	2	362	1015	1377	137	414	288	2889	095	067	497
12	00	0	53	0	1	X	9	2	2	359	0920	1279	127	364	121	2889	095	067	497
01	71	0	55	0	1	Y	9	2	2	248	0891	1139	110	365	265	2889	095	067	497
07	02	0	69	0	1	1	9	2	2	304	0903	1207	127	367	304	2889	095	067	497
01	65	0	74	0	1	2	9	2	2	311	0919	1230	124	358	446	2889	095	067	497
17	00	0	77	0	1	Y	9	2	2	286	0973	1259	120	361	261	2889	095	067	497
08	00	0	83	0	1	1	9	2	2	357	0954	1311	130	381	242	2889	095	067	497
15	00	0	84	0	1	X	9	2	2	441	0871	1312	111	360	148	2889	095	067	497
01	54	0	88	0	1	2	9	2	2	259	1010	1269	128*	375	246	2889	095	067	497
01	02	0	93	0	1	Y	9	2	2	275	0990	1265	119	379	287	2889	095	067	497
06	00	0	96	0	1	1	9	2	2	340	0973	1313	129	412	213	2889	095	067	497
01	00	0	89	0	1	1	9	2	2	320	0933	1253	122	356	400	2889	095	067	497

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	9	2	3	375	1015	1390	138	413	247	2890	092	072	499
12	00	0	53	0	1	X	9	2	3	273	0872	1145	120	350	115	2890	092	072	499
01	71	0	55	0	1	Y	9	2	3	257	0833	1090	112	362	236	2890	092	072	499
07	02	0	69	0	1	1	9	2	3	310	0905	1215	121	362	290	2890	092	072	499
01	65	0	74	0	1	2	9	2	3	282	0926	1208	111	361	456	2890	092	072	499
17	00	0	77	0	1	Y	9	2	3	306	0858	1264	129	358	277	2890	092	072	499
08	00	0	83	0	1	1	9	2	3	390	0926	1316	126	366	227	2890	092	072	499
15	00	0	84	0	1	X	9	2	3	383	0873	1256	128	380	142	2890	092	072	499
01	54	0	88	0	1	2	9	2	3	319	0948	1267	128	374	236	2890	092	072	499
01	02	0	93	0	1	Y	9	2	3	298	0937	1235	124	362	256	2890	092	072	499
06	00	0	96	0	1	1	9	2	3	414	0878	1292	126	402	177	2890	092	072	499
01	00	0	89	0	1	1	9	2	3	337	1060	1397	137	362	395	2890	092	072	499
03	52	0	47	0	1	Y	9	2	4	396	1040	1436	141	423	266	2881	095	070	506
12	00	0	53	0	1	X	9	2	4	349	0885	1234	121	348	117	2881	095	070	506
01	71	0	55	0	1	Y	9	2	4	305	0855	1160	116	365	246	2881	095	070	506
07	02	0	69	0	1	1	9	2	4	379	0961	1340	125*	365	299	2881	095	070	506
01	65	0	74	0	1	2	9	2	4	361	0956	1317	120*	382	463	2881	095	070	506
17	00	0	77	0	1	Y	9	2	4	352	0934	1286	127	361	303	2881	095	070	506
08	00	0	83	0	1	1	9	2	4	397	0924	1321	125	360	242	2881	095	070	506
15	00	0	84	0	1	X	9	2	4	445	0878	1323	121*	340	170	2881	095	070	506
01	54	0	88	0	1	2	9	2	4	302	0945	1247	128*	381	248	2881	095	070	506
01	02	0	93	0	1	Y	9	2	4	367	0897	1264	123*	370	274	2881	095	070	506
06	00	0	96	0	1	1	9	2	4	394	0925	1319	128*	383	211	2881	095	070	506
01	00	0	89	0	1	1	9	2	4	289	0945	1234	129*	348	395	2881	095	070	506

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	9	3	1	380	0910	1290	130	425	265	2907	089	055	493
12	00	0	53	0	1	X	9	3	1	389	0884	1273	128	382	146	2907	089	055	493
01	71	0	55	0	1	Y	9	3	1	321	0825	1146	116	373	221	2907	089	055	493
07	02	0	69	0	1	1	9	3	1	368	0892	1260	128	262	315	2907	089	055	493
01	65	0	74	0	1	2	9	3	1	407	0851	1258	129	351	445	2907	089	055	493
17	00	0	77	0	1	Y	9	3	1	381	0937	1318	134	371	268	2907	089	055	493
08	00	0	83	0	1	1	9	3	1	402	0941	1343	133	390	195	2907	089	055	493
15	00	0	84	0	1	X	9	3	1	301	0885	1186	124	362	182	2907	089	055	493
01	54	0	88	0	1	2	9	3	1	332	0928	1260	137	395	225	2907	089	055	493
01	02	0	93	0	1	Y	9	3	1	367	0899	1266	132	366	288	2907	089	055	493
06	00	0	96	0	1	1	9	3	1	417	0816	1233	133	378	211	2907	089	055	493
01	00	0	89	0	1	1	9	3	1	346	0923	1269	125	344	376	2907	089	055	493
03	52	0	47	0	1	Y	9	3	2	399	0991	1390	138	398	275	2906	089	063	301
12	00	0	53	0	1	X	9	3	2	350	0900	1250	128	364	141	2906	089	063	301
01	71	0	55	0	1	Y	9	3	2	307	0836	1143	114	374	225	2906	089	063	301
07	02	0	69	0	1	1	9	3	2	358	0906	1264	129	358	300	2906	089	063	301
01	65	0	74	0	1	2	9	3	2	336	0864	1200	120	347	465	2906	089	063	301
17	00	0	77	0	1	Y	9	3	2	337	0890	1227	121	346	286	2906	089	063	301
08	00	0	83	0	1	1	9	3	2	380	0893	1273	131	370	225	2906	089	063	301
15	00	0	84	0	1	X	9	3	2	394	0826	1220	123	354	172	2906	089	063	301
01	54	0	88	0	1	2	9	3	2	324	0944	1268	130	390	209	2906	089	063	301
01	02	0	93	0	1	Y	9	3	2	375	0911	1286	133	387	283	2906	089	063	301
06	00	0	96	0	1	1	9	3	2	390	0966	1356	136	415	235	2906	089	063	301
01	00	0	89	0	1	1	9	3	2	309	0968	1277	126	340	385	2906	089	063	301

table I continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
03	52	0	47	0	1	Y	9	3	3	461	0996	1457	147	413	230	2900	091	067	312
12	00	0	53	0	1	X	9	3	3	326	0912	1238	124	377	127	2900	091	067	312
01	71	0	55	0	1	Y	9	3	3	270	0677	0947	118	358	218	2900	091	067	312
07	02	0	69	0	1	1	9	3	3	357	0894	1251	133	378	294	2900	091	067	312
01	65	0	74	0	1	2	9	3	3	387	0866	1253	129	351	414	2900	091	067	312
17	00	0	77	0	1	Y	9	3	3	322	0948	1270	125	358	275	2900	091	067	312
08	00	0	83	0	1	1	9	3	3	398	0886	1284	132	359	190	2900	091	067	312
15	00	0	84	0	1	X	9	3	3	487	0851	1338	136	380	174	2900	091	067	312
01	54	0	88	0	1	2	9	3	3	379	0923	1302	132	381	223	2900	091	067	312
01	02	0	93	0	1	Y	9	3	3	283	0912	1195	132	353	248	2900	091	067	312
06	00	0	96	0	1	1	9	3	3	368	0943	1311	134	414	177	2900	091	067	312
01	00	0	89	0	1	1	9	3	3	355	0914	1269	134	349	370	2900	091	067	312
03	52	0	47	0	1	Y	9	3	4	419	0981	1400	145	423	221	2882	093	072	213
12	00	0	53	0	1	X	9	3	4	392	0896	1288	129	394	116	2882	093	072	213
01	71	0	55	0	1	Y	9	3	4	291	0833	1124	115	365	221	2882	093	072	213
07	02	0	69	0	1	1	9	3	4	369	0883	1252	133	362	270	2882	093	072	213
01	65	0	74	0	1	2	9	3	4	308	0867	1175	130	358	397	2882	093	072	213
17	00	0	77	0	1	Y	9	3	4	290	0918	1208	128	367	270	2882	093	072	213
08	00	0	83	0	1	1	9	3	4	350	0877	1227	133	360	180	2882	093	072	213
15	00	0	84	0	1	X	9	3	4	456	0825	1281	132	374	155	2882	093	072	213
01	54	0	88	0	1	2	9	3	4	280	0934	1214	130	368	192	2882	093	072	213
01	02	0	93	0	1	Y	9	3	4	350	0945	1295	133	363	221	2882	093	072	213
06	00	0	96	0	1	1	9	3	4	332	0903	1235	132	420	170	2882	093	072	213
01	00	0	89	0	1	1	9	3	4	353	0899	1252	130	356	361	2882	093	072	213

TABLE II

Original Data on 5 Cows that Completed Three Four-Day Periods of Intensive Sampling in March and in June of 1954

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Genco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
04	48	0	42	0	2	X	3	1	1	462	0943	1405	125	356	222	2949	043	031	540
02	57	0	45	0	2	0	3	1	1	472	0984	1456	130	371	341	2949	043	031	540
04	02	0	52	0	2	X	3	1	1	359	0883	1242	117	278	376	2949	043	031	540
02	00	0	72	0	2	Y	3	1	1	269	0818	1087	110	374	394	2949	043	031	540
09	00	0	75	0	2	9	3	1	1	439	0974	1413	132	373	341	2949	043	031	540
04	48	0	42	0	2	X	3	1	2	423	0928	1351	121	366	213	2939	056	030	345
02	57	0	45	0	2	0	3	1	2	412	0926	1338	127	251	355	2939	056	030	345
04	02	0	52	0	2	X	3	1	2	351	0873	1224	118*	305	372	2939	056	030	345
02	00	0	72	0	2	Y	3	1	2	370	0750	1120	115	359	326	2939	056	030	345
09	00	0	75	0	2	9	3	1	2	356	0905	1261	141	365	333	2939	056	030	345
04	48	0	42	0	2	X	3	1	3	387	0934	1321	131	347	206	2928	064	040	128
02	57	0	45	0	2	0	3	1	3	396	0898	1294	124	360	348	2928	064	040	128
04	02	0	52	0	2	X	3	1	3	320	0836	1156	113	296	375	2928	064	040	128
02	00	0	72	0	2	Y	3	1	3	307	0767	1074	096	328	397	2928	064	040	128
09	00	0	75	0	2	9	3	1	3	381	0932	1313	131	365	326	2928	064	040	128
04	48	0	42	0	2	X	3	1	4	410	0931	1341	128	361	203	2918	067	041	548
02	57	0	45	0	2	0	3	1	4	386	0790	1176	132	351	378	2918	067	041	548
04	02	0	52	0	2	X	3	1	4	395	0838	1233	123	304	394	2918	067	041	548
02	00	0	72	0	2	Y	3	1	4	263	0798	1061	103	352	376	2918	067	041	548
09	00	0	75	0	2	9	3	1	4	393	0929	1322	129	350	335	2918	067	041	548

table II continued:

Sire No.	Dam	Lactation	Cow No.	Inte sive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
04	48	0	42	0	2	X	3	2	1	411	0885	1296	129	355	225	2954	059	041	548
02	57	0	45	0	2	0	3	2	1	388	0905	1293	124	342	323	2954	059	041	548
04	02	0	52	0	2	X	3	2	1	356	0869	1225	121	319	375	2954	059	041	548
02	00	0	72	0	2	Y	3	2	1	293	0810	1103	115	376	368	2954	059	041	548
09	00	0	75	0	2	9	3	2	1	432	0965	1397	136	375	299	2954	059	041	548
04	48	0	42	0	2	X	3	2	2	397	0907	1304	127	357	203	2943	067	045	397
02	57	0	45	0	2	0	3	2	2	396	0866	1262	126	348	313	2943	067	045	397
04	02	0	52	0	2	X	3	2	2	334	0864	1198	117	311	388	2943	067	045	397
02	00	0	72	0	2	Y	3	2	2	262	0795	1057	104	373	375	2943	067	045	397
09	00	0	75	0	2	9	3	2	2	390	0979	1369	132	352	320	2943	067	045	397
04	48	0	42	0	2	X	3	2	3	413	0977	1390	128	360	216	2907	060	053	473
02	57	0	45	0	2	0	3	2	3	401	0987	1388	127	369	347	2907	060	053	473
04	02	0	52	0	2	X	3	2	3	364	0899	1263	117	306	386	2907	060	053	473
02	00	0	72	0	2	Y	3	2	3	254	0895	1149	106	365	371	2907	060	053	473
09	00	0	75	0	2	9	3	2	3	393	1008	1401	130*	356	326	2907	060	053	473
04	48	0	42	0	2	X	3	2	4	413	0982	1395	129	356	203	2865	064	043	419
02	57	0	45	0	2	0	3	2	4	415	0973	1388	133	346	365	2865	064	043	419
04	02	0	52	0	2	X	3	2	4	355	0925	1280	117	315	391	2865	064	043	419
02	00	0	72	0	2	Y	3	2	4	346	0695	1041	106	356	382	2865	064	043	419
09	00	0	75	0	2	9	3	2	4	400	0967	1367	123	364	320	2865	064	043	419

table II continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
04	48	0	42	0	2	X	3	3	1	402	0944	1346	125	339	211	2858	061	038	222
02	57	0	45	0	2	0	3	3	1	399	0916	1315	137	359	406	2858	061	038	222
04	02	0	52	0	2	X	3	3	1	351	0850	1201	118	301	385	2858	061	038	222
02	00	0	72	0	2	Y	3	3	1	254	0850	1104	105	351	395	2858	061	038	222
09	00	0	75	0	2	9	3	3	1	389	0965	1354	126	350	356	2858	061	038	222
04	48	0	42	0	2	X	3	3	2	393	0943	1336	121	348	195	2889	060	034	612
02	57	0	45	0	2	0	3	3	2	415	0974	1389	127	382	345	2889	060	034	612
04	02	0	52	0	2	X	3	3	2	341	0901	1242	116	301	371	2889	060	034	612
02	00	0	72	0	2	Y	3	3	2	302	0836	1138	100*	361	377	2889	060	034	612
09	00	0	75	0	2	9	3	3	2	394	0960	1354	132*	365	353	2889	060	034	612
04	48	0	42	0	2	X	3	3	3	380	0896	1276	127*	355	203	2911	075	045	285
02	57	0	45	0	2	0	3	3	3	403	0912	1315	128*	373	353	2911	075	045	285
04	02	0	52	0	2	X	3	3	3	341	0873	1214	115*	309	366	2911	075	045	285
02	00	0	72	0	2	Y	3	3	3	262	0749	1011	100*	355	388	2911	075	045	285
09	00	0	75	0	2	9	3	3	3	396	0976	1372	132*	362	335	2911	075	045	285
04	48	0	42	0	2	X	3	3	4	439	0911	1350	136	350	213	2896	068	045	594
02	57	0	45	0	2	0	3	3	4	355	0892	1247	120	365	366	2896	068	045	594
04	02	0	52	0	2	X	3	3	4	328	0842	1170	112	301	380	2896	068	045	594
02	00	0	72	0	2	Y	3	3	4	246	0764	1010	095	357	402	2896	068	045	594
09	00	0	75	0	2	9	3	3	4	404	0968	1372	137	357	332	2896	068	045	594

table II continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
04	48	0	42	0	2	X	6	1	1	336	0986	1322	132	354	151	2902	078	050	770
02	57	0	45	0	2	0	6	1	1	467	0856	1323	136	372	209	2902	078	050	770
04	02	0	52	0	2	X	6	1	1	360	0899	1259	122	320	325	2902	078	050	770
02	00	0	72	0	2	Y	6	1	1	276	0799	1075	108	307	275	2902	078	050	770
09	00	0	75	0	2	9	6	1	1	391	0851	1242	134	352	308	2902	078	050	770
04	48	0	42	0	2	X	6	1	2	385	0838	1223	122	374	140	2897	084	048	712
02	57	0	45	0	2	0	6	1	2	356	0968	1324	132	376	211	2897	084	048	712
04	02	0	52	0	2	X	6	1	2	355	0922	1277	122	312	330	2897	084	048	712
02	00	0	72	0	2	Y	6	1	2	264	0770	1034	102	320	251	2897	084	048	712
09	00	0	75	0	2	9	6	1	2	402	0916	1318	132	355	293	2897	084	048	712
04	48	0	42	0	2	X	6	1	3	344	0963	1307	130	374	157	2875	086	070	688
02	57	0	45	0	2	0	6	1	3	349	0975	1324	132	371	233	2875	086	070	688
04	02	0	52	0	2	X	6	1	3	364	0825	1189	118	314	331	2875	086	070	688
02	00	0	72	0	2	Y	6	1	3	312	0812	1124	112	312	213	2875	086	070	688
09	00	0	75	0	2	9	6	1	3	406	0937	1343	134	350	322	2875	086	070	688
04	48	0	42	0	2	X	6	1	4	404	0913	1317	130	344	143	2870	082	070	411
02	57	0	45	0	2	0	6	1	4	409	0911	1320	128	243	226	2870	082	070	411
04	02	0	52	0	2	X	6	1	4	311	0858	1169	118	321	316	2870	082	070	411
02	00	0	72	0	2	Y	6	1	4	301	0833	1134	112	315	205	2870	082	070	411
09	00	0	75	0	2	9	6	1	4	400	0903	1303	128	343	322	2870	082	070	411

table II continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample Mo.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
04	48	0	42	0	2	X	6	2	1	425	0938	1363	136	360	133	2875	080	065	524
02	57	0	45	0	2	0	6	2	1	376	0781	1157	115	362	219	2875	080	065	524
04	02	0	52	0	2	X	6	2	1	325	1151	1476	148	304	072	2875	080	065	524
02	00	0	72	0	2	Y	6	2	1	285	0735	1020	103	323	245	2875	080	065	524
09	00	0	75	0	2	9	6	2	1	375	0888	1263	126	349	307	2875	080	065	524
04	48	0	42	0	2	X	6	2	2	309	1030	1339	130	360	121	2872	088	072	710
02	57	0	45	0	2	0	6	2	2	412	0936	1348	130	367	222	2872	088	072	710
04	02	0	52	0	2	X	6	2	2	500	0846	1346	132	338	116	2872	088	072	710
02	00	0	72	0	2	Y	6	2	2	257	0775	1032	107	313	255	2872	088	072	710
09	00	0	75	0	2	9	6	2	2	306	1093	1399	138	357	285	2872	088	072	710
04	48	0	42	0	2	X	6	2	3	454	0929	1383	138	351	121	2880	092	074	722
02	57	0	45	0	2	0	6	2	3	355	0883	1238	124	368	209	2880	092	074	722
04	02	0	52	0	2	X	6	2	3	325	0865	1190	119	316	194	2880	092	074	722
02	00	0	72	0	2	Y	6	2	3	253	0750	1003	096	308	260	2880	092	074	722
09	00	0	75	0	2	9	6	2	3	405	0971	1376	137	352	298	2880	092	074	722
04	48	0	42	0	2	X	6	2	4	369	0906	1275	128	346	111	2891	093	075	691
02	57	0	45	0	2	0	6	2	4	349	0926	1275	127	352	205	2891	093	075	691
04	02	0	52	0	2	X	6	2	4	325	0850	1175	117	325	231	2891	093	075	691
02	00	0	72	0	2	Y	6	2	4	350	0714	1064	112	316	268	2891	093	075	691
09	00	0	75	0	2	9	6	2	4	393	0992	1385	130	352	284	2891	093	075	691

table II continued:

Sire No.	Dam No.	Lactation	Cow No.	Intensive	Complete	Mo. Calved	Sample No.	Period	Day	Fat (% X 100)	SNF (% X 100)	T.S. Moj. (% X 100)	T.S. Cenco (% X 10)	Protein (% X 100)	Daily Milk Yield (lb. X 10)	Av. Bar. Pressure (X 100)	Maximum Temp. (F.)	Minimum Temp. (F.)	Solar Radiation
04	48	0	42	0	2	X	6	3	1	444	0881	1325	132	352	071	2893	097	076	721
02	57	0	45	0	2	0	6	3	1	412	0927	1339	134	371	190	2893	097	076	721
04	02	0	52	0	2	X	6	3	1	407	0918	1325	132	346*	197	2893	097	076	721
02	00	0	72	0	2	Y	6	3	1	281	0754	1035	104	309	235	2893	097	076	721
09	00	0	75	0	2	9	6	3	1	433	0891	1324	133	338	285	2893	097	076	721
04	48	0	42	0	2	X	6	3	2	485	0863	1348	135	369	074	2892	096	075	721
02	57	0	45	0	2	0	6	3	2	403	0904	1307	130	378	169	2892	096	075	721
04	02	0	52	0	2	X	6	3	2	337	0906	1243	124	334	186	2892	096	075	721
02	00	0	72	0	2	Y	6	3	2	281	0754	1035	104	314	224	2892	096	075	721
09	00	0	75	0	2	9	6	3	2	420	0956	1376	138	357	215	2892	096	075	721
04	48	0	42	0	2	X	6	3	3	451	0821	1272	126	369	075	2898	095	075	654
02	57	0	45	0	2	0	6	3	3	376	0882	1258	123	356	174	2898	095	075	654
04	02	0	52	0	2	X	6	3	3	395	0913	1308	128	348	211	2898	095	075	654
02	00	0	72	0	2	Y	6	3	3	297	0782	1079	105	313	201	2898	095	075	654
09	00	0	75	0	2	9	6	3	3	421	0978	1399	137	358	239	2898	095	075	654
04	48	0	42	0	2	X	6	3	4	420	0919	1339	131	383	071	2898	094	074	707
02	57	0	45	0	2	0	6	3	4	386	0956	1342	127	379	166	2898	094	074	707
04	02	0	52	0	2	X	6	3	4	336	0922	1258	126	355	199	2898	094	074	707
02	00	0	72	0	2	Y	6	3	4	248	0762	1010	103	322	224	2898	094	074	707
09	00	0	75	0	2	9	6	3	4	380	0738	1118	112	357	234	2898	094	074	707

TABLE III

Coefficients of Correlation Pooled Over Days Within Periods Between Certain Constituents of Holstein Milk and Between Those Constituents and Concurrent Weather Data. (12 cows and sample periods in March, June and September)

Constituents Related	Sampling Period	Cow No. 47	53	55	69	74	77	83	84	88	89	93	96
		r	r	r	r	r	r	r	r	r	r	r	r
1[a]2[b]	3	.515	-.164	-.340	.022	.313	-.060	-.703	-.318	-.205	.357	.155	-.572
1 2	6	-.598	-.049	-.195	-.411	.099	-.225	-.695	-.426	-.180	-.175	-.245	-.247
1 2	9	.386	.199	.194	.041	-.482	.046	-.051	-.188	-.438	-.048	-.472	-.498
1 3[c]	3	.858	.427	.391	.602	.846	.216	-.234	-.029	.365	.787	.448	.017
1 3	6	-.010	.355	.415	-.118	.462	.398	-.073	-.037	.312	.382	.517	.606
1 3	9	.804	.869	.507	.577	.432	.463	.402	.791	.732	.283	.791	.068
1 4[d]	3	.212	.257	.078	.541	-.576	-.127	.070	-.014	.539	.902	-.233	-.144
1 4	6	.129	.384	.393	-.204	.115	.332	.640	.016	.245	.323	.465	.639
1 4	9	.456	.429	.508	.629	.581	.420	-.183	.255	.034	.613	.572	.099
1 5[e]	3	-.603	.511	.281	.209	.845	-.378	-.302	-.197	-.042	.199	.210	-.204
1 5	6	-.490	.452	-.127	.540	.118	-.385	-.047	-.057	.628	.147	-.100	.574
1 5	9	-.200	.140	.074	-.277	-.293	-.112	-.062	.078	-.173	-.061	-.103	-.473
1 6[f]	3	.549	.257	.318	-.764	-.580	-.638	-.087	.660	-.114	.654	.010	-.609
1 6	6	.014	.334	-.232	-.026	.299	.162	.169	-.291	.595	-.278	-.222	-.427
1 6	9	-.281	.035	-.037	-.165	-.306	.354	-.089	-.107	.188	-.478	.248	.066
1 7[g]	3	.206	.155	.084	.233	.399	.546	.294	.372	-.097	-.079	-.085	.076
1 7	6	.649	.020	-.051	.143	-.089	-.171	.072	.548	.020	.190	.312	-.184
1 7	9	.335	.255	.244	.372	.606	.545	.324	-.349	.727	-.066	.449	.205

table III continued:

Constituents Related	Sampling Period	Cow No. 47	53	55	69	74	77	83	84	88	89	93	96
		r	r	r	r	r	r	r	r	r	r	r	r
18[h]	3	-.208	-.174	-.598	-.546	-.570	-.424	-.657	.119	-.534	.487	-.167	-.019
18	6	.166	-.189	-.022	-.044	-.410	.375	-.187	.304	-.520	-.397	-.503	-.000
18	9	-.199	.083	-.090	.045	-.305	-.274	-.344	.362	-.263	-.255	.000	-.580
19[i]	3	.321	.298	-.361	-.675	-.712	-.324	-.384	.266	-.197	.556	-.136	.129
19	6	-.199	-.281	-.156	-.216	-.357	.298	-.199	-.113	-.644	-.736	.453	.012
19	9	.378	-.108	-.260	.121	-.357	-.461	-.377	.667	0.35	-.241	.087	-.324
10[j]	3	.206	.294	.545	.125	-.123	.198	.332	.259	.217	.205	.027	.579
10	6	.412	-.209	-.464	-.162	.144	.363	-.370	.599	.243	.117	-.012	.014
10	9	-.625	-.136	.029	-.144	-.034	.254	.397	-.439	-.010	-.177	-.046	.135
23	3	.882	.822	.732	.811	.751	.962	.856	.957	.836	.858	.952	.808
23	6	.807	.916	.811	.954	.928	.805	.768	.920	.878	.843	.703	.620
23	9	.859	.658	.944	.840	.581	.731	.894	.237	.290	.817	.167	.831
24	3	.552	.448	.520	-.026	-.575	-.543	.398	.496	-.455	.255	.129	.338
24	6	.688	.845	.580	.910	.579	.790	-.026	.873	.767	.545	.314	.401
24	9	.399	.360	-.280	-.129	-.385	-.108	-.403	-.003	-.721	.447	-.723	.145
25	3	.081	-.022	-.047	.098	.155	-.354	.167	.094	.309	.505	.056	-.058
25	6	.028	.054	.693	-.306	.407	-.329	.381	.531	-.078	.596	.515	-.247
25	9	-.131	.612	-.317	.203	.371	.212	.299	.405	-.392	.392	.364	.475

table III continued:

Constituents Related	Sampling Period	Cow No. 47	53	55	69	74	77	83	84	88	89	93	96
		r	r	r	r	r	r	r	r	r	r	r	r
2 6	3	.466	-.399	-.204	-.200	.178	.066	.078	-.112	.342	.272	-.366	.273
2 6	6	-.076	-.046	.672	.223	.551	-.176	.275	.574	-.236	.048	.126	-.566
2 6	9	.162	.044	.789	.513	.513	.056	.545	.583	.476	.060	-.003	.370
2 7	3	-.555	-.251	-.353	-.142	.260	-.144	-.087	-.231	-.025	-.646	.263	-.441
2 7	6	-.553	-.039	.182	-.092	.048	.313	-.098	-.369	.414	-.022	.003	.172
2 7	9	-.230	-.100	.126	-.010	-.434	-.056	.011	-.319	-.096	-.103	-.319	.056
2 8	3	.139	.033	-.112	.083	-.198	-.095	.246	.353	.078	.166	-.407	.150
2 8	6	-.087	-.258	-.094	.120	-.107	.174	-.280	-.365	-.002	-.216	-.064	.166
2 8	9	.352	-.219	.517	.499	.713	.435	.321	-.357	.680	.098	.422	.434
2 9	3	.446	.045	.162	.049	-.041	.574	.180	.604	.320	.189	-.244	.148
2 9	6	.241	-.341	-.375	.240	-.231	-.058	-.177	-.174	-.187	.064	.056	.208
2 9	9	.753	.071	.334	.135	.254	-.232	-.278	-.252	.249	.277	.311	.482
2 0	3	.292	.348	-.211	.319	-.070	.375	-.258	-.172	-.036	.173	.268	-.245
2 0	6	-.408	-.079	.404	.228	.313	.329	.284	.149	.104	-.200	-.187	.247
2 0	9	-.210	-.613	.324	.298	.594	.207	.576	.080	.449	.216	-.044	-.211
3 4	3	.432	.517	.557	.250	-.633	-.529	.582	.528	-.152	.771	.047	.332
3 4	6	.954	.945	.772	.924	.559	.946	.534	.971	.860	.688	.619	.846
3 4	9	.510	.511	-.076	.243	.179	.321	-.453	.250	-.376	.572	.142	.242

table III continued:

Constituents Related	Sampling Period	Cow No. 47 r	53 r	55 r	69 r	74 r	77 r	83 r	84 r	88 r	89 r	93 r	96 r
3 5	3	-.283	.274	.132	.200	.670	-.450	.009	.039	.270	.443	.115	-.236
3 5	6	-.327	.231	.567	-.156	.407	-.545	.486	.561	.229	.632	.382	.262
3 5	9	-.229	.398	-.245	.017	.110	.215	.248	.441	-.462	.232	.163	.235
3 6	3	.581	-.218	.033	-.607	-.308	-.110	.043	.084	.262	.539	-.328	-.085
3 6	6	-.084	.091	.485	.235	.603	-.067	.532	.508	.061	-.107	-.052	-.810
3 6	9	-.052	.049	.680	.330	.243	.256	.460	.150	.560	.134	.275	.468
3 7	3	-.219	-.141	-.285	.023	.416	.009	.095	-.130	-.078	-.470	.212	-.482
3 7	6	-.212	-.029	.138	-.053	.009	.191	-.071	-.170	.410	.083	.231	-.008
3 7	9	.038	.146	.610	.194	.117	.109	.156	-.674	.701	.079	.272	.196
3 8	3	-.031	-.070	-.542	-.253	-.502	-.209	-.142	.409	-.225	.378	-.420	.161
3 8	6	.014	-.318	-.101	.116	-.249	.392	-.555	-.272	-.255	-.419	.312	.136
3 8	9	.115	-.047	.424	.431	.449	.200	.140	.232	.234	.070	.293	.126
3 9	3	.426	.213	-.103	-.356	-.517	.472	-.033	.718	.194	.430	-.263	.311
3 9	6	.153	-.432	-.441	.191	-.340	.127	-.422	-.241	-.494	-.342	.381	.180
3 9	9	.695	-.047	.206	.175	-.071	-.384	-.425	.353	.225	.250	.313	.346
3 0	3	.288	.489	.188	.328	-.123	.421	-.111	-.102	.087	.227	.251	.111
3 0	6	-.205	-.158	.098	.195	.333	.531	.064	.424	.218	-.123	-.174	.215
3 0	9	-.482	-.413	.295	.165	.579	.478	.706	-.285	.330	.350	-.082	-.156

table III continued:

Constituents Related	Sampling Period	Cow No. 47 r	53 r	55 r	69 r	74 r	77 r	83 r	84 r	88 r	89 r	93 r	96 r
4 5	3	-.247	.147	-.039	.461	-.456	.017	.285	.466	.243	.562	.245	-.217
4 5	6	-.331	.249	.698	-.222	.582	-.354	.411	.443	.300	.624	.270	.377
4 5	9	.065	.702	-.190	.102	-.078	.576	.556	.496	.753	.431	-.218	.483
4 6	3	.141	.066	-.042	-.527	.316	-.518	.121	.338	-.258	.729	.610	-.301
4 6	6	-.153	.020	.422	.216	.345	.041	.456	.374	.195	.101	-.211	-.823
4 6	9	-.329	.088	.017	-.214	-.538	.073	-.853	.295	-.378	-.440	-.240	-.036
4 7	3	-.367	-.003	.120	.488	-.136	.387	-.300	.316	.194	.166	.366	-.332
4 7	6	-.082	.097	-.079	-.143	-.136	.130	-.042	-.064	.404	.093	-.181	-.173
4 7	9	-.355	-.181	.080	.073	.041	-.159	-.006	-.185	.103	-.413	.338	.063
4 8	3	.590	.450	-.349	-.477	.675	-.182	-.386	.070	-.611	.240	-.369	.761
4 8	6	.076	-.275	-.205	.096	-.360	.356	-.572	-.142	-.207	-.331	.028	.082
4 8	9	.193	-.271	.125	.065	.000	-.336	-.656	-.413	-.713	-.288	-.411	-.607
4 9	3	.787	.201	.025	-.177	.657	-.220	-.279	.156	-.624	.458	-.558	.601
4 9	6	.178	-.415	-.283	.242	-.387	.117	-.500	-.199	-.481	-.265	.223	.125
4 9	9	.463	-.498	-.023	.016	-.279	-.337	-.565	.119	-.818	.242	-.126	-.561
4 0	3	-.050	.436	.157	.344	.459	-.776	.020	-.250	.197	.054	.390	-.508
4 0	6	-.221	-.247	-.169	.111	.024	.483	-.274	.545	-.050	-.274	-.351	.235
4 0	9	-.462	-.368	-.067	-.430	-.334	.016	-.743	-.618	-.256	-.384	-.495	-.705

table III continued:

Constituents Related	Sampling Period	Cow No. 47	53	55	69	74	77	83	84	88	89	93	96
		r	r	r	r	r	r	r	r	r	r	r	r
5 6	3	-.286	.381	.678	-.324	-.773	.399	.226	-.191	.412	.657	.625	.010
5 6	6	.054	.846	.596	.531	.785	.199	.675	.310	.757	-.119	.402	-.222
5 6	9	-.541	.061	-.826	-.402	.544	.089	-.371	.366	-.485	.235	.203	-.492
5 7	3	-.498	.100	-.633	.017	.633	-.448	-.703	-.194	-.121	-.321	-.361	-.472
5 7	6	-.085	-.119	-.083	.219	-.358	-.119	-.673	-.376	-.201	-.138	-.086	-.128
5 7	9	-.707	-.419	-.385	-.473	-.862	-.628	-.221	-.507	-.185	-.166	-.317	-.467
5 8	3	.255	.052	.374	-.357	-.643	.072	.265	.076	-.165	.006	-.040	-.170
5 8	6	-.427	-.780	-.472	-.332	-.707	-.224	-.755	-.411	-.614	-.208	-.299	.361
5 8	9	-.227	-.614	-.702	.351	-.075	-.268	-.502	-.582	-.710	.303	-.134	-.255
5 9	3	-.203	-.011	-.260	.063	-.665	-.334	-.374	-.133	-.035	.287	-.528	-.556
5 9	6	-.318	-.710	-.456	-.739	-.629	-.064	-.452	-.015	-.518	-.062	-.045	.355
5 9	9	-.327	-.510	-.641	.627	-.094	-.383	-.753	-.359	-.777	.618	-.403	-.139
5 0	3	.160	.140	.142	.651	.135	.035	-.236	.338	.049	-.044	.150	-.189
5 0	6	-.186	-.344	.043	.117	-.111	-.250	-.295	-.138	.218	-.331	.013	.243
5 0	9	-.297	-.778	-.530	-.290	-.229	-.360	-.164	-.637	-.382	-.196	-.202	-.700
6 7	3	-.332	.485	-.298	-.573	-.564	-.826	.319	.345	-.057	-.204	-.250	.188
6 7	6	-.271	-.350	-.342	-.425	-.333	-.465	-.215	-.392	-.492	-.818	-.292	.229
6 7	9	.485	.495	.358	.335	-.259	-.241	.247	-.026	.320	.581	.545	.624

table III continued:

Constituents Related	Sampling Period	Cow No. 47	53	55	69	74	77	83	84	88	89	93	96
		r	r	r	r	r	r	r	r	r	r	r	r
6 8	3	-.102	.054	.010	.676	.695	.371	-.162	.196	.475	.585	-.002	-.439
6 8	6	.132	-.824	-.374	-.782	-.523	-.405	-.861	-.801	-.660	-.148	-.052	-.391
6 8	9	.380	-.506	.813	.118	-.141	.152	.703	-.759	.594	.496	.241	.156
6 9	3	.416	-.201	-.427	.447	.672	.135	-.607	.210	.749	.769	-.451	-.211
6 9	6	.160	-.666	-.254	-.642	-.464	-.338	-.769	-.660	-.492	.405	-.004	-.458
6 9	9	-.012	-.564	.551	-.523	-.447	.122	.388	-.562	.377	.531	-.191	-.090
6 0	3	.270	-.489	-.128	-.325	-.113	.114	-.355	-.282	.233	.032	-.240	-.334
6 0	6	.343	-.203	.058	-.204	.097	-.125	-.134	-.228	-.332	-.547	.235	-.155
6 0	9	.548	-.021	.573	.596	.313	.076	.616	-.356	.643	.441	.603	.321

a. butterfat per cent
b. SNF per cent
c. T.S. (Moj.) per cent
d. T.S. (Cenco) per cent
e. Protein per cent
f. Daily Milk yield (lbs.)
g. Av. Barometric pressure
h. Max. temp. (F.)
i. Min. temp. (F.)
j. Solar radiation (gm.cal./min/cm^2)

Table IV

Coefficients of Correlation Pooled Over Days Within Periods Between Certain Constituents of Holstein Milk and Between Those Constituents and Concurrent Weather Data (5 cows and sample periods in March and June).

Constituents Related	Sample Period	Cow No. 42 r	45 r	52 r	72 r	75 r
1[a] 2[b]	3	.167	.586	.130	-.549	.511
1 2	6	-.315	-.271	-.231	-.066	-.322
1 3[c]	3	.690	.795	.644	.219	.836
1 3	6	.124	.366	.373	.625	.056
1 4[d]	3	.114	.414	.856	.439	-.127
1 4	6	.220	.440	.280	.734	.095
1 5[e]	3	.267	.014	.051	-.155	.480
1 5	6	.428	-.121	.357	-.020	-.348
1 6[f]	3	.638	-.172	.494	-.630	-.253
1 6	6	-.547	-.101	-.282	-.115	-.156
1 7[g]	3	.224	.200	.018	.055	.224
1 7	6	.510	.201	-.082	-.097	.424
1 8[h]	3	-.689	-.740	-.214	-.224	-.368
1 8	6	.537	-.271	.155	.013	.331
1 9[i]	3	-.310	-.551	-.016	-.498	.031
1 9	6	.155	-.255	.094	.207	.084
1 0[j]	3	.513	.007	.388	-.179	.516
1 0	6	.660	.069	.352	-.277	.024
2 3	3	.829	.958	.842	.695	.899
2 3	6	.495	.797	.816	.737	.927
2 4	3	-.185	.066	.032	.111	-.365
2 4	6	.370	.616	.847	.420	.786
2 5	3	.002	.132	.193	.293	-.087
2 5	6	-.214	.068	-.285	-.279	.193
2 6	3	-.160	-.135	-.014	.053	-.098
2 6	6	.503	-.036	-.542	-.487	.076

table IV continued:

Constituents Related	Sample Period	Cow No. 42 r	45 r	52 r	72 r	75 r
2 7	3	-.539	-.216	-.242	.037	-.190
2 7	6	-.497	.095	.018	-.238	-.417
2 8	3	-.310	-.523	-.267	-.341	.044
2 8	6	-.456	.347	-.274	-.439	.139
2 9	3	.062	-.124	.028	.137	.640
2 9	6	-.079	.099	-.204	-.256	.240
2 0	3	-.025	.075	.280	.218	.237
2 0	6	.064	.325	-.315	-.318	.064
3 4	3	-.079	.197	.486	.610	-.268
3 4	6	.955	.872	.974	.826	.867
3 5	3	.152	.103	.177	.209	.189
3 5	6	-.198	-.010	-.069	-.232	.065
3 6	3	.245	-.162	.257	-.480	-.192
3 6	6	-.116	-.098	-.684	-.458	.018
3 7	3	-.269	-.090	-.177	.090	-.007
3 7	6	-.410	.217	-.032	-.252	-.272
3 8	3	-.619	-.655	-.323	-.591	-.160
3 8	6	.051	.165	-.170	-.335	.277
3 9	3	-.131	-.289	.012	-.268	.424
3 9	6	.410	-.065	-.139	-.060	.286
3 0	3	.273	.059	.427	.101	.414
3 0	6	-.069	.358	-.091	-.436	.077
4 5	3	-.168	.017	.325	.630	.333
4 5	6	-.276	.120	-.061	-.040	.051
4 6	3	.185	.607	.422	-.710	-.232
4 6	6	-.082	.029	-.770	-.196	.094
4 7	3	-.057	-.494	.193	.377	.655
4 7	6	-.324	.336	-.143	-.219	-.124
4 8	3	.507	-.183	-.085	-.600	-.187
4 8	6	.047	.017	-.112	-.266	.064
4 9	3	.638	-.209	-.067	-.436	-.323
4 9	6	.351	-.299	.027	.022	-.017

table IV continued:

Constituents Related	Sample Period	Cow No. 42 r	45 r	52 r	72 r	75 r
4 0	3	.034	-.251	.246	.197	.251
4 0	6	-.036	.516	-.205	-.305	.264
5 6	3	.161	.010	.191	-.287	-.344
5 6	6	-.243	-.356	-.199	-.175	-.569
5 7	3	.536	-.300	-.129	.376	.450
5 7	6	.322	.484	.392	-.049	.295
5 8	3	-.110	.172	.595	-.393	-.525
5 8	6	.170	.301	.682	-.128	.132
5 9	3	.037	.407	.492	-.012	-.441
5 9	6	-.104	-.106	.500	-.090	-.085
5 0	3	.294	.189	-.010	.645	.169
5 0	6	.319	.845	.252	-.397	.397
6 7	3	.452	-.736	-.299	-.356	-.499
6 7	6	-.460	-.708	.242	.165	-.540
6 8	3	-.575	.142	.105	.191	-.132
6 8	6	-.870	-.714	-.299	-.261	-.720
6 9	3	-.057	-.088	.397	.280	-.410
6 9	6	-.627	-.350	-.483	-.424	-.407
6 0	3	.154	-.240	.135	-.070	-.084
6 0	6	-.254	-.356	.054	.472	-.349

a. butterfat per cent
b. SNF per cent
c. T.S. (Moj.) per cent
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e. Protein per cent
f. Daily Milk yield (lbs.)
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Master of Science

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THESIS TITLE: A STUDY OF CERTAIN CHARACTERISTICS OF HOLSTEIN MILK

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