JOURNAL OF DAIRY SCIENCE

Contents

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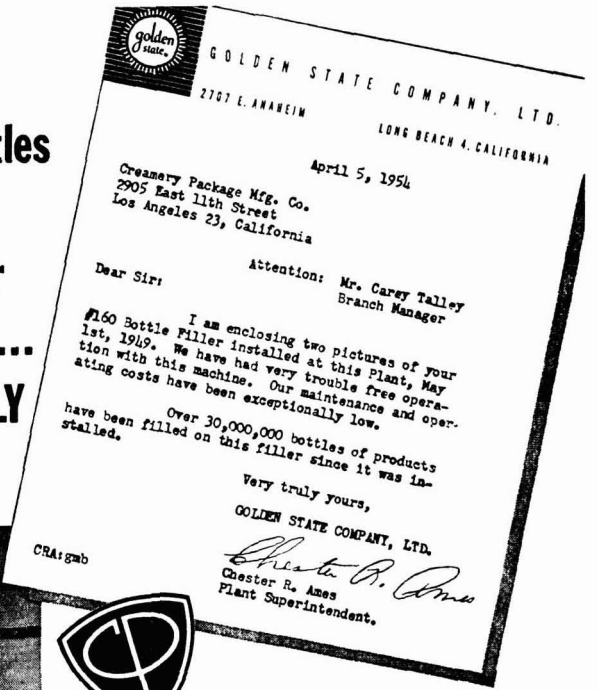

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April 5, 1954

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CELL COUNTS OF PLATFORM SAMPLES OF HERD MILK

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Many reports have appeared in the literature regarding the leucocyte counts of milk from healthy cows and cows with infected udders. Cherrington *et al. (3)* found the average cell count per milliliter of milk from healthy cows to be 43,000 and the average from diseased cows to be 3,000,000. Chu *(4)* in 1949 stated that the total cell count of 100,000 per milliliter, which had been generally regarded as the borderline for normal milk, was too high.

Few studies have been published on the cell counts of mixed herd milk as received for processing at milk plants. MacLeod and Anderson *(7)* in a study of the cell counts of morning and evening samples of herd milk over a 17-month period found that the geometric average cell count of morning samples was 275,000 cells per milliliter and that of the evening samples 289,000.

This article reports a study undertaken to investigate cell counts of platform samples of mixed herd milk as received by two large processing plants in Connecticut over an 11.5-month period.

PROCEDURE

Leucocyte counts. Weekly samples of the milk from 39 herds during the period from March 1, 1946, to February 15, 1947, were taken at the receiving platform. Films of the milk samples were made, stained, and examined microscopically in accordance with standard procedures *(1)*. Cell counts of the herd milk were recorded in millions of cells per milliliter, and these recorded counts were converted to logarithms for statistical analysis.

Percentage of mastitis animals within herds. The results of the laboratory examination of the milk from the individual cows of a large majority of the herds included in this study were obtained from the Department of Animal Diseases of the University of Connecticut. Not all herds were tested each month; actually the examinations were spaced on the average 2 to 3 months apart *(8)*.

Statistical analysis. The mean percentages of mastitis animals within the herds tested were calculated for each of the six bimonthly intervals of the period under observation. Beginning with the period from March 1 to March 15 the cell

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counts[1] of milk were averaged for all samples received during each successive 2-week period. The resulting 23 biweekly mean counts[2] comprised the leucocyte data analyzed in this study. The period from March 1 to March 15, 1946, was assigned a value of 1, the period from March 16 to March 31, a value of 2, continuing until the 23rd interval from February 1 to February 15, 1947.

The best fitting polynomial function of the biweekly mean count of the herd milk (Y) on successive biweekly intervals (X) was fitted by the method of least squares *(5, 6)*.

RESULTS AND DISCUSSION

A total of 1,707 milk samples were examined; 1,053 of these were received at one plant and the remaining 654 at the second milk plant. The logarithmic mean count of the herd milk for the entire 11.5-month period was 5.67, corresponding to a geometric mean count of 470,000 cells per milliliter. This is a relatively high cell count for herd milk when compared to that of 275,000 for morning and 289,000 for evening samples of milk from one herd (44 animals) over a 17-month period as reported by MacLeod and Anderson *(7)*. Possibly of more importance was the fact that the milk from a selected group of 10 healthy animals within this herd *(7)* over a 40-week period had a geometric mean cell count of approximately 70,000 cells per milliliter.

TABLE 1

Biweekly logarithmic and geometric mean counts of herd milk delivered to two processing plants and the percentages of mastitis animals within herds

Period of tests		Mean cell counts per ml.		Bimonthly mean percentages of mastitis animals within herds
Date	Assigned value	Logarithmic	Geometric	
1946-47				
Mar. 1-Mar. 15	1	5.81	650,000	
Mar. 16-Mar. 31	2	5.72	520,000	18.8
Apr. 1-Apr. 15	3	5.71	510,000	
Apr. 16-Apr. 30	4	5.68	480,000	
May 1-May 15.	5	5.68	480,000	
May 16-May 31	6	5.66	460,000	16.7
June 1-June 15	7	5.44	350,000	
June 16-June 30	8	5.61	410,000	
July 1-July 15	9	5.83	680,000	
July 16-July 31	10	5.83	680,000	28.6
Aug. 1-Aug. 15	11	5.82	660,000	
Aug. 16-Aug. 31	12	5.85	710,000	
Sept. 1-Sept. 15	13	5.90	790,000	
Sept. 16-Sept. 30	14	5.72	520,000	22.3
Oct. 1-Oct. 15	15	5.80	630,000	
Oct. 16-Oct. 31	16	5.61	410,000	
Nov. 1-Nov. 15	17	5.53	340,000	
Nov. 16-Nov. 30	18	5.58	380,000	20.8
Dec. 1-Dec. 15	19	5.74	550,000	
Dec. 16-Dec. 31	20	5.78	600,000	
Jan. 1-Jan. 15	21	5.56	360,000	
Jan. 16-Jan. 31	22	5.15	140,000	20.3
Feb. 1-Feb. 15	23	5.33	210,000	
	Average	5.67	470,000	

[1] Cell counts refer to the logarithms of the actual counts.

[2] Mean counts refer to logarithmic average counts.

TABLE 2
Analysis of regression

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Linear term	1	0.1277	0.1277	7.47[a]
Quadratic term	1	0.1510	0.1510	8.83[b]
Cubic term	1	0.1070	0.1070	6.26[a]
Quartic term	1	0.0126	0.0126	—
Remainder	18	0.3070	0.0171	—
Total	22	0.7053	—	—

[a] $P = < 0.05$
[b] $P = < 0.01$

The mean counts of the herd milk for the various 2-week time intervals from March, 1946, to February 15, 1947, and the mean percentage of mastitis animals within the herds calculated for the six bimonthly intervals covered by the experiment are given in Table 1.

The analysis of the various trends contributing to the regression curve fitted to the leucocyte data is given in Table 2.

It is evident from Table 2 that the linear, quadratic, and cubic terms of the regression are of sufficient magnitude to be statistically significant; consequently a third order polynomial function of the logarithmic leucocyte count on successive biweekly time intervals was fitted and was as follows:

$$Y = 5.8284 - 0.0667X + 0.0087X^2 - 0.0003X^3$$

In a previous publication *(8)* it was found that 78% of the variation in the mean leucocyte count of herd milk may be explained in terms of the mean percentage of infection within the herd. It is apparent from Table 1 that during the period under study the incidence of mastitis animals within the herds examined was highest during July and August and lowest during March, April, May, and June. The leucocyte count of herd milk was highest during July,

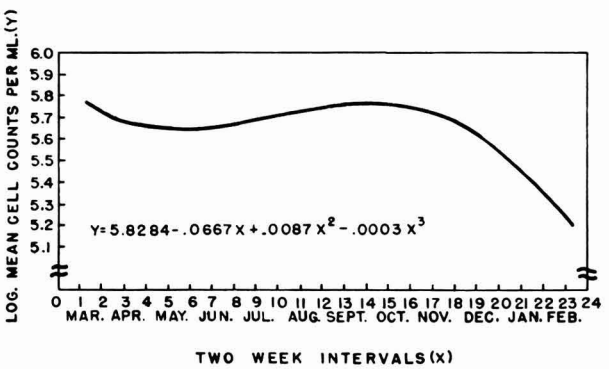

FIG. 1. Regression curve depicting the magnitude of biweekly mean leucocyte counts of mixed herd milk sampled at the receiving platform of milk processing plants, over an 11.5-month period.

August, September, and the first part of October and lowest during January and February. It might have been expected that when the percentage of mastitis animals within the herds was at its lowest, the leucocyte count would have been correspondingly low. This was not always the case. These data suggest that perhaps factors other than the incidence of mastitis may be involved in the magnitude of the leucocyte counts of herd milk during the winter months. It may be possible that physical factors, such as weather conditions and the increased exercise involved in pasture grazing, are considerations that contribute to the fluctuations in the magnitude of the cell counts of herd milk. In general in most parts of the country during winter, cows have less chance to exercise, have more chance to rest, and are not subjected directly to as many climatic changes as during the summer months. It has been established *(7)* that morning milk samples have significantly fewer leucocytes than evening samples. This difference in the magnitude of the cell counts may be due in part to the cows being at rest for a considerable time prior to the morning milking period. Until further experiments have been conducted and substantiating data obtained, no conclusions may be drawn as to the presence of seasonal or cyclic trends in the leucocyte count of herd milk sampled at the receiving platform of processing plants.

SUMMARY

The leucocyte counts of 1,707 platform samples of milk from 39 herds were determined for an 11.5-month period. This period was divided into 23 2-week intervals, and the logarithmetic average count of the herd milk for each period was calculated. The geometric mean cell count of the herd milk was approximately 500,000 cells per milliliter for the entire period. A polynomial function of logarithmic mean cell count on biweekly intervals was fitted to depict the leucocyte counts of herd milk over an 11.5-month period. In this study, although there was considerable variation from month to month in the leucocyte counts of herd milk, the cell counts were generally highest in the summer and lowest in the winter. The mean percentage of mastitis animals was at its highest during the late summer and lowest during the spring and early summer. The results suggest that factors other than the number of mastitis animals within a herd may affect the leucocyte counts of herd milk during the midwinter months.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to the Brock-Hall Dairy Co., Inc., Hamden, Conn., and General Ice Cream Corp., Bryant and Chapman Division, Hartford, Conn., for their cooperation in furnishing samples of mixed herd milk.

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HISTOCHEMICAL STUDIES OF FAT METABOLISM IN MAMMARY GLANDS OF LACTATING COWS[1, 2]

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Although it is generally conceded that the longer chain fatty acids of milk fat are derived for the most part from the neutral fat of blood, the form in which neutral fat passes into the mammary gland tissue and the exact mechanism of synthetic transformation of the neutral fat into milk fat are still unknown.

Kelly and Petersen *(3)* reported finding large amounts of fatty acids located predominantly in the basal portions of the alveolar cells of lactating bovine mammary glands and neutral fat distributed at the distal end. Since most of the longer chain fatty acids of milk are derived from blood fat *(2, 5, 8, 9)*, this suggested the possibility that free fatty acids pass into the epithelial cells as such following hydrolysis of the neutral fat or that the fat is hydrolyzed to fatty acids immediately after entering the cells and resynthesized to neutral fat in the distal portion of the cell. Shaw and Petersen *(9)* obtained evidence that distention of the alveoli was needed to obtain normal passage of blood fat into the mammary gland. In the latter studies one half of the udder was milked out while the other half was left distended. Arteriovenous studies revealed a normal uptake of blood fat by the distended half of the udder but no withdrawal of fat from the blood traversing the half of the udder which had been milked out. It was noted, further, that the intravenous injection of oxytocin stopped the passage of blood fat into the mammary gland, presumably because of the constriction of the alveoli resulting in a lowered permeability of the basement membrane. The uptake of the more freely diffusible substances, such as glucose and amino acids, was not affected by the above procedures. These studies suggest that particle size is important in the passage of fat into the mammary gland and support the view that fat passes into the epithelial cells as larger particles rather than as the more diffusible fatty acids.

Since there is no completely satisfactory method for the differentiation of the various lipids, it appeared that some of the data presented by Kelly and Petersen, from which they concluded that there were large amounts of fatty acids in the basal portions of the secretory cells, might be subject to a different interpretation. It seemed advisable to repeat this work and to use additional staining methods as an aid in the interpretation of the results. It was the purpose of this study to attempt, through the medium of histochemical techniques, to

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[1] Scientific article No. A450, contribution No. 2514 of the Maryland Agricultural Experiment Station.

[2] Part of the experimental data in this paper is taken from a thesis submitted by M. L. Yamin-Smith in partial fulfillment of the requirements for the degree of Master of Science in zoology, University of Maryland.

ascertain the distribution of lipids in the secretory cells of the mammary gland and from their position in the cells *(a)* to attempt to determine the form in which blood fat passes into the secretory cells and *(b)* to obtain information regarding the synthesis of fat within the cells.

EXPERIMENTAL PROCEDURE

Mammary gland tissue was obtained from the active glands of three dairy cows in mid-lactation. The tissue was excised ante-mortem (immediately after stunning and before bleeding the animal) and post-mortem at certain intervals (½, 1, 2, and 4 hours). Immediately after removing the tissue from the gland it was fixed in 10% neutral formalin solution to which 5% phenol was added to stop lipase activity. After fixation for 24 hours, the tissue was cut with a freezing microtome into thin sections (15μ) and stained within a few hours with neutral red, brilliant cresyl blue, nile blue sulfate, Sudan IV, Oil Red O, osmic acid, and Weigert's hematoxylin-borax-ferricyanide solution (Fischler's method). For the last method the tissue was first fixed in saturated calcium salicylate solution containing 10% formalin. Paraffin sections also were prepared and stained by the hematoxylin-eosin method. The Schultz method was used for the detection of cholesterol. All staining was done by the classical techniques *(4, 7)*. Some of the tissue was incubated for several hours at 37° C. in saline solution to which 1% sulfanilamide was added, after which it was placed in the proper fixative.

Since many of the staining materials used were basic and could stain the protoplasm of the secretory cells and other nonfatty substances of the cells in addition to fat, it was deemed necessary to extract the fatty material from some of the slides of the frozen sections for purposes of comparison. Thus some of the slides were passed from water, successively, to 85-95% alcohol, absolute alcohol, a mixture of absolute alcohol and ether, xylol, and thence returned again to water by reversed order through the same substances.

RESULTS

The slides of frozen sections which were stained with neutral red, and which ordinarily stains fatty acids intense red and neutral fat a pale yellow, showed a picture (Figure 1) similar to that reported by Kelly and Petersen, although these authors referred only to a "deep stain" along the base of the secretory cells which they assumed to be free fatty acids. In the present study, neutral red resulted in a red-brown area along the basement membrane as well as the distal part of the secretory cells, with more or less large yellow droplets at the distal part of the cells. Granules of the same color were also seen scattered throughout the secretory cells. It was noted that this red-brown area was dull and not of the brilliant intense color which the neutral red indicator usually gives in acid medium such as might be expected if large amounts of fatty acids were present. Dark brown spots could be seen in both the proximal and distal parts of the secretory cells in places in which there was an absence of neutral

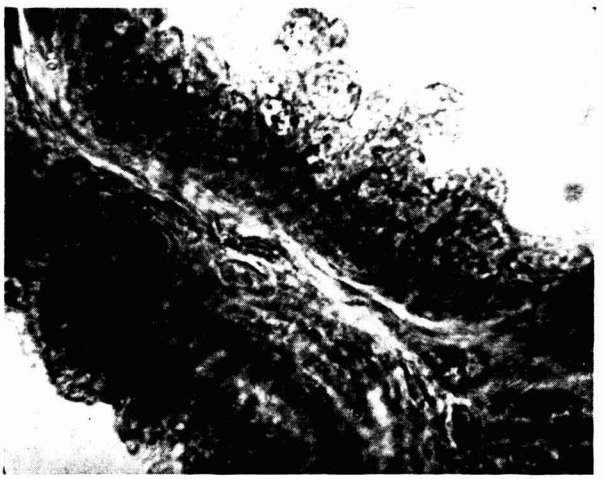

FIG. 1. Frozen section, stained with neutral red. Note deep stained area along the basement membrane and scattered dark dots, as well as light stained dots or circles (neutral fat) at the distal part of the secretory cells (960 X).

fat globules. Frozen sections stained with neutral red, after the removal of all fatty substances, still exhibited these red-brown areas or spots as well as granules (Figure 2), indicating that the red-brown areas did not represent fatty acids.

Brilliant cresyl blue, which presumably stains fatty acids deep blue and leaves fat unstained, produced a dark blue area along the basement membrane. After removal of all fatty substances, this area again stained dark blue with brilliant cresyl blue.

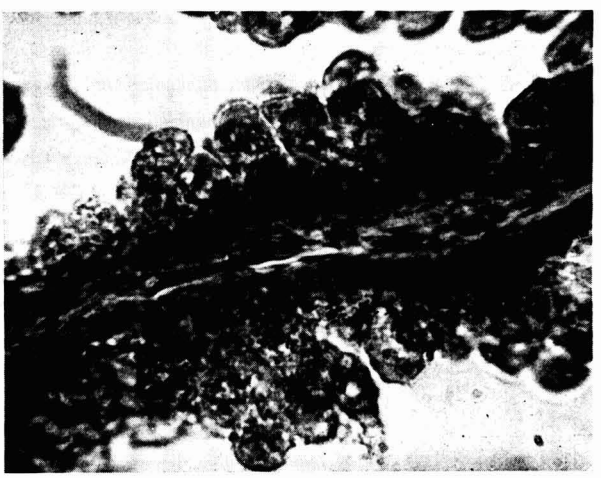

FIG. 2. Frozen section, stained with neutral red after extraction of lipids. Note the persistence of a deeply stained area along the basement membrane and scattered dark dots, as well as light stained circles at the distal part of the secretory cells (960 X).

Nile blue sulfate stains neutral fats pink or red and is believed by some to stain the fatty acids and other lipids violet or blue. With this stain the neutral fat of mammary gland sections was stained a pinkish purple. Dark blue granules, as well as dark blue areas toward the proximal part of the epithelial cells, were also observed. Kelly and Petersen assumed that this was due to the presence of fatty acids. However, as will be noted in Figure 3, after the removal of the fat substances prior to staining, these areas as well as the granules failed to disappear.

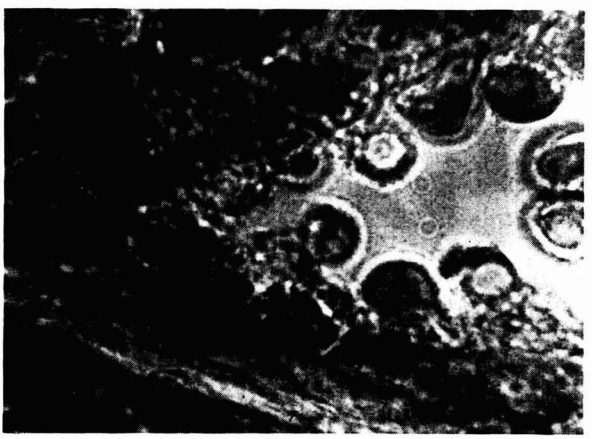

FIG. 3. Frozen section stained with nile blue sulfate after extraction of lipids. Note deeply stained area along the basement membrane and scattered dark dots, as well as light circles at the distal part of the secretory cells (1920 X).

With Sudan IV, which stains neutral fat red and leaves fatty acids unstained, the small and large fat droplets stained red. It was noted that even the smallest droplets, at the verge of visibility, located near the basement membrane were stained red. An unstained area along the basement membrane failed to appear. Such an area would have indicated fatty acids.

Oil Red O, which stains the fats and lipids a brilliant deep orange, and osmic acid, a general fat stain which stains fats black, both gave positive reactions with all fat droplets dispersed throughout the protoplasm of the secretory cells. The large droplets were at the distal part, and the small ones were at the proximal part of the cells. The small fat droplets located at the proximal part of the cells were not as numerous as had been expected.

Frozen sections stained according to Fischler's method for fatty acids (Figure 4) failed to reveal the deep stained areas which showed up with neutral red. Dark blue stained dots, probably protoplasmic or secretory granules, were observed scattered through the protoplasm of the secretory cells. The neutral fats remained unstained. After incubation of the tissue the number, as well as the size, of the dark dots was noticeably increased in proportion to the time of incubation. These dark dots can be seen in Figure 5 showing tissue which was

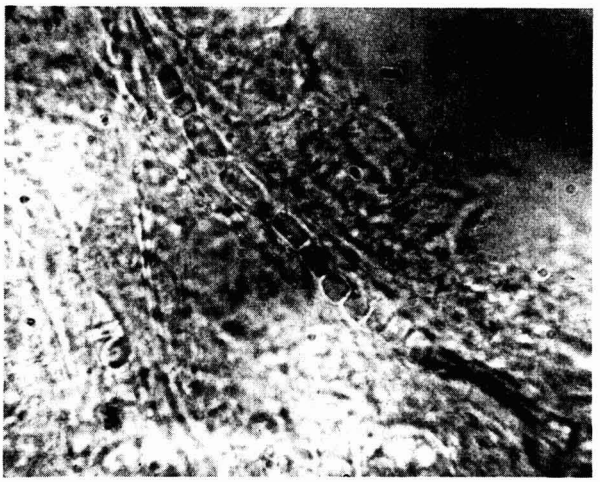

FIG. 4. Frozen section stained according to Fischler's Method for staining fatty acids. Note the absence of a deeply stained area along the basement membrane and the presence only of scattered small dark dots (960 X).

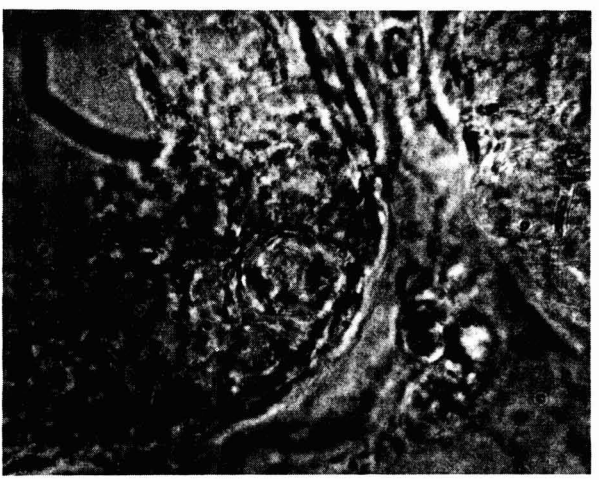

FIG. 5. Frozen section of incubated tissues stained as above (Fig. 4). Note the increase in number and size of dark granules (free fatty acids), especially at the middle part of the secretory cells (960 X).

incubated for 9 hours at 37° C. prior to freezing and staining, as contrasted to Figure 4 showing tissue from the same gland which was placed in the proper fixative immediately after stunning the animal. The acid value of the neutral fat-fatty acid fraction of the lipids of tissue frozen immediately after stunning was 9.31 and after incubation, 68.10. This shows that the free fatty acids can be detected when a sufficient amount is present.

In paraffin sections stained with hematoxylin-eosin, the nucleus of the secretory cells was observed in the protoplasmic part adjacent to the basement membrane, whereas the fatty droplets of various sizes and number were located toward the distal part (Figure 6). There was no evidence of clear areas which would suggest the presence of extractable fat substances along the basement membrane. By the use of such stains as nile blue sulfate, brilliant cresyl blue, and the Fischler stain, a halo of dark particles was observed to approximate the

FIG. 6. Paraffin section. Note the location of the nuclei adjacent to the basement membrane and the fat droplets (light circles) at the distal part of the secretory cells (hematoxylin-eosin stain, 960 X).

borders of the neutral fat droplets. The coloring of the stained particles was somewhat characteristic of fatty acids and at first they were thought to be fatty acids. However, when all of the fatty material was removed by extraction and the sections then stained, the particles still could be seen. It appears, therefore, that these particles represent protoplasmic granules thrust back on the periphery by the pressure of the increasing size of the fat globules.

The cholesterol test yielded positive results. Most of the cholesterol droplets were found at the free end of the cells of the acinus; that is, they were in the supra-nuclear position but not adjacent to the free border of the secretory cells. Gomori *(1)* states that this reaction may be considered absolutely specific for cholesterol and its esters.

DISCUSSION

The neutral red stain failed to show clearly the presence of fatty acids at the proximal part of the cell. The dull brown-red stained areas or spots observed at the proximal part of the secretory cells lacked precise location and distinct brilliance and failed to disappear after a complete extraction of the lipids. These spots, therefore, could not have been fatty acids; most likely they were artifacts

brought about by the effect of the dye upon the protoplasm and nuclei of the cells (myoepithelial), which are more numerous along the basement membrane, and/or by precipitation of the dye on protoplasmic granules in abundance and the presence of small droplets of neutral fat. According to Gomori *(1)*, intense red staining by neutral red is highly suggestive of fatty acids, but no such intense red was observed. Brilliant cresyl blue, a rather general fat stain, gave no indication of the presence of fatty acids.

Nile blue sulfate, after the extraction of the lipids, gave a visual image similar to the slides in which the lipids were not extracted, producing dark blue dots which were apparently protoplasmic granules in the areas free from neutral fat. A criticism of the reliability of nile blue sulfate for the differentiation of fatty substances was made by Lison *(6)* and others some time ago. At the present time it is believed that the blue stained material resulting from the use of this dye cannot even be interpreted as a fat substance since this dye may also stain common cellular elements blue.

Scarlet IV showed droplets of neutral fat of all sizes distributed over the entire protoplasm of the cells. Areas along the proximal part of the cells which were stained dark red by neutral red, or dark blue by nile blue sulfate, revealed the presence of nuclei and protoplasmic granules and numerous very small droplets of neutral fat beyond the nuclei.

Fischler's method for staining fatty acids has been criticized as unsuitable since other substances (calcium, iron granules) also can be stained dark blue *(6)*. Its use in this laboratory on various tissues revealed that the granules of the alpha cells of the pituitary, the granules of the eosinophils and mastocytes, and the protoplasmic granules of mammary glands also react positively. However, as far as the mammary gland is concerned, Fischler's method can be used for differentiation if suitable controls are used, since, in addition to the fatty acids, proto plasmic granules also may be stained dark blue, but in this case the small size and even distribution of these granules throughout the cytoplasm of the cell can serve for their identification. Gomori *(1)* states that the Fischler reaction is specific for fatty acids if suitable controls are used. The absence of dark stained areas at the proximal part of the secretory cells excludes the possibility of the presence there of any appreciable amount of fatty acids. In incubated tissue, the increase in number and in size of the dark dots near the middle zone of the cells, in which usually small and medium-sized droplets of neutral fat are present, suggest the conversion of the small droplets of neutral fat to fatty acids by lipase activity.

The various staining media now available are not sufficiently specific to demonstrate precisely the presence or absence of fatty acids in protoplasmic material *(6)*. Therefore, it cannot be stated, categorically, on the basis of our present study that fatty acids are not present in the basal part of the secretory cells of the mammary gland. However, there was no indication of the presence of fatty acids, and the bulk of the evidence favors the view that fatty acids, as such, are not present in appreciable amounts in the basal part of the cell. If free fatty acids are formed by hydrolysis of blood fat in the passage of fat from the blood

into the secretory cells, or by hydrolysis within the proximal part of the cell, they must be converted into fat molecules very rapidly within the cells.

CONCLUSION

From a comparison of the reactions given by the use of various staining methods for fatty substances in sections of bovine mammary gland tissue, with or without lipid material removed, there is no evidence that free fatty acids are present in appreciable amounts in the proximal part of the secretory cells. All fatty droplets, from the largest, located at the free end of the secretory cells, to the smallest, occuping the middle space, appear to be neutral fat.

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EXPERIMENTS WITH ION-SELECTIVE MEMBRANES. I. THE ELECTROLYTIC DEIONIZATION OF PROTEIN-FREE WHEY

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The deionization of aqueous solutions by electrodialysis has been used for many years *(6, 10, 11, 12)*. Kato *(9)*, Wiechers *(1, 2, 13)*, and others have employed electrodialysis for the deionization of milk and whey. However, electrodialysis employing nonselective or weakly ion-selective membranes such as parchment, cellophane, or treated cloth is limited to cells composed of three compartments: anode, middle, and cathode. Some further separation of the anions (or cations) has been achieved by inserting one or two membranes between the anode (or cathode) and the middle cell, but the unit remains essentially a three-compartment cell.

The introduction of ion-selective membranes for the electrolytic deionization of water of high salt content employing multicompartment cells (50 or more membranes) *(8)* suggested the use of these membranes for the deionization of whey. The experiments described below present the results of investigations on the deionization of various kinds of milk whey with ion-selective membranes.

EXPERIMENTAL PROCEDURE

Electrolytic cell. The electrolytic cell of the type used for the separation of amino acids *(cf. 3)* was modified to have 15 compartments between electrode compartments instead of one (Figure 1). When the cell is in operation, eight

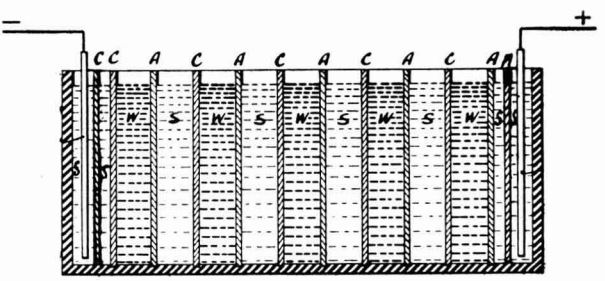

FIG. 1. Electrodialysis cell. W = whey compartment; S = saline compartment; A = anion permeable membrane; C = cation permeable membrane.

compartments contain whey and seven compartments contain salt solution. The first whey compartment is separated from the anode compartment by an anion permeable membrane and from the adjoining salt compartment by a cation permeable membrane. The whey and salt compartments, as well as the anion and cation permeable membranes, alternate in this way across the cell, and the

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final whey compartment is separated from the cathode by a cation permeable membrane. However, in cases where the whey contains cations which form insoluble hydroxides, e.g., Fe^{+++}, it is preferable to have a salt compartment between the cathode and the final whey compartment. In this case the salt compartment is separated from the cathode and from the adjacent whey compartment by cation permeable membranes. Thus, if the pH of the compartment adjacent to the cathode should rise because of the back diffusion of OH^- ions from the cathode department, $Fe(OH)_3$ will be precipitated in the salt compartment and not in the whey. When the cell is in operation, the anions of the whey are displaced into the adjacent compartment on the anode side and the cations into the adjacent compartment on the cathode side.

The electrode compartments are $8.5 \times 7.5 \times 5.0$ cm. and the intervening compartments are each $8.5 \times 7.5 \times 1.2$ cm. The ion selective membranes are Amberplex C_1 and A_1, supplied by the Rohm and Haas Company, Philadelphia, Pa. Six carbon rods clamped in a buss bar are used as a cathode, and a thin sheet of platinum foil serves as an anode. The surface area of the cathode is about 85 sq. cm. and the anode area is 50 sq. cm. A 100-w. light bulb is connected in series along with an ammeter, and a volt meter is connected in parallel to the anode and cathode. The use of a light bulb in series allows the potential drop across the cell to vary directly with the resistance of the cell. However, the maximum voltage has, of necessity, been limited to 115 v., d.c.

Operation of cell. After preliminary experiments had shown that a lactose-NaCl solution could be almost completely deionized with a loss of lactose due to diffusion of less than 1%, the following type of experiment was carried out.

Sixty-five ml. of deproteinized whey *(4)* are added to each of the eight whey compartments, and an equal amount of 0.025% NaCl solution is placed in each of the salt compartments. The initial amperage is about 600 ma. and the initial voltage about 50 v. Changes in amperage and voltage readings are recorded every 10 minutes, and the electrodialysis is continued until the amperage falls to about 25 ma. The time required is about 200 minutes. At this time the whey compartments are emptied and the contents are anaylzed for reducing sugar, ash, and nitrogen, and organic acids *(14)*. The power consumption is calculated by measuring the area under a Watt-time curve.

Analytical methods. The amount of reducing sugar in the whey is determined before and after deionization by the method of Folin and Wu *(7)*. The deionized whey is dried under vacuum, and the ash content of the dried whey is determined by the method described for lactose in the U.S. Pharmacopoeia. Total nitrogen is determined by the Kjeldahl method and organic acids by paper chromatography *(14)*.

Preparation of whey. Milk whey containing 0.5-0.6% of protein cannot be used successfully in the electrolytic cell because the protein will collect both on the surface and in the pores of the cation permeable membrane. This deposition of protein impedes the flow of current and eventually destroys the membranes. Consequently, the whey must be deproteinized.

Conventionally, whey is deproteinized by heat coagulation. The filtrate from

this process contains a proteinous material which is precipitated by trichloroacetic acid *(4)*. In order to reduce the protein content of the whey as much as possible, the proteins are precipitated with ferric chloride *(4)*. When the whey is prepared by precipitating the casein from skimmilk with acid (HCl, H_2SO_4, H_3PO_4, etc.), the resulting whey is called "acid whey." When commercial cheese whey is used as the starting material, the whey is designated "cheese whey."

Acid and cheese wheys were deproteinized by both heat coagulation and precipitation of the proteins with $FeCl_3$. Less residual proteinaceous materials remain in acid whey than in cheese whey following "deproteinization" by heat or by the $FeCl_3$ method. However, $FeCl_3$ deproteinization of either type of whey is much superior to heat coagulation *(4)*.

Deproteinization of cheese whey by ferric chloride has a disadvantage in that the excess Fe^{+++} remaining in solution after precipitation of the proteins appears to be chelated with the organic acids (lactic, citric, etc.) of the whey and with the residual polypeptides. This phenomenon is not observed in $FeCl_3$-acid whey. The iron chelates in cheese whey do not move in the electrical field and thus remain in the whey compartments. However, if sufficient sodium dithionite is added to the $FeCl_3$ whey to reduce all the iron to the ferrous state *(5)*, the chelates are broken up and the iron behaves as a cation.

RESULTS AND DISCUSSION

Electrodialysis of $FeCl_3$-acid whey. The electrodialysis of whey deproteinized with $FeCl_3$ gives essentially the same results as those obtained with a lactose-salt solution; that is, there is no loss of lactose by diffusion during the electrodialysis (Table 1). However, there is some loss of lactose from whey which has been deproteinized by heating. When whey proteins are precipitated by holding

TABLE 1

Operating conditions and analytical results on whey solids obtained by the electrodialysis of $FeCl_3$-acid whey

	Operating conditions				
Experiment No.	7	9	10	11	12
Volume of whey *(ml.)*	460	475	500	500	500
Initial pH of whey	4.3	7.0	7.4	2.0	4.3
Final pH of whey	3.9	5.1	5.6		4.5
Maximum amperage *(ma.)*	600	585	620	560	500
Minimum amperage *(ma.)*	18	25	32	27	33
Maximum voltage *(v.)*	110	112	108	110	112
Minimum voltage *(v.)*	49	49	43	56	65
Total power consumption *(kw.-hr.)*	.050	.040	.050	.055	.045
Power consumption/kilo lactose *(kw.-hr.)*	2.71		2.37	2.89	2.25
Time of electrodialysis *(min.)*	200	120	185	300	180
	Analytical results				
Initial reducing sugar *(%)*		5.7	5.2		4.2
Final reducing sugar *(%)*		5.7	5.2		3.9
Lactose in whey *(% by weight)*	4.0		4.5	4.0	3.9
Nitrogen in whey solids *(%)*	0.36	0.74	0.41	0.34	0.62
Ash in whey solids *(%)*	0.25	1.50	1.55	0.39	0.62

the whey at 95° C. for 2 hours[1] there is always some protein left in solution *(cf.4)*. On electrodialysis, most of this soluble protein precipitates. This precipitate has been found to contain lactose, and most of the loss in lactose can be accounted for in this precipitate rather than by diffusion into the salt compartments of the cell.

The ash and nitrogen content of dried, deionized whey and of $FeCl_3$-acid whey averages about 0.32 and 0.37%, respectively, if the pH of the whey is below 4.5. However, if the pH of the whey is increased above 4.5, the ash content of the deionized whey also increases. When whey is electrodialyzed at pH 7, the ash content of the dried, deionized whey is about 1.5%. This ash is very red in color, which indicates the presence of iron. Apparently the solubility of the iron decreases as the pH increases above 4.5. Consequently, in order to remove iron, $FeCl_3$-acid whey must be electrodialyzed at a pH below 4.5.

The nitrogen content of whey which was electrodialyzed at pH 7 is also higher than that in whey electrodialyzed at a pH below 4.5. This may be due to the presence of greater amounts of low molecular weight polypeptides and other N_2-containing compounds.

The power requirement to deionize 500 ml. of $FeCl_3$-acid whey is about 0.050 kw.-hr. Consequently, the power required to produce 1 kg. of lactose would be about 2.6 kw.-hr.

During electrodialysis the pH of the whey always falls slightly. This is due to the fact that the membranes are less selective toward the hydrogen ion than they are toward the other ions.

Electrodialysis of $FeCl_3$-cheese whey. In the initial experiments with $FeCl_3$-cheese whey it soon became evident that this whey did not deionize as completely as $FeCl_3$-acid whey (Table 2). Here again the principal ash constituent was iron. However, in this case, the iron cannot be removed by lowering the pH of the whey. Apparently the lactic acid present in cheese whey forms a chelate complex with ferric ions, and this complex is stable at a pH as low as 2. In view of this, the ferric iron was reduced with a small quantity of dithionite *(5)* to facilitate its electrolytic removal from the whey. After deionization, the whey

TABLE 2

Ash and nitrogen contents of whey solids from electrodialyzed $FeCl_3$-whey

	Acid whey	Acid whey[a] $Na_2S_2O_4$	Cheese whey	Cheese whey[a] $Na_2S_2O_4 \cdot 2H_2O$	Cheese whey cation and anion resin treatment	Cheese whey $Na_2S_2O_4 \cdot 2H_2O$ anion and cation resin
Final amperage *(ma.)*	18	143	38	43	90	80
Ash in whey solids *(%)*	0.24	0.15	0.65	0.40	0.19	0.09
Nitrogen in whey solids *(%)*	0.33		0.34	0.34	0.24	0.09

[a] 4 g. $Na_2S_2O_4 \cdot 2H_2O$/liter of deproteinized whey.

[1] The heat coagulation of the whey at pH 4.5 was carried out in this manner to simulate one form of commercial practice.

solids from the dithionite-treated $FeCl_3$-cheese whey contained 0.40% ash and 0.34% nitrogen. This value for ash is still high when compared to the average value of 0.30% ash in lactose from deionized $FeCl_3$-acid whey. On the other hand, it is significantly lower than the ash (0.65%) in lactose from $FeCl_3$-cheese whey which was deionized without the dithionite treatment. Consequently, if the immobility of ferric iron is due to the formation of a chelate complex with lactic acid, this complex is largely dissociated by reduction of the Fe^{+++} to Fe^{++}. Furthermore, the dithionite treatment, besides facilitating the removal of the iron from $FeCl_3$-cheese whey, has an important added advantage in that it prevents the formation of an iron containing nitrogenous precipitate which otherwise always forms during the electrodialysis of the untreated cheese whey.

Final purification of lactose. After electrodialysis, the dried, deionized $FeCl_3$-cheese whey still contains between 0.2 and 0.3% ash, about the same amount of nitrogen, and up to 15% organic acids, principally lactic and citric. These residual impurities can be removed from the lactose either by crystallization or by treating the deionized whey with granular ion exchange resins. If crystallization is employed, a single crystallization with a minimum of washing is sufficient to lower the ash content to less than 0.1%. Furthermore, the mother liquors and wash water can be recycled through the electrolytic cell for a time and most of the lactose recovered. In this case, the final mother liquors contain most of the extraneous organic materials. The milk minerals are in the salt compartments of the electrolytic cell.

If granular ion exchange resins are used, nitrogen compounds and residual minerals are adsorbed on the resins, and almost 100% yields of U.S.P. lactose can be obtained by drying the final effluent. In the present work the deionized whey was first passed through a small column of Amberlite IRC-112 (Rohm and Haas Co.), and the pH was then adjusted to 6.8 with Duolite A-4 (Chemical Process Co., Redwood City, Calif.). This treatment reduced the ash and nitrogen content of the lactose to negligible (less than 0.1%) quantities (Table 2). Furthermore, the final solution is water white and does not foam on vacuum evaporation.

Effect of concentration in salt cells on electrical power consumption. The manufacturer's notes on Amberplex A-1 and C-1 show that the ion-selectivity of these membranes decreases as the ion concentration of the solutions on either side of the membrane increases. Such a decrease in selectivity has also been shown in the present work by the following experiment.

Three equal volumes of $FeCl_3$-cheese whey were electrodialyzed without changing the solution in the salt cells. The data show that in order to get the same degree of deionization, the power requirement will increase in proportion to the salt cell concentration (Table 3). For the first volume of whey, 0.110 kw.-hr. was required to reduce the amperage to 160 ma. For the second volume, 0.130 kw.-hr. was required to give a final amperage of 154 ma., and for the third volume, 0.154 kw.-hr. was required to reduce the amperage to only 172 ma. These values for final amperage correspond to an ash content in the whey solids of 2.4, 2.35, and 2.6%, respectively. The times required to obtain the

TABLE 3

Effect of salt cell concentration on power consumption

Volume No.	1	2	3
Final amperage *(ma.)*	160	154	172
Ash in whey solids *(%)* [a]	2.4	2.35	2.6
Power consumption *(kw. hr.)*	0.110	0.130	0.154
Time of electrodialysis *(min.)*	190	300	375

[a] The ash content of whole dried whey was 5.5%.

final amperage in each case were 190, 300, and 375 minutes, respectively. Therefore, an economy in time as well as in electrical power is achieved by keeping the salt cell concentration at a minimum value.

SUMMARY

The ionizable components can be easily and quickly removed from deproteinized whey by electrodialysis through ion-selective membranes without the loss of appreciable quantities of diffusible nonionic substances.

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INFLUENCE OF FERTILITY LEVEL AND TREATMENT OF SEMEN ON NONRETURN DECLINE FROM 29 TO 180 DAYS FOLLOWING ARTIFICIAL SERVICE[1]

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Long return to service intervals are being recognized as an important source of loss to dairymen. It was earlier believed that abnormally long estrous cycles were due to missed heats or "silent" heats, but it is now being recognized that embryonic death is partially responsible. Early embryonic mortality could be caused by an imperfect zygote lacking capacity for sustained mitosis, by hormonal imbalances causing improper uterine environment, by localized infections of the female reproductive tract, or by characteristics or contaminants of semen. Doubtless all these factors and others are involved.

Olds and Seath *(13)* observed that approximately two-thirds of 2,429 estrous cycles recurred from 17 to 26 days, whereas only one-half of repeat services fell during this interval of time. It was also observed that 11.5% of the cycles were 27 to 33 days in length for repeat services, compared with only 3.3% for intervals not following service. The average for all cycles following service was 35.7 days, compared with an average of 30.6 days for cycles not following service.

It was earlier recognized by Casida *et al. (5)* and Barrett *et al. (4)* that 30- to 60-day nonreturns to service in artificial breeding were approximately 15% too high compared with pregnancy diagnosis 34 to 50 days after breeding. The 60- to 90-day nonreturn rates were approximately 6% too high and the 90- to 120-day nonreturns were approximately 3% too high. Tanabe and Casida *(21)* and later Tanabe and Almquist *(20)* observed an incidence of early embryonic mortality at 34 days post-service of 39.2 and 36.1% for repeat breeding cows and heifers, respectively.

Salisbury and Bratton *(16)* and Salisbury *et al. (17)* reported that nearly one-half of pregnancy maintenance failure was due to differences between fertility levels of bulls, with a correlation of –0.6 to –0.7 between fertility levels of bulls and nonreturn decline. Age of semen at time of breeding and season of year *(18)* showed significant differences in nonreturn decline. Evidence was also presented by Foote and Bratton *(11)* that addition of penicillin and streptomycin to egg yolk–citrate diluter containing sulfanilamide reduced the nonreturn decline from 18.8 to 12.8 percentage units from 28 to 35 days to 150 to 180 days. Olds *et al. (14)* observed a highly significant decline in long return to service intervals following the inclusion of penicillin and streptomycin in the egg yolk–citrate diluter. Salisbury and Bratton *(15)* have also shown that

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inclusion of sulfanilamide allowed for greater dilution with less decline in fertility. Inclusion of penicillin and streptomycin in diluter containing sulfanilamide (Willett and Larson, *22)* did not influence rate of fertility decline with increasing dilution. Holt *(12)* could demonstrate no difference between the presumed conception rate at 3 weeks and at 3 months between egg yolk–citrate containing and that not containing sulfanilamide.

These findings *(11, 14, 16, 17, 18)* have implicated semen as one cause of long returns to service and have further suggested bacterial contamination as one possible cause. However, a residual remains which has been partially explained by Tanabe and Casida *(21)* and Tanabe and Almquist *(20).*

Christian *et al. (7)* and Corley *et al. (8)* could find no difference in fertility level of interbreed vs. intrabreed matings. Christian and Casida *(6)* and Flerchinger and Erb *(9)* have shown that certain bulls used on first-service cows may influence the conception rate of other bulls used for the repeat services. These differences as related to level of sire fertility are economically important since long periods between services cause undue delay in conception. A more complete understanding of how fertility level of semen is related to nonreturn decline should lead to methods minimizing sire influences.

EXPERIMENTAL PROCEDURE

Forty Guernsey, Jersey, and Holstein bulls in routine service at Northwest Co-op Breeders, Mount Vernon, Wash., were used. Only occasionally were bulls used on other than a 7-day collection schedule. Semen collections were started at 7:00 A.M., and semen was available for one county the day of collection. Dilution was with warm egg yolk–citrate immediately after collection. The sodium salt of penicillin was added irregularly at the rate of 800-1,000 Oxford units per milliliter of diluted semen between March and July, 1950. Streptomycin (500γ per milliliter) and penicillin (500 Oxford units per milliliter) were added irregularly between July and November of 1950. An approximately equal number of untreated semen samples by bulls collected before and after each treatment period served as the controls. During a 2-week period in July, 1950, 3 mg. of sulfanilamide per milliliter of diluted semen was added in addition to the penicillin and streptomycin. Penicillin-treated semen served as the control before treatment, and penicillin-streptomycin-treated semen served as the after-sulfanilamide treatment control.

Semen of the higher fertility bulls was used on week-ends for 1, 2, and 3 days after collection, counting the day of collection as day 1. Semen was collected daily except Sunday.

Dilution rarely exceeded 1 part of semen to 40 parts of diluter; hence sperm numbers per milliliter of diluted semen were unlikely ever to fall below 10 million. A minimum of 60% initial motility was necessary before semen was shipped for inseminating purposes.

Nonreturn data were compiled from herd owner files maintained by Northwest Co-op Breeders Association. Service sire, age of semen when used, treat-

ment, days to previous and following service, and service number were coded for each service.

Statistical analyses were as outlined by Snedecor *(19)*. Nonreturns were determined for each day following service up to 180 days. Sires were divided into fertility groups on the basis of their 180-day nonreturns for all services included in the study.

RESULTS AND DISCUSSION

Individual bull differences. All bulls used for this study had an excess of 150 total services. The total decline in nonreturns from 29 to 180 days was 14.1%, with two-thirds of the total decline occurring during the 30- to 59-day return to service period. Another 3.3% occurred during the 60- to 89-day return to service period and only 1.6% after this time. Nonreturns for the 30- to 59-day and succeeding 30-day periods represent the number returning for service by 59, 89, 119, and 180 days. This is different from most reported methods where a 30- to 60-day nonreturn is compared with a 60- to 90-, etc., in that the latter methods result in a mid-point of each 30-day period. The total nonreturn decline of 14.1% is lower than the 14.9% reported by Barrett *et al. (1)*, using pregnancy diagnosis 35 to 49 days after breeding, and is somewhat higher than the 12.6% reported for 5-month nonreturns by Salisbury *et al. (18)*.

As would be expected, considerable between-bull variation exists for the 30- to 59-, 60- to 89-, and 30- to 180-day nonreturn periods. The 30-day nonreturn ranged from 66.0 to 83.8% and the 180-day nonreturns from 49.0 to 73.2%. The nonreturn decline from 30 days to 180 days varied from 10.6 to 27.3%.

Relation of nonreturn decline periods. The relationship between 29- and 180-day nonreturns and successive nonreturn decline periods (30 to 59 days, 60 to 89 days, and 90 to 119 days) was determined from individual bull averages.

The correlation between 29-day and 180-day nonreturns by bulls was +0.87. The 180-day nonreturn compared with nonreturn decline from 30 to 180 days was –0.66 (Table 1). This latter value is in close agreement with the correlation of –0.78 reported by Salisbury *et al. (18)* for the same type of comparison. Furthermore, Salisbury *et al.* observed a correlation of +0.96 between 1- and 5-month nonreturns among bulls compared with +0.87 among bulls in this study. The relationship between the 180-day nonreturn rates and the nonreturn decline from 30 to 59 days was also high ($r = -0.70$). The 30- to 59-day nonreturn decline compared with the 29-day nonreturn showed a correlation of –0.32 for among bulls, compared with –0.36 reported by Foote and Bratton *(11)* for semen not treated with antibiotics.

As shown in Table 1, the bulls with greater 30- to 59-day nonreturn declines also showed greater 60- to 89-day declines ($r = 0.42$). The 180-day nonreturn also was highly significantly correlated with the 60- to 89-day nonreturn decline ($r = -0.47$), but the 29-day nonreturn was not ($r = -0.19$).

The close relationship between the 29- and the 180-day nonreturns, as shown in Figure 1, makes the 29-day nonreturn a reliable early measure of fertility.

TABLE 1

Linear correlation and regression coefficients for the nonreturn measurements using individual bull averages

Comparison (x) (y)	D.F.	Correlation coefficient	Regression coefficient by · x
			(% nonreturns)
29 day nonreturn × 180 day nonreturn	38	0.87[a]	1.12
29 day nonreturn × 30- to 59-day decline	38	−0.32[b]	−0.14
29 day nonreturn × 60- to 89-day decline	38	−0.19	−0.04
180 day nonreturn × total decline	38	−0.66[a]	−0.33
180 day nonreturn × 30- to 59-day decline	38	−0.70[a]	−0.24
180 day nonreturn × 60- to 89-day decline	38	−0.47[a]	−0.07
180 day nonreturn × 90- to 119-day decline	38	0.08	0.00
30-59 day decline × 60- to 89-day decline	38	0.42[a]	0.19
60- to 89-day decline × 90- to 119-day decline	38	−0.17	−0.01
59 day nonreturn × 30- to 59-day decline	38	−0.60[a]	−0.22
59 day nonreturn × 60- to 89-day decline	38	−0.31[b]	−0.05
59 day nonreturn × total decline	38	−0.49[a]	−0.26

[a] Significant at the 1% level of probability.
[b] Significant at the 5% level of probability.

The bulls with higher 180-day nonreturn rate also showed less nonreturn decline from 29 to 180 days. This averaged 0.33% for each 1% increase in the 180-day nonreturn within a 180-day nonreturn range of 49 to 73%. Approximately two-thirds of this difference could be accounted for between 30 and 59 days. Thus, using only a 60- to 90-day nonreturn would fail to show this important among-bull difference in nonreturn decline.

Fertility groups. The 40 bulls were divided into four fertility groups on the basis of their 180-day nonreturns. As shown in Table 2, the average total non-

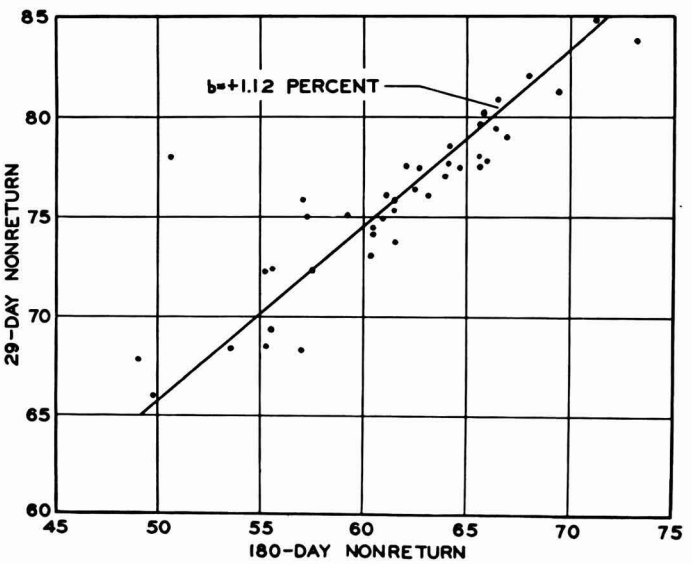

FIG. 1. Relation between 29- and 180-day nonreturns by bulls.

TABLE 2
Nonreturn decline by fertility groups

Fertility group	Range 180-day nonreturn	Services	Nonreturn		Nonreturn decline			
			29 days	180 days	30 to 59 days	60 to 89 days	90 to 119 days	30 to 180 days
	(%)	(No.)	(%)	(%)	(%)	(%)	(%)	(%)
1	49.0-55.5	6,210	70.4	53.3	11.5	3.8	1.1	17.1
2	57.0-60.9	10,030	74.0	58.8	10.2	3.3	1.0	15.2
3	61.1-64.7	18,879	76.7	63.1	8.8	3.2	1.0	13.6
4	65.6-73.2	17,164	79.8	67.0	8.4	2.9	0.9	12.8

return decline was 4.3% less for the highest fertility group compared with the lowest fertility group with 3.1% of this change occurring between 30 and 59 days. As determined by analysis of variance using bull means and individual degrees of freedom, the nonreturn decline between 30 and 59 days was significantly greater for fertility groups 1 and 2 compared with fertility groups 3 and 4. The differences between fertility groups with respect to nonreturn decline from 60 to 89 days was less than 1% and not significant. There was no significant difference between breeds.

The differences in length of service periods between fertility groups, as shown in Figure 2, reveal a higher percentage of cows returning for service during the 18- to 24-day period for the low fertility group, but the rate of decline was also noticeably greater from 25 to 32 days. Each fertility group showed a higher rate of decline from 36 to 48 days, which is the expected length of two normal estrous cycles. This reflects missed or "silent" estrus or that the inseminator was not called to rebreed the cow at the previous estrus.

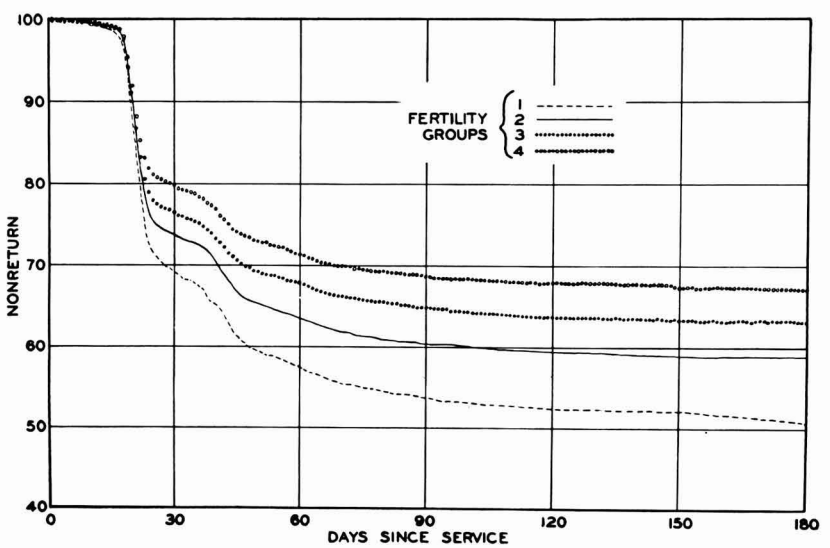

FIG. 2. Differences in nonreturn decline by fertility groups.

TABLE 3

Influence of treatment on nonreturn by fertility groups

Fertility group	Services			29-day nonreturn			30- to 59-day decline			180-day nonreturn			180-day decline		
	Before	Treated	After	Before	Treated	After	Before	Treated	After	Before	Treated	After	Before	Treated	After
	(No.)	*(No.)*	*(No.)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*
							Penicillin								
1	1,233	1,970	1,495	69.1	72.0	65.4	12.0	10.4	13.1	50.9	56.5	47.2	18.2	15.5	18.2
2	1,182	1,629	1,487	71.1	72.1	73.0	13.1	10.7	9.5	53.0	56.7	58.3	18.1	15.4	14.7
3	2,396	3,510	2,932	75.9	74.2	74.9	10.5	9.3	8.7	60.5	60.9	62.5	15.4	13.3	12.4
4	1,776	3,237	2,324	79.3	76.2	79.3	9.1	9.8	7.9	65.8	61.8	67.6	13.5	14.4	11.7
Total	6,587	10,346	8,238	74.7	74.1	74.1	10.9	9.9	9.4	58.8	59.7	60.4	15.9	14.4	13.7
							Penicillin and Streptomycin								
1	840	831	479	68.8	71.8	71.4	15.6	10.1	13.8	46.4	55.4	51.8	22.4	16.4	19.6
2	2,006	3,126	1,661	73.2	75.8	74.2	11.2	9.0	9.9	56.9	62.0	58.8	16.3	13.8	15.4
3	4,007	5,031	3,603	76.9	78.6	77.2	8.7	7.7	9.4	63.7	65.8	61.8	13.2	12.8	15.4
4	3,899	5,597	3,394	80.5	81.1	80.9	8.6	7.3	9.0	67.4	69.3	67.2	13.1	11.8	13.7
Total	10,752	14,585	9,137	76.9	78.6	77.7	9.7	8.0	9.5	62.4	65.7	62.8	14.5	12.9	14.9
	(a)	(b)	(c)				Penicillin, streptomycin, and sulfanilamide								
1	131	128	121	52.7	79.7	65.3	13.0	10.2	9.9	32.8	65.6	52.1	19.9	14.1	13.2
2	202	307	313	70.8	79.5	77.6	10.4	9.5	8.9	55.9	65.5	65.2	14.9	14.0	12.4
3	225	503	563	75.6	79.7	76.6	9.8	6.5	6.1	62.7	69.6	66.8	12.9	10.1	9.8
4	361	669	886	78.4	81.2	80.8	8.9	6.9	8.1	65.9	70.6	68.6	12.5	10.6	12.2
Total	919	1,607	1,883	72.4	80.3	78.0	10.0	7.6	7.7	58.2	68.9	66.4	14.2	11.4	11.6

(a) Penicillin
(b) Penicillin, streptomycin and sulfanilamide
(c) Penicillin and streptomycin

Fertility groups by treatment. Several investigators *(1, 2, 3, 10, 14)* have observed that penicillin and streptomycin improved materially the fertility of semen from low-fertility bulls but did not benefit bulls of high fertility.

As shown in Table 3, semen from bulls of low fertility treated with penicillin increased the average 180-day nonreturn 7.5% compared with a decrease of 4.9% for the highest fertility group as compared with the before- and after-treatment periods containing no antibiotics.

Further details for nonreturn decline (Group 1 vs. Group 4), as shown in Figure 3, reveal a rather marked difference in the number of cows returning for service during the 24- to 30-day return to service period for the penicillin-treated

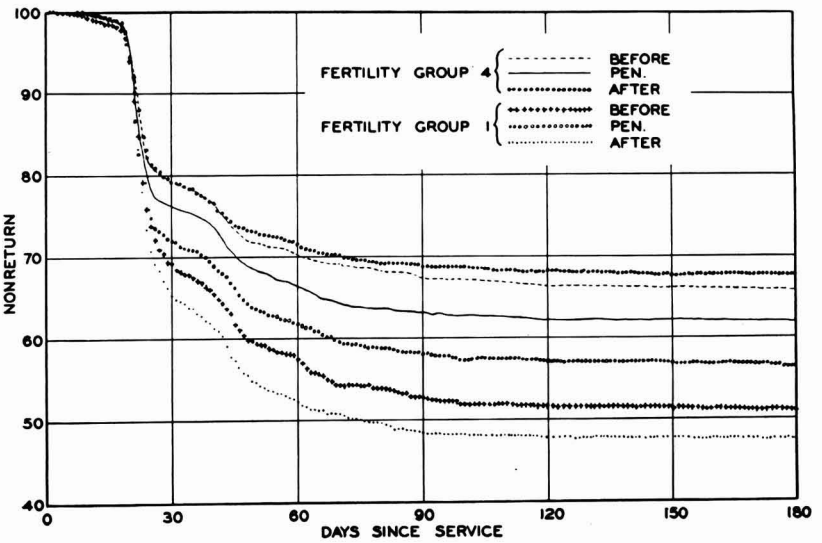

FIG. 3. Influence of penicillin on the nonreturn of high and low fertility bulls.

vs. untreated semen from low-fertility bulls. This same comparison for the highest fertility group shows the decrease in nonreturn due to a higher number of returns to service from day 23 through day 26 as compared with untreated semen.

Penicillin-streptomycin-treated semen (Table 3) was superior to the untreated control semen within all fertility groups, with fertility group 1 showing a 6.3% increase in nonreturn at 180-days. The nonreturn decline from 30- to 180-days was, in addition, 4.6% less for the treated vs. untreated semen of bulls in fertility group 1. The nonreturn decline for the same period for fertility groups 2, 3, and 4 was approximately 2% less for treated vs. untreated semen. Nearly all of this difference in nonreturn decline was the result of fewer cows returning to service during the 30- to 59-day return to service period, since the decline from 60 to 180 days was 4.8, 4.9, and 5.4%, respectively, for before treatment, during treatment, and after treatment. Details of the nonreturn decline by days

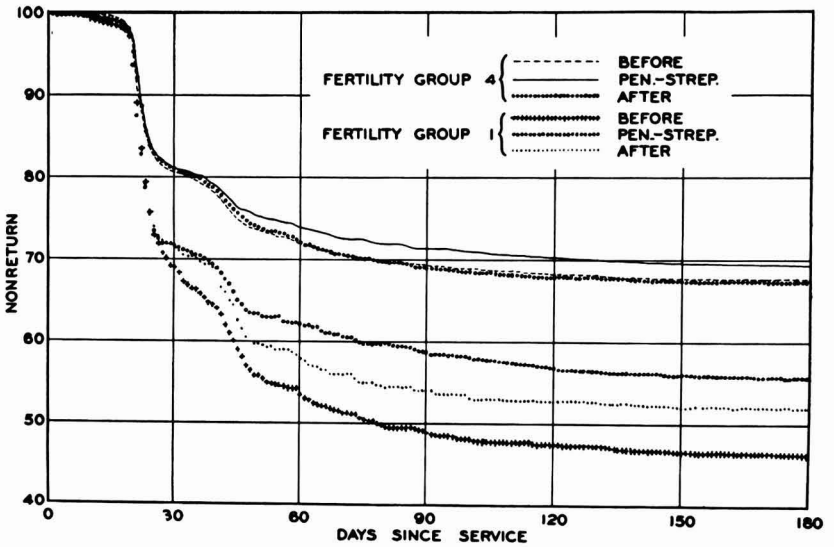

FIG. 4. Influence of a combination of penicillin and streptomycin on the nonreturn of high and low fertility bulls.

from service, as shown in Figure 4, reveal trends similar to those observed in Figure 3 for penicillin, except that the decline on the average was much more pronounced for the 47- to 50-day return to service period.

Combination of penicillin, streptomycin, and sulfanilamide showed the greatest increase in 180-day nonreturn for all fertility groups, with the greatest increase occurring from semen of low-fertility bulls (Table 3). The nonreturn decline for the 25- to 30-day return to service period was particularly rapid for the period before addition of sulfanilamide and streptomycin when the semen contained only penicillin (Figure 5).

The rather definite trend for a higher percentage of cows to return for service during the 25- to 30-day return to service period when bred to bulls of lowest fertility (Figure 2) and for the same type of difference to appear when semen of low fertility bulls has added antibiotics suggests that evidence of early embryonic death exists prior to 30 days post-service. These differences are of sufficient magnitude to be of economic importance. Furthermore, 510 cows returning to service from 29 to 32 days after a previous service showed a 180-day nonreturn rate of 52.0%, which was 9.6% lower than the 18- to 24-day return to service group. In addition, the nonreturn decline was 6.6% greater.

General discussion. Tanabe and Casida *(21)* and Tanabe and Almquist *(20)* have established a high incidence of early embryonic mortality at 34 days post-breeding among repeat breeding cows and heifers. Salisbury *et al. (18)* and Foote and Bratton *(11)* have presented data which implicate the semen of the bull as one cause of delayed returns to service as measured from the 28- to 35-day nonreturns.

The study reported herein is in essential agreement with Salisbury *et al.* and Foote and Bratton as follows: *(a)* A 1-month nonreturn is a reliable measure of a bull's 150- to 180-day nonreturn, because the bulls with the higher 29-day nonreturns also showed higher 180-day nonreturns ($r = +0.87$), and the 29- to 180-day nonreturn decline has a significant ($P < 0.01$) negative correlation ($r = -0.70$) with the 180-day nonreturn. *(b)* Use of antibiotics in the semen, particularly combinations of penicillin-streptomycin and penicillin-streptomycin-sulfanilamide, decreases the 30- to 59-day nonreturn decline. Olds *et al (14)*

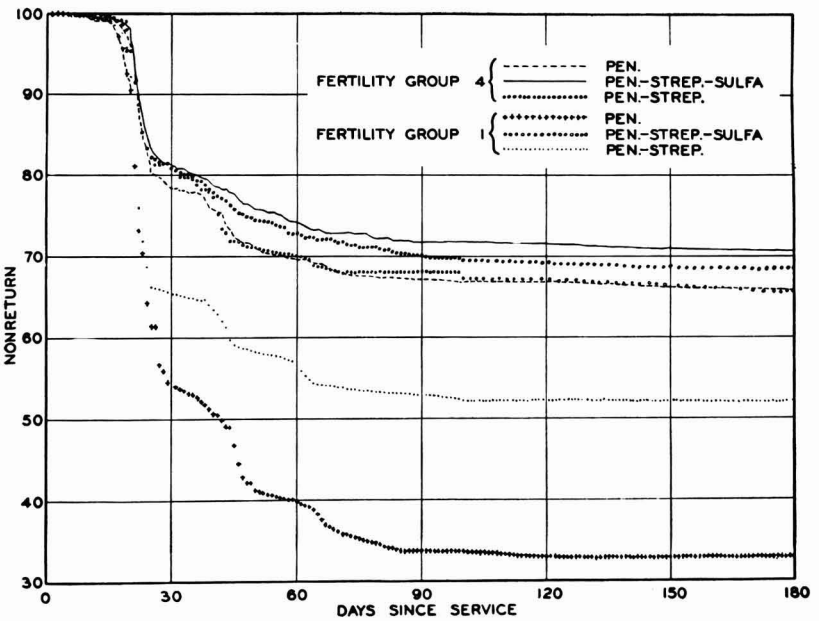

FIG. 5. Influence of a combination of penicillin, streptomycin and sulfanilamide on the nonreturn of high and low fertility bulls.

also have observed this difference in percentage of returns between control and antibiotic-treated semen. *(c)* Low-fertility bulls (180-day nonreturn) benefited the most by use of antibiotics in the semen.

This study differs from others reported *(11, 14, 18)* in that the nonreturn was determined for each day following service through 180 post-service days. This method revealed important differences between bulls and treatments from 25 to approximately 60 days post-service. These data strongly suggest that the nonreturn decline of a bull can best be measured through comparison of 29-day and 60-day nonreturns, since no significant differences between bulls existed after 60 days. This is interpreted to mean that changes after this time are due to random influences in the cow population and not related to the semen used for insemination.

SUMMARY

Semen from forty bulls used for over 50,000 artificial services was analyzed for bull differences in nonreturn decline for each day following service up to 180-days post-service. Bulls were divided into four fertility groups on the basis of their 180-day nonreturns. Semen from low fertility bulls was associated with a higher than average number of returns to service during the 25- to 29-day period. The decline from 30 to 59 days was significantly higher for low fertility bulls, with no significant difference between fertility groups after 60 days. The high correlation for among-bulls between the 29- and 180-day nonreturn rates ($r = +0.87$; $P < 0.01$) makes the 29-day nonreturn a reliable early measure of breeding efficiency. The 180-day nonreturn was negatively correlated with the 30- to 59-day nonreturn decline ($r = -0.70$; $P < 0.01$) and with the 60- to 89-day decline ($r = -0.47$; $P < 0.01$). The 29-day nonreturn was negatively correlated with the 30- to 59-day nonreturn decline ($r = -0.32$; $P < 0.05$) but not with the 60- to 89-day decline. Combinations of penicillin-streptomycin and penicillin-streptomycin-sulfanilamide reduced nonreturn decline for all four fertility groups, with semen of low fertility showing a significantly greater reduction. Penicillin alone reduced nonreturn decline only for low-fertility bulls.

ACKNOWLEDGMENT

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INFLUENCE OF TREATMENT AND FERTILITY LEVEL OF SEMEN ON DISTRIBUTION AND NONRETURN DECLINE OF REPEAT SERVICE INTERVALS[1]

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Though the modal interval between recurrent estrus in the cow is 20 to 22 days whether or not the cow is mated *(1, 2, 3, 10, 14, 15)* the average interval tends to be longer (32-37 days) when measured by actual services *(5, 9, 14)* and when intervals between mating of over 60 days are included, as would represent the actual situation in artificial breeding, average from 35.7 to 37.0 days *(5)*.

Cows returning to artificial service at intervals exhibiting but small deviations around the modal length of estrus or multiples of it have been shown to be higher in fertility than those returning to service at either shorter or longer intervals *(6, 12, 14)*.

Marked differences have been reported *(7)* in nonreturn decline from 29 to 180 days between fertility groups and antibiotic treatments with the major decline occurring between 30 to 59 days post service.

Others *(2, 4)* have presented data which indicate the cow has individuality with respect to length of estrous cycle and that sterile copulations had no measurable effect on the length of the next estrous cycle *(11)*.

Since long returns to service are a source of economic loss to the dairy industry, it was the purpose of this study to learn more about return to service patterns as influenced by fertility level of bulls and treatment of semen.

EXPERIMENTAL PROCEDURE

Details of the bulls providing the semen and its handling, dilution and treatment with antibiotics are given in a previous paper *(7)*.

Service data were collected from records kept by Northwest Co-op Breeders Association. Service sire, age of semen when used, treatment, days to previous and following service, and service number were coded for I.B.M. analysis. All repeat service records were used from a previous study *(7)*.

Statistical analyses were as outlined by Snedecor *(16)*. Nonreturns were determined for each day following service up to 180 days. No nonservice estrus data were available. Sires were divided into fertility groups on the basis of their 180-day nonreturns for all services included in this and a previous study *(7)*.

The return for service data from artificial breeding were supplemented with

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estrus and service data from the State College of Washington dairy herd. This covered a 6-year period beginning in 1947 and included Holsteins and Jerseys. These data were deemed necessary so that distributions of lengths of recurring estrous cycles could be compared with similar distributions for intervals between artificial services.

A clear-cut distinction should be made between the studies using only apparently normal cows *(15)*, those limiting the length of return to service intervals *(5)*, and those which use all data *(9, 14)*. In the last case, there is a possibility of bias in artificial breeding data, since the dairyman may not retain a cow if she returns for service more than 100 days after breeding and thus would tend to make the number of long returns appear less than is actually the case in a population of cows because such a cow would remain recorded as a nonreturn. Thus all services with returns up to 180 days were used for this study.

RESULTS AND DISCUSSION

Return to service intervals. In this study, there were 19,683 repeat service intervals which averaged 35.0 days in length. This compares with 35.1 days for 417 service periods in the State College breeding herd and 35.7 days for cows in the Kentucky Agricultural Experiment Station herd *(14)*. The average length of estrous cycles when cows were not bred averaged 29.0 days for 976 cycles in the State College of Washington herd and 30.6 in the Kentucky herd. In these latter two cases, intervals following service were compared with intervals not following service during the same period of time. Since the averages are in remarkable agreement with the 35.0 days for the artificial breeding data, one can assume with reasonable assurance that the cow populations involved are similar with respect to average length of intervals following service.

The distributions of length of repeat service intervals from artificial breeding data are in good agreement with similar distributions from the two breeding herds (Table 1).

Nonservice cycles recurred sooner than 27 days in 73.0 and 73.2% of the cases, respectively, for Washington and Kentucky herd data. This compares with a range of 55.5 to 61.8% for service cycles for the four groups of data shown in the summary portion of Table 1. This tends to fix the difference attributable to service at somewhere between 11 and 18% for repeat service cows, with a tendency toward the upper limit because of probable bias in artificial breeding data. For all cows, the difference attributable to service would be approximately one-third as great since nearly two out of every three cows do not return following first service in artificial breeding.

The possibility that cows tend to repeat for service at similar intervals is also shown in Table 1 for 7,587 repeat service intervals followed by repeat service intervals. As compared with the 17 to 25- and 34 to 52-day ranges, cows with days since previous service cycles of 1 to 16, 26, 27 to 29, 30 to 33, 60 to 89, and 90 to 119 days tended to show more following service cycles recurring sooner than 17 days, fewer in the normal range of 17 to 26 days, more in the abnormal

TABLE 1

Influence of days since previous service on days to following service and comparisons with breeding herd data

Days since previous service	No. of following periods	Days									
		1-16	17-26	27-29	30-33	34-52	53-59	60-89	90-119	120	> 53-total
1-8	47	4.3	44.6	4.3	4.3	17.0	6.4	6.4	12.7	0.0	25.5
9-16	221	8.7	46.4	2.3	5.0	21.8	3.6	9.6	1.5	1.0	15.7
17	100	7.0	57.0	1.0	3.0	16.0	6.0	5.0	1.0	4.0	16.0
18	235	3.4	53.6	3.4	1.7	20.9	4.8	8.5	1.4	2.2	16.9
19	578	2.6	58.5	1.6	1.7	20.6	3.6	7.6	1.7	2.1	15.0
20	816	0.5	56.4	2.3	2.1	21.6	2.5	10.2	2.7	1.8	17.2
21	833	1.1	58.8	1.2	2.4	20.3	3.0	9.8	1.9	1.4	16.1
22	758	2.2	62.9	1.3	2.5	16.2	2.5	7.9	2.4	2.0	14.8
23	501	2.4	58.5	1.6	2.6	21.0	1.4	7.4	3.8	1.2	13.8
24	315	1.0	57.8	2.5	1.9	19.0	2.9	10.5	3.5	1.0	17.9
25	179	1.1	58.7	2.2	3.9	19.0	3.4	8.4	1.7	1.7	15.2
26	106	4.7	53.8	3.8	1.9	23.6	2.8	3.8	2.8	2.8	12.2
27-29	200	4.5	51.1	3.0	5.5	21.1	2.0	10.1	1.6	1.0	14.7
30-33	228	6.1	45.4	2.7	4.8	23.8	4.8	8.8	2.2	1.3	17.1
34-52	1,455	2.2	55.8	1.9	2.7	20.3	3.1	9.6	2.8	1.5	17.0
53-59	229	0.9	62.2	3.9	0.9	17.1	2.6	7.1	3.5	1.7	14.9
60-89	547	4.4	51.4	2.2	2.6	17.9	2.9	12.6	3.3	2.6	21.4
90-119	150	6.7	46.7	4.0	2.7	15.3	4.7	13.3	2.7	4.0	24.7
120	89	1.1	52.2	2.2	0.0	20.0	1.1	16.7	4.4	2.2	24.4
Total	7,587	3.5	58.3	2.6	3.0	19.2	3.0	7.2	2.0	1.2	13.4
Total all service intervals	19,683	2.9	57.4	2.3	2.4	19.3	3.0	8.4	2.7	1.7	15.8
Nonservice[a]	976	7.7	65.3	2.1	2.3	15.4	1.3	4.0	1.2	0.7	7.2
Service[a]	417	1.9	55.5	4.8	2.4	20.2	4.1	7.0	3.1	1.0	15.2
Nonservice[b]	2,429	6.5	66.7	3.3[c]		13.7					9.8
Service[b]	1,347	4.1	51.1	11.5[c]		18.5					14.8

[a] State College of Washington herd data.
[b] Olds and Seath *(14)*.
[c] 27 to 33-day intervals.

range of 27 to 33 days, fewer in the 34 to 52-day range, and more in the greater than 52-day ranges. From these distributions the normalcy of a 26-day service cycle is questionable, though the number of cases is admittedly small.

Repeat service cycles recurred at intervals near the mode of 21 days with none falling outside the modal length of 18 to 24 days. However, as shown in Table 2, there was a tendency for more abnormal repeat service and nonservice cycles to recur outside the 18- to 25-day range. This tendency was more pronounced for the nonservice cycles as compared with repeat service cycles. Likewise, there was a tendency for cycles shorter than 21 days to be more frequently followed by 19- to 21-day cycles (mode) than those which were 22 to 24 days in length.

For the 576 comparisons for nonservice, the 20- to 24-day range for previous cycles was followed by a markedly greater number recurring in the 17- to 26-day range. The differences were not as great for the service cycles.

As shown in Table 3, longer previous service intervals were followed by longer service intervals. There was an increase of 6.3 days in average length of following service interval as previous service interval increased from 1 to 149 days in length. The number of intervals in the greater-than-149-day group were

TABLE 2

Comparison of days since previous estrus with days to following estrus

Days since previous estrus	Days to following service Artificial breeding			Not previously bred State College of Washington herd		
	Records	Mode	17-26 day ranges	Records	Mode	17-26 day ranges
(Days)	*(No.)*	*(Days)*	*(%)*	*(No.)*	*(Days)*	*(%)*
< 18	368	20	49.1	77	21	39.0
18	235	19	53.6	8	20	62.5
19	578	20	58.5	22	21	63.6
20	816	21	56.4	55	21	76.4
21	833	22	58.8	80	23	73.8
22	758	22	62.9	68	23	72.1
23	501	21	58.5	53	23	77.4
24	315	22	57.8	41	24	82.9
25	179	21	58.7	24	23	58.3
26	106	21	53.8	19	23	52.6
> 26	2,898	21	53.8	129	21	69.9
Total	7,587	21	57.4	576	21	69.4

too few to attach significance. These 7,587 previous service periods averaged 33.1 days in length compared with 35.6 days for those following ($P < 0.01$). This is not readily understood, but it is likely that the percentage of cows showing habitual early abortion was increasing since fewer cows from a population of first-service cows remained open and returning for service. The 12,472 first-service cows which repeated averaged 34.4 days to the following service and 12,345 cows which conceived on repeat service averaged 35.9 days since previous service. Wiltbank *et al. (17)* have shown that atretic large follicles occur more frequently early in the postpartum period, but Erb and Morrison *(8)* did not observe a greater incidence of cystic follicles and short cycles during the first 75 days. Because days since previous service represents mostly first-service failures and days to following service mostly second-service failures, it is also possible that the differences in average interval length can be attributable to more abnormally long cycles for the cows repeating for three or more services. Influences possibly due to treatment of semen, age of semen, and fertility level of bull should be thoroughly randomized in this quantity of data.

The linear correlation between previous and following service period for the

TABLE 3

Influence of days since previous service on average days to following service

Days since previous service[a]	No. of following periods	Average days to following service
(Range)		*(Days)*
1-29	4,889	35.2
30-59	1,912	35.4
60-89	547	38.2
90-119	150	40.2
120-149	64	41.5
> 149	25	39.0
Total	7,587	35.6

[a] Mean for 7,587 service periods was 33.1 days.

7,587 pairs of repeat-service cows which repeated was +0.038. Although this correlation does not represent a true physiological condition because it involves service rather than nonservice periods, it does represent the practical field situation. The data in Table 3 reveal only a slight tendency for cows to repeat for service at similar intervals. This tendency is more pronounced for nonservice cows (Table 2). These data are not considered to be in disagreement with Asdell *et al. (2)*, Chapman and Casida *(4)*, who observed definite inherent individual tendencies, or Olds and Seath *(14)*, who showed a repeatability of estrous cycle length of 6.9%. Different methods and sources of data in these studies prohibit direct comparison.

Influence of treatment and fertility level. Erb and Flerchinger *(7)*, using these same data, showed that fertility level and antibiotic treatment of semen were associated with measurable changes in nonreturn decline from 29 to 180 days. The average length and distribution of repeat service intervals were studied by antibiotic treatment within fertility groups of bulls. By analysis of variance, using individual degrees of freedom, it was observed that no significant differences existed between control and antibiotic treatment periods with respect to average length of days since previous service. This indicates the randomness of the data, since antibiotics may or may not have been used at the previous service. Thus, days to following service would reflect any changes due to antibiotic treatment. The difference in average days to following service was significantly higher ($P < 0.01$) for the experiment involving penicillin-streptomycin as compared with the periods involving penicillin or penicillin-streptomycin-sulfanilamide. The treatment period for the latter showed significantly longer ($P < 0.01$) intervals to following service as compared with the before and after treatment periods. This was not true for the penicillin or penicillin-streptomycin treatment periods.

The average interval to following service by fertility groups was significantly lower ($P < 0.05$) for the low fertility group of bulls with an average of 33.7 days compared with 35.0 days for the three groups of higher fertility. Thus the tendency was for following service intervals to be longer when the semen contained antibiotics and for the low fertility bulls to show a shorter following service interval. There were no significant interactions between fertility level of semen and treatment.

As previously reported *(7)*, 29- to 180-day decline was decreased and 180-day nonreturn increased more when semen of low fertility bulls was treated with antibiotics. The relation of treatment and fertility level of semen to distribution of return to service intervals is shown in Table 4. The differences in distribution are small for all comparisons. A higher percentage of repeat service intervals recurred in the 17- to 26-day range following insemination with antibiotic-treated semen ($P < 0.05$). The low fertility group showed the greatest improvement, but all fertility groups showed some improvement. None of the differences in the remaining groups was significant. Intervals following breeding with antibiotic-treated semen showed fewer returns at 27 to 29 days, with the lower fertility bulls showing the greatest improvement. Any improvement in decreasing

TABLE 4

Influence of treatment and fertility level of semen on distribution of return to service intervals

Repeat service interval	Distribution of days to following service								
	No pen.	Pen.	No pen.-strep.	Pen.-strep.	Fertility groups 1	2	3	4	Total
Days	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1-16	3.3	2.7	2.7	2.8	3.3	2.6	2.7	3.1	2.9
17-26	57.4	59.5	55.7	57.9	57.0	58.2	58.8	55.6	57.5
27-29	3.0	2.2	2.2	1.8	3.0	2.4	2.0	2.4	2.4
30-33	2.6	2.4	2.5	2.0	2.9	2.2	2.3	2.5	2.4
34-52	19.3	19.3	20.2	18.4	19.2	19.5	19.0	19.6	19.3
53-59	3.0	2.8	3.1	2.8	2.8	3.0	2.6	3.5	3.0
60-89	7.9	7.7	8.8	8.7	8.1	7.8	8.4	8.6	8.3
90-119	2.3	2.1	3.0	3.4	2.3	2.6	2.3	3.0	2.7
120 +	1.3	1.3	1.7	2.2	1.3	1.7	1.7	1.8	1.7
No. intervals	5,979	4,169	7,446	5,000	3,493	4,923	8,392	7,302	24,110[a]
Mode (days)	21	20	21	21	20	21	21	21	21
180-day nonreturns	59.6	59.7	62.6	65.7	53.3	58.8	63.1	67.0	62.4[b]

[a] Total exceeds 19,683 because some semen samples were used for both before and after treatment controls. Experiment involving penicillin-streptomycin-sulfanilamide included in fertility group totals.

[b] Includes 52,283 services *(7)*.

nonreturn decline and increasing the number of cows repeating at 17 to 26 days instead of some later time is economically important although it may not be statistically significant. The higher fertility bulls in this study showed a higher average return to service interval, and they showed fewer cows (55.6%) returning for service at 17 to 26 days. However, this group of cows represents a higher concentration of problem cows, since the 180-day nonreturn was 13.7% higher as compared with the low-fertility group. Thus fewer cows were returning for service with only slightly longer service intervals.

TABLE 5

Influence of length of previous service interval on the nonreturn rate of the repeat service

Days since previous service	Services	29-day-non-return	180-day non-return	30- to 59-day decline	30- to 180-day decline
	(No.)	(%)	(%)	(%)	(%)
1-5	47	85.1	63.8	8.5	21.3
6-17	713	70.3	50.8	14.1	19.5
18-24	10,390	76.1	61.6	9.5	14.5
25-28	1,057	75.9	60.0	11.3	15.9
29-32	510	73.1	52.0	15.1	21.1
33-36	468	76.3	57.7	13.1	18.6
37-40	985	75.6	58.8	11.0	16.8
41-44	1,313	78.4	64.2	9.1	14.2
45-48	772	78.4	65.2	8.5	13.2
49-60	1,087	75.7	61.8	8.7	13.9
61-80	1,226	80.3	65.6	8.4	14.7
81-100	573	82.2	70.2	6.5	12.0
101-120	296	83.8	72.6	6.1	11.2
121-160	203	82.3	69.5	5.5	12.8
161-180	43	86.0	76.7	9.3	9.3
Total	19,683	76.7	61.8	9.7	14.9

Relation of days since previous service to nonreturn and nonreturn decline. These data are shown in Table 5 and are in essential agreement with Moeller and VanDemark *(12)* and Olds and Seath *(14)* in that repeat service within 17 days and from 25 to 35 days show lower conception rates. The 29- to 32-day intervals (510 cows) showed a 180-day nonreturn of 52.0%, which was 9.6% lower than the 18- to 24-day return to service group. In addition, the nonreturn decline was 6.6% greater. Intervals shorter than 18 days since previous service likewise showed a higher 29- to 180-day decline and a lower 180-day nonreturn of approximately the same magnitude.

The longer intervals (80 days) since previous service show an increasing 180-day nonreturn. It is likely that these values are biased, since the dairyman could hardly afford to maintain a cow through more than one long return to service interval. However, these are in the minority when compared with the total and represent a problem when using artificial breeding data that is not logically corrected by omitting the data, since it represents average field conditions.

SUMMARY

The average length of 19,683 repeat service intervals was 35.0 days compared with 35.1 days for 417 service intervals in a closely observed dairy herd. Similarly, 57.4% of repeat service intervals recurred from 17 to 26 days compared with 55.5% in the closely observed herd. In this latter group 65.3% of 976 nonservice intervals recurred from 17 to 26 days.

As compared with the 17 to 25 and 34 to 52 days since previous service ranges, cows (7,587 cases) with days since previous service of 1 to 16, 26, 27 to 29, 30 to 33, 60 to 89, and 90 to 119 days tended to show more following service cycles recurring sooner than 17 days, fewer recurring from 17 to 26 days, more recurring from 27 to 33 days, fewer recurring from 34 to 52 days, and more recurring after 52 days.

Repeat service cycles recurred at intervals near the mode of 21 days, with none falling outside the modal length of 18 to 24 days. The average interval to following service increased approximately 6 days with increasing length of days since previous service (7,587 pairs with a correlation of +0.038); days to following service averaged 35.6 days as compared with 33.1 for days since previous service ($P < 0.01$).

Use of penicillin, penicillin-streptomycin, and penicillin-streptomycin-sulfanilamide did not materially influence the average length of return to service interval. Bulls of lower fertility had a lower average return to service interval than bulls of higher fertility ($P < 0.01$). This was caused primarily by a higher percentage of repeat services ($P < 0.05$) recurring from 17 to 26 days in the low fertility group.

The 180-day nonreturn rate for repeat service following service intervals of 29 to 32 days was 52.0%, which was 9.6% lower than the 18 to 24 day group; the nonreturn decline was also 6.6% higher for the 29- to 32-day group. Repeat

service intervals of less than 18 days showed similar differences when compared with the 18- to 24-day group.

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THE NUTRITIVE VALUE OF CORN SILAGE FOR MILKING COWS[1]

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Most experiments involving the use of corn silage as a feed for milking cows have been based on the partial or complete replacement of hay or a hay-crop silage in a ration which already contained considerable amounts of grain. Wheeler *(33)* replaced part of the hay with corn silage and then replaced the silage with hay in a ration in which the cows received 6 to 9 lb. of grain per day. The effect on milk production did not appear to be significant, although the author concluded, in general, that an increase in milk production accompanied the use of corn silage. Williams *(36)* fed one group of cows a ration of corn silage, hay, and about 4 lb. of grain per day and another group the same ration except that corn stover replaced the silage. The group on corn silage produced more milk; therefore, it was concluded that corn silage could replace a considerable proportion of the grain ration. According to Williams and Cunningham *(37)*, no significant change in milk production occurred when 10 lb. of hay in an all-hay ration was replaced with 35 lb. of corn silage.

Carroll *(8)* reported that cows fed corn silage in place of hay showed slightly higher milk and butterfat production, but the results were not considered significant. The amount of grain fed per day varied from 3 to 4.1 lb. In a double reversal experiment, Fairchild and Wilbur *(11)* compared a corn silage with a non-corn silage ration and found that the cows produced 2.7 lb. more milk per day on the silage ration. The increase in milk production may have been due to the consumption of 1.6 lb. more total digestible nutrients on the corn silage ration. Foster and Meeks *(12)* found that 3 tons of corn silage were equivalent to 1 ton of hay when silage replaced hay in the ration of dairy cattle. While investigating the effects of heavy and light corn silage feeding, White *et al. (34)* and Pratt and White *(29)* observed that a 50% reduction of silage and an increase in hay intake had no appreciable effect on milk production. The cows produced about 22.5 lb. of fat-corrected milk and consumed about 8.5 lb. of grain per day per cow. Similar results have been reported by other investigators *(1, 2, 3, 9, 10)*.

In comparing corn silage with hay-crop silages for milk production, comparisons have been made in nearly all cases when considerable amounts of grain have been included in the ration. Hegsted *et al. (15)* reported that when alfalfa silage which had been preserved with either molasses or by the A. I. V. method replaced part of the hay and all or part of the corn silage in the basal ration, no significant effect on milk production resulted. Ten to 11.2 lb. of corn was fed

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per day per cow. According to Waugh *et al. (32)* alfalfa-brome silage and corn silage were similar in feeding value for milk production when 8.4 to 11.3 lb. of grain was fed per day. Bender *et al. (6)* concluded that a ration containing timothy silage is equal in productive value to that containing corn silage. The cows were fed about 10 lb. of grain daily in each ration. Archibald and Parsons *(4)* also reported that grass silage was equal in productive value to corn silage. The amount of grain fed in this experiment was not stated. King *(24, 25)* compared corn silage with alfalfa silage in the ration of cows and found no significant difference in milk production. About 11 lb. of grain was fed per day in each ration. Atkeson and Anderson *(5)* found that clover silage and corn silage were practically equal for milk production when 8.5 to 10.8 lb. of grain was fed daily. Other investigators *(7, 17, 26, 35)* have reported similar results when hay-crop silage and corn silage have been compared.

Reed and Fitch *(30)* fed one group of cows on alfalfa hay alone and another group on alfalfa hay and corn silage for two lactation periods and found that the hay and silage group produced slightly more milk than the group on hay alone. Graves *et al. (13)* obtained similar results for a barn-feeding experiment.

Morrison *(28)* states in a summary of a review of literature on the value of corn silage for dairy cattle, "In experiments with dairy cows, good corn silage has actually been worth 33 to 40% as much per ton as good legume or mixed hay. The feeding value of corn silage for dairy cows therefore agrees well with the amount of digestible nutrients it furnishes."

In view of the failure of the above reports in the literature to show conclusively whether corn silage is capable of making a major contribution to the ration, feeding experiments were conducted to ascertain the possibility of the existence of the unidentified grain factor(s) in corn silage. For purposes of comparison, the same depletion method used to determine the grain equivalent [unidentified factor(s)] in grain and hay was employed in this investigation *(18, 19, 20, 21, 22, 23)*.

EXPERIMENTAL

The description of corn silages and hays, their chemical composition, coefficients of digestibility, digestible protein, and total digestible nutrients are shown in Table 1. Corn silages from nine different crop years were used in this investigation. All silages were the ear-corn varieties harvested in the dent stage except No. 5, which was a silage corn (Eureka) harvested in the immature stage.

Coefficients of digestibility were determined for silages No. 2, 6, 8, and 9 without the use of any other feed except salt. The coefficients used for the other silages were those reported by Morrison *(28)* for well-matured dent corn, all analyses. Morrison's coefficients for immature dent corn silage, southern-type were used for No. 5.

Ten different hays were used in the investigation (Table 1). First cutting alfalfa-brome hays were used in 13 trials, first cutting red clover-timothy hays were used in four trials, and second cutting alfalfa hays were used in six trials. The hays were graded as follows: ungraded, hays 1 and 4; U. S. No. 1, hays

TABLE 1

Description of corn silages and hays used in the experiment

Corn silage or hay No.	Trial No.	Moisture	Ash	Protein	Ether ext.	Crude fiber	N.F.E.	Dig. prot.	TDN	Crop year and description
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
					Corn silage					
1[a]	1	68.2	1.45	2.88 53[b]	1.13 74	6.3 66	20.0 69	1.53	21.4	1939
2	2,3	71.5	1.61	2.63 59[c]	1.60 85	5.6 65	17.1 76	1.55	21.3	1940
3	4,5	72.3	1.30	2.64 53[b]	0.87 74	5.7 66	17.2 69	1.40	18.5	1945
4	6-13 (incl.)	74.1	1.59	2.73 53[b]	0.86 74	5.6 66	15.1 69	1.45	17.0	1944
5	14,15	81.3	0.95	1.72 53[b]	0.57 73	6.1 66	9.4 62	0.91	11.7	1945 (Eureka)
6	16	66.3	1.65	4.73 52[c]	1.06 70	6.1 66	20.2 74	2.46	23.1	1946
7	17	67.2	1.65	2.76 53[b]	1.14 74	7.3 66	20.0 69	1.46	21.9	1947
8	18	70.6	1.49	2.20 53[c]	1.30 74	6.0 66	18.4 69	1.17	20.0	1950
9	19-23 (incl.)	69.3	1.28	2.72 49[c]	1.09 66	5.9 61	19.7 74	1.33	21.1	1952
					Hays used with corn silage					
1	1	12.6	6.8	15.3 71[c]	1.64 16	27.2 44	36.5 70	10.9	49.0	Ungraded, 2nd-cut., alfalfa, 1939
2	2,3	11.5	5.8	16.2 71[c]	1.64 —	29.4 41	35.5 69	11.5	51.7	U.S. No. 1, 2nd-cut., alfalfa, 1940
3	4,5	13.0	6.4	14.6 72[c]	1.74 39	28.6 45	35.7 68	10.5	49.2	U.S. No. 1, 2nd-cut., alfalfa, 1943
4	6-13 (incl.)	12.0	5.4	12.1 62[d]	1.29 35	31.9 56	37.3 64	7.5	50.3	Ungraded, 1st-cut., alfalfa-brome, 1944
5	14,15	12.1	5.3	14.0 62[d]	1.52 35	31.3 56	35.8 64	8.7	50.3	U.S. No. 3, 1st-cut., alfalfa-brome, 1945
6	16	12.8	7.0	11.2 62[d]	1.76 35	28.4 56	38.8 64	6.9	49.1	U.S. No. 1, 1st-cut., alfalfa-brome, 1946
7	17	10.6	6.5	11.7 62[d]	2.11 35	29.8 56	39.3 64	7.3	50.8	U.S. No. 3, 1st-cut., alfalfa-brome, 1947
8	18	9.4	4.7	11.2 66[c]	1.57 29	27.1 53	46.0 64	7.4	52.2	U.S. No. 1, 2nd-cut., alfalfa-brome, 1950
9	19-22 (incl.)	9.8	5.5	9.8 52[c]	2.19 33	30.4 61	42.3 64	5.1	52.3	U.S. No. 2, 1st-cut., clover-timothy, 1952
10	23	9.8	5.6	10.7 57[c]	1.14 4	36.3 58	36.5 66	6.1	51.3	U.S. No. 2, 1st-cut., alf-clover-quack, 1952

[a] The first line represents the chemical composition of the roughage. The second line represents the coefficients of digestibility. Those marked with footnote [b] represent values from Morrison *(28)*, [c] represent actual coefficients, and [d] the mean coefficients obtained from 12 alfalfa-brome hays fed previously (unpublished data).

2, 3, 6, and 8; U. S. No. 2, hays 9 and 10; and U. S. No. 3, hays 5 and 7. Actual coefficients were used to determine the digestible protein and total digestible nutrient values for all of the hays except No. 4, 5, 6, and 7. The mean coefficients obtained from 12 alfalfa-brome hays that had been fed previously at this station were used for these hays.

Random samples of corn plants were collected from the fields one day before the corn was ensiled during four of the crop years included in this study. The estimated yield and total digestible nutrient content of the four corn silages,

TABLE 2

Estimated yields and TDN content per acre of corn silage, corn stalks, and corn grain from randomized data

Crop year and description	Yields per acre			TDN per acre			Amount of corn silage required to supply 1 lb. of No. 2 corn
	Silage	Stalks	Corn grain[a]	Silage	Cobs and stalks	Corn grain[a]	
	(tons)	*(tons)*	*(bu.)*	*(lb.)*	*(lb.)*	*(lb.)*	*(lb.)*
1945 Eureka	16.8	15.2	6.8	3744	3470	273	88.6
1946 Ohio M15	5.3	3.4	24.9	2526	1407	1118	7.5
1950 Pioneer 373	11.6	7.6	55.0	5084	2626	2458	7.5
1952 Pioneer 373	8.2	5.2	50.4	4262	2006	2257	5.8

[a] 14% moisture.

corn stalks (12% moisture), and corn grain (14% moisture) per acre and the amount of corn silage required to supply 1 lb. of corn grain are presented in Table 2. No attempt was made to adjust for losses which occurred during fermentation.

One Jersey (Trial 14) and 15 Holstein cows were used in the investigation. Cow A26 was used in Trials 3, 4, and 7 during three different crop years; and cows A25, A27, A37, 412, and A29 were used in two different trials each during different crop years. All of the cows had been depleted on an all-hay ration before part of the hay was replaced with corn silage. The 12-day period preceding the replacement of part of the hay with silage was used as the standard for comparison. Short basal periods appear to be more desirable, since the natural trend in milk production is downward with the advance in lactation. The experimental periods varied from 9 to 60 days in length. The cows varied from 22 to 392 days in lactation at the beginning of the basal period. The methods used in handling the milk and the management of the cows have been reported *(22)*. The TDN requirements of the cows were calculated on the basis of the recommendations of Loosli *et al. (27)*.

The relative efficiency of utilization of the TDN in the all-hay and the hay-corn silage rations was based on the amount of FCM produced per pound of total digestible nutrients ingested.

RESULTS

Table 3 shows the stage of lactation, body weight, butterfat test, the average daily yield of FCM, the pounds of hay, silage, and dry matter consumed, the TDN required and received, and the pounds of FCM produced per pound of

TABLE 3

The effect of replacing part of the hay in an all-hay ration with corn silage on the average daily yield of FCM

Trial No.	Cow No.	Exptl. period	In milk	Body wt.	Fat test	FCM yield	Feed intake			TDN		FCM/lb of TDN
							Hay	Silage	DM	Req.	Rec.	
		(d.)	*(d.)*	*(lb.)*	*(%)*	*(lb.)*	*(lb.)*	*(lb.)*	*(lb.)*	*(lb.)*	*(lb.)*	*(lb.)*
1	A24	12	36	967	3.3	28.4	33.8	—	29.5	16.9	16.7	1.70
		42	48	967	3.1	30.0	10.0	43.1	22.4	17.4	14.1	2.13
2	A21	12	136	1166	3.5	18.0	39.1	—	34.6	14.8	20.2	0.89
		36	148	1174	3.9	21.4	20.0	56.1	33.7	15.9	22.2	0.96
3	A26	12	61	980	2.9	22.8	37.8	—	33.5	15.2	19.5	1.17
		60	94[a]	974	3.6	25.6	20.0	48.4	31.5	16.0	20.6	1.24
4	A26	15	293	1150	3.6	20.8	40.0	—	34.8	15.6	19.7	1.06
		27	308	1138	3.9	22.3	15.0	69.2	32.1	16.0	20.1	1.11
5	A25	12	219	1045	3.8	19.8	35.0	—	30.4	14.6	17.2	1.15
		21	231	1055	3.7	22.3	15.0	60.0	29.6	15.5	18.4	1.21
6	A25	12	177	972	3.8	12.4	27.5	—	24.2	11.8	13.8	0.90
		30	189	977	3.8	19.2	10.2	58.2	24.1	14.0	15.0	1.28
		30	219	1010	3.5	20.3	10.0	60.0	24.4	14.6	15.2	1.34
7	A26	12	129	1112	3.3	17.1	39.7	—	34.9	14.1	20.0	0.86
		9	141	1086	3.2	23.2	15.0	60.0	28.8	15.9	17.7	1.31
		36	150	1089	3.4	24.4	14.5	74.6	32.1	16.3	19.9	1.23
8	A27	12	287	1113	3.1	4.4	35.0	—	30.8	10.1	17.6	0.25
		21	299	1096	3.4	5.8	11.7	57.3	25.2	10.4	15.6	0.37
9	A37	12	244	1137	3.3	13.2	35.0	—	30.8	13.0	17.6	0.75
		27	256	1087	3.3	16.1	11.3	58.0	24.9	13.7	15.5	1.04
		33	283	1123	3.3	15.0	10.0	58.5	24.0	13.5	15.0	1.00
10	412	12	263	1138	4.0	13.4	35.0	—	30.8	13.1	17.6	0.76
		60	275	1099	3.6	18.2	10.6	59.0	24.6	14.4	15.4	1.18
11	A22	12	105	1044	2.8	21.1	38.5	—	33.9	15.0	19.4	1.09
		18	117	1029	3.1	24.4	19.2	48.8	29.6	16.0	18.0	1.36
		15	135	1047	2.7	24.3	15.0	59.6	28.7	16.1	17.7	1.37
12	A31	12	163	958	3.3	18.0	33.0	—	29.0	13.5	16.6	1.08
		15	175	945	3.1	19.2	15.0	48.1	25.7	13.8	15.7	1.22
		24	190	928	3.2	21.3	10.0	61.1	24.6	14.4	15.4	1.38
13	A29	12	22	1138	2.6	18.0	29.6	—	26.0	14.6	14.8	1.22
		18	34	1107	2.8	21.0	15.0	48.3	25.7	15.4	15.8	1.33
14	127	12	75	750	4.9	7.9	20.8	—	18.3	9.0	10.5	0.75
		18	87	733	4.7	9.3	11.1	39.3	17.1	9.4	10.2	0.91
15	423	12	60	1064	3.3	18.5	30.0	—	26.4	14.3	15.1	1.23
		18	72	1054	3.2	21.6	14.7	59.4	24.0	15.2	14.3	1.51
16	412	12	93	1141	3.2	21.8	34.6	—	30.2	15.8	17.0	1.28
		18	105	1153	3.3	24.2	14.0	50.0	29.1	16.7	18.4	1.32
17	A29	12	392	1157	4.2	8.1	33.8	—	30.3	11.5	17.2	0.47
		24	404	1140	3.7	9.6	15.0	54.8	31.4	11.9	19.6	0.49
18	A37	9	28	1283	3.0	17.3	34.0	—	30.8	15.3	17.7	0.98
		27	37	1341	3.3	21.3	24.0	45.0	34.9	16.9	21.7	0.98
19	A27	12	178	1102	3.1	10.4	31.8	—	28.7	11.9	16.6	0.63
		27	190	1095	3.1	11.9	14.8	29.9	19.9	12.4	14.1	0.84
20	A49	12	219	1308	4.2	12.5	39.7	—	35.8	13.9	20.8	0.60
		18	231	1304	4.0	12.6	19.8	30.0	27.1	13.9	16.7	0.75
21	T6	12	313	667	5.2	10.6	23.3	—	21.0	9.4	12.2	0.87
		21	325	677	5.0	12.5	12.8	18.9	17.3	10.1	10.7	1.17
22	A42	12	283	1221	4.2	20.9	36.0	—	32.5	16.0	18.8	1.11
		21	295	1198	3.8	22.0	26.0	20.0	29.6	16.2	17.8	1.24
		21	316	1188	3.7	21.7	16.0	40.0	26.7	16.1	16.8	1.29
23	T9	12	198	956	3.1	12.5	25.9	—	23.4	11.7	13.3	0.94
		24	210	965	2.9	13.4	15.9	19.9	20.4	12.1	12.4	1.08

[a] First 21 days of silage feeding omitted; cow off feed.

TDN consumed. In Trials 1, 7, 8, 9, 10, 12, 15, 19, 20, 21, and 23 the TDN intake during the silage feeding periods was less than that on the basal hay ration, but the amount of FCM increased against the natural tendency to decline with the advance of lactation. The increase in FCM in Trial 20 was not significant, but it is of interest to note that the reduction of 4.1 lb. of TDN per day did not result in a decline in milk production. In Trials 4, 14, and the last part of 7, the amount of FCM increased, although there was no significant difference in the TDN intake between the basal and experimental ration. In the last part of Trial 7, cow A26 produced 7.3 lb. more milk per day for a 36-day period when 74.6 lb. of silage replaced 25.2 lb. of hay.

Cow A24 (Trial 1) was depleted on second cutting alfalfa hay. When 43.1 lb. of silage replaced 23.8 lb. of this hay, the amount of FCM increased 1.6 lb. per day with 2.3 lb. less TDN intake, which was 3.3 lb. less than the theoretical requirement. Cow A31 (Trial 12) produced 1.2 lb. more FCM per day on 0.9 lb. less TDN when 48.1 lb. of silage replaced 18 lb. of first cutting alfalfa-brome hay. When the hay intake was reduced to 10 lb. and the silage increased to 61.1 lb., the amount of FCM was 3.3 lb. more per day on 1.2 lb. less TDN than received on the basal ration. The increase in milk production in both cases was associated with a slight decrease in body weight. In Trial 11, milk production increased 3.3 lb. with the ingestion of 1.4 lb. less TDN when 48.8 lb. of silage replaced 19.3 lb. of hay. Milk production remained the same when the hay was reduced to 15 lb. and the silage intake increased to 59.6 lb.

In Trials 2, 3, 5, 6, 17, and 18, the cows received more TDN during the silage-feeding periods than when on the basal ration. The contribution of silage was determined in these trials by calculating the increase in FCM per pound of TDN intake. All trials showed an increase in milk production except Trial 18, which remained unchanged. No significant trend was noted in the per cent of butterfat in the milk when part of the hay was replaced with corn silage.

The data presented in Table 4 were obtained from randomizing the corn fields and were used to calculate the contribution made by the corn silage fed

TABLE 4

The hay equivalent and amount of corn grain supplied by the corn silage where randomized data were available[a]

Trial No.	Cow No.	Corn silage	Equivalent to		Increased production of FCM/day
			Hay[b]	Corn[c]	
		(lb.)	*(lb.)*	*(lb.)*	*(lb.)*
14	127	39.3	9.0	0.3	1.4
15	423	59.4	13.7	0.7	3.1
16	412	50.0	13.5	6.7	2.4
18	A37	45.0	9.9	6.0	4.0
19	A27	29.9	6.6	5.2	1.5
20	A49	30.0	6.6	5.2	0.1
21	T6	18.9	4.2	3.1	1.9
22	A42	20.0	4.4	3.4	1.1
23	T9	19.9	4.4	3.4	0.9

[a] No account taken of the losses that occurred in the silo.
[b] 12% moisture.
[c] 14% moisture.

in Trials 14, 15, 16, 18, 19, 20, 21, 22, and 23 in respect to corn grain (14% moisture) and hay equivalent (12% moisture for stalks and cobs). The amount of grain in the Eureka silage was very low, but the hay equivalent was high (Trials 14 and 15). Cow 412 (Trial 16) received 6.7 lb. of corn and 13.5 lb. of hay equivalent in the 50 lb. of silage fed in place of 20.6 lb. of hay. Milk production increased 2.4 lb. per day and the TDN intake increased 1.4 lb. The changes in body weight do not appear to be correlated with changes in dry matter intake under the conditions of this experiment.

DISCUSSION

As indicated in Table 1, corn silage No. 6 contained 4.73% crude protein on the wet basis and 13.2% on the dry basis. The very high protein content of this silage may have been due to a high level of available nitrogen in the soil and also to the dry weather which prevailed during the growing season. The yield of silage was only 5.3 tons per acre. Haigh and Hogan *(14)* found that silage made from upland drought corn contained 11.3% protein on the dry basis.

The results obtained when part of the hay in an all-hay ration was replaced with corn silage showed an increase in the production of FCM regardless of the crop year, cutting, or U. S. grade of hay used to deplete the cows. The amount of FCM produced per pound of TDN intake increased markedly in Trials 1, 6, 7, 9, 10, 11, 15, and 21, when the cows were changed from the basal ration to the hay and silage ration. The efficiency of utilization of TDN for milk production increased in 22 trials during the silage-feeding periods and remained unchanged in one (Trial 18). These results are in agreement with those reported previously, which indicated that grain is needed for efficient milk production to balance the roughage in the ration. The factor(s) in grain that aids in the utilization of hay has been referred to as the unidentified lactation factor(s) *(21, 22, 23)*.

The results of this study are in agreement with those of Woll and Voorhies *(38)* who observed that cows being fed alfalfa hay alone increased in milk production when part of the alfalfa was replaced with corn silage. Hills *(16)* reported that, without exception, a change from corn silage to hay reduced milk production, whereas a change from hay to silage increased milk production. Archibald and Parsons *(4)* and Scharrer and Schreiber *(31)* have reported similar results. All of these investigators fed a small amount of grain in both rations. Williams and Cunningham *(37)* reported no significant difference in milk production when corn silage replaced part of the hay in an all-hay ration. Their results may have been due to the feeding of hay which contained a considerable amount of the unidentified grain factor(s). Huffman *et al. (23)* found that hays sometimes vary in the amount of unidentified factor(s), which may account for the results obtained by Williams and Cunningham.

Most of the corn silage investigations reported in the literature failed to show that the corn in the silage increased milk production when all or part of the hay or hay-crop silage was replaced with corn silage because all of the

rations already contained considerable amounts of grain. These results have been used as the basis for the present concept that a pound of TDN in corn silage has the same nutritive value for milking cows as hay or hay-crop silage. On the basis of the findings reported in this paper, it appears that the failure of the majority of investigators to show a superiority of the TDN in corn silage was due to the high grain content of the mixed ration. The additional amount of grain supplied by the corn silage was prevented from manifesting its grain effect.

The results of this investigation indicate that an allowance should be made for the grain in corn silage when feeding cows for milk production. Two of the corn fields that were randomized showed that the cows obtained 1 lb. of corn grain in each 7.5 lb. of silage consumed (Table 2). In other words, a cow consuming 45 lb. of silage would obtain 7.5 lb. of corn grain. The leaves and stalks in this amount of silage would be equal to 9.9 lb. of hay.

The feeding of immature corn silage (Eureka) in place of part of the hay also brought about an increase in milk production, although the amount of corn grain in the silage was very low (Trials 14 and 15). The grain equivalent in this type of silage resembles the milk-producing power of young pasture grass.

SUMMARY AND CONCLUSIONS

Sixteen cows were depleted of their milk-producing factors on an all-hay ration to determine the effect on milk production when part of the hay was replaced with corn silage. An increase occurred in 22 of 23 trials in the amount of FCM produced per pound of TDN consumed when the cows were fed corn silage. In 11 trials, FCM increased even when the TDN intake was less during the silage-feeding periods than when on the all-hay ration.

Corn fields were randomized just prior to ensiling in four different years, and the data indicate that each 100 lb. of corn silage was equivalent to 22 to 27 lb. of hay and contained from 13 to 17.4 lb. of corn grain, excluding the Eureka corn.

No significant differences occurred in the per cent of butterfat in the milk or in the body weight of the cows when part of the hay was replaced with corn silage.

The data show conclusively that the grain in corn silage contributes the unidentified grain factor(s) which is needed to balance the TDN in roughage; therefore, corn silage should not be considered a true roughage, but a mixture of roughage and grain.

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PARTURIENT PARESIS. VII. A STUDY OF THE LEUCOCYTES OF COWS WITH PARTURIENT PARESIS.[1]

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Radical changes have been shown to occur in the levels of some of the chemical constituents of blood during parturient paresis (milk fever). Some of the body systems concerned with the maintenance of equilibrium are stimulated to greater activity by changes of the internal environment. A multitude of studies have demonstrated that the pituitary adrenocortical system increases the resistance of an animal to a vast number of stresses and plays a major role in maintaining homeostasis *(7, 8)*.

A relative lymphopenia (decrease in the per cent of lymphocytes) and an eosinopenia (decrease in the total eosinophils) are morphological changes which invariably occur shortly after exposure to stress in the normal animal *(7, 8)*. A previous study indicated that parturition in dairy cattle produces a stress condition, as evidenced by the leucocyte response test *(5)*.

Garm *(2, 3)* concluded that parturient paresis was a "disease of adaptation" after observation of changes in the hypophysis, adrenals and thyroid glands, and leucocytes of cows with parturient paresis. Holcombe *(4)* postulated from a consideration of low excretion levels of urinary reducing corticoids and neutral steroids that parturient paresis results from cortical exhaustion.

Westermarck *(11)* administered ACTH to six cows with milk fever which had also received some form of calcium therapy. Three of the cows with prolonged milk fever in which Ca therapy had been unsuccessful responded to the administration of ACTH. He concluded that symptoms of hypocorticoidism are evident in acute paresis which may be caused by inadequate amounts of ACTH. In prolonged paresis he observed symptoms of adrenal exhaustion, which were attributed to a hypersecretion of mineralocorticoids and a hyposecretion of glucocorticoids.

Ward *et al. (9, 10)* have made comprehensive studies, prepartal and postpartal, of the intake, excretion, and blood levels of some of the mineral elements associated with milk fever. They did not detect excretory changes of sufficient magnitude to indicate an adrenal involvement. A study was made by Meyer and coworkers *(6)* on the effect of pregnancy and lactation in rats on the formation of connective tissue and the permeability of knee joint synovial membranes. Pregnancy inhibited connective tissue formation and protected the synovialis against injury by injections of formaldehyde. These actions were postulated to be the effect of higher levels of glucocorticoids during pregnancy.

This study was undertaken to determine whether milk fever produces a condition of stress as indicated by the leucocyte response test.

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EXPERIMENTAL METHODS

The cows used in this study were in the dairy herd of the University of Wisconsin. All of the cows were Jerseys except 40G, a Guernsey. An attempt was made to obtain blood samples from each cow 5 days prior to parturition in order to establish a prepartum level of leucocytes and glucose. Also, blood samples were drawn within a short time prior and subsequent to calving. Calcium determinations were made on the blood samples taken prior to treatment for milk fever to verify the observable symptoms of milk fever. Treatment for milk fever was generally not initiated until the cow was paralyzed to the extent that she was in a recumbent position and unable to rise. The time of treatment for each cow is indicated in the time column opposite "milk fever" or "relapse of milk fever" in the "remarks" column of Table 1. Treatment consisted of an intravenous injection of 250 ml. of calcium gluconate.

Three cows, 40G, 48J, and 45J, were injected intramuscularly with 250 I.U. of ACTH at 27, 22, and 17 hours, respectively, after treatment for milk fever. Blood samples were drawn at 8-hour intervals for 24 hours after ACTH injection, with the exception of cow 45J, from which the second sample was drawn 14 hours after injection, at the time of a relapse. ACTH was administered to determine whether the adrenal cortex was capable of responding to the stimulus of ACTH after parturition and milk fever.

The leucocyte and blood sugar data were obtained by methods previously described *(5)*. Serum calcium was determined by the Clark-Collip method *(1)*.

RESULTS

The results of the study are presented in Table 1. The response of the leucocytes and blood sugar to the stress of parturition is essentially the same as previously reported *(4)*.

All of the cows except 40J and 48J exhibited an elevation in the total number of leucocytes in the blood drawn at time of treatment for milk fever. Also, there was a shift in the ratio of lymphocytes and neutrophils as a result of a decrease of lymphocytes and an increase of neutrophils in the blood of all cows. The shift in ratio was not of sufficient magnitude to cause a crossover in the per cent of lymphocytes and neutrophils in cows 14J, 40J, 45J, and 48J. All cows except 40J showed an eosinopenia in the milk fever blood sample. Milk fever had no observable effect on the monocytes or basophils during the period of observation. In some cows the blood sugar appeared to be elevated in milk fever, but in others there was no discernible change. The serum calcium was approximately half of the normal values.

Five of the cows had relapses following the initial treatment for milk fever. In cows 7J and 55J the changes in the leucocytes resulting from the initial attack of milk fever had not returned to normal when a relapse occurred. A shift from the normal ratios in the leucocytes was observed in the relapses, but the degree of shift was less than in the initial attack. In cows 14J and 51J the relapses occurred after the leucocytes had returned within normal ranges. In

TABLE 1

The effect of parturition, milk fever, and ACTH on some constituents of blood

(Days)	(Hours)	Leucocytes per emm.	Cells per 100 leucocytes: Lymphocytes	Neutrophils: Seg.	Neutrophils: Stabs	Eosinophils	Monocytes	Basophils	Blood sugar (mg. %)	Serum calcium (mg. %)	Remarks
Prepartum					*Cow No. 7J*[a]						
1		7,920	42.3	48.3		8.3	1.1	0.0	48.7		
	1.50	9,920	32.6	64.7		2.1	0.6	0.0	62.2	9.4	
	00.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	0.50	8,960	31.8	65.2		2.1	0.9	0.0	65.0	8.0	
	20.00	13,160	26.0	73.9		0.1	0.0	0.0	71.9	9.1	Milk fever[b]
2		11,720	66.2	33.8		0.0	0.0	0.0	60.3	4.9	Relapse milk fever
3		9,840	56.9	40.9		2.2	0.0	0.0	30.5		
6		6,080	60.9	34.0		3.6	1.4	0.0	44.8		
Prepartum					*Cow No. 55J*						
5		10,360	64.0	27.5	2.7	6.0	0.5	0.0	46.9		
4		10,440	58.5	35.0	1.0	4.0	1.5	0.0	48.0		
3		10,400	56.0	32.5	5.5	2.5	3.5	0.0	44.3		
2		9,800	42.5	42.0	7.5	1.5	6.5	0.0	51.1		
1		12,300	43.0	39.0	10.5	6.0	1.5	0.0	49.4		
	7.75	13,500	43.0	46.0	8.0	1.5	1.5	0.0	49.6		
	1.50	16,200	37.5	48.5	5.0	2.0	7.0	0.0	44.8		
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	0.50	14,150	31.5	56.5	11.5	0.5	0.0	0.0	45.9		
	7.75	21,850	40.5	42.0	12.5	1.0	4.0	0.0	41.2	3.7	Milk fever
1		17,450	37.0	47.5	11.0	2.0	2.5	0.0	46.4		
2		14,800	44.0	40.5	6.0	2.0	7.5	0.0	54.7	6.5	Relapse milk fever
3		13,500	56.5	28.0	0.5	6.5	8.5	0.0	37.0		
4		8,500	61.5	34.0	0.5	2.0	2.0	0.0	45.2		
5		8,550	74.5	16.0	1.0	3.5	5.0	0.0	43.6		

[a] The stabs were included with the segments on this cow.

[b] Given 150 ml. of calcium gluconate before sample was drawn.

TABLE 1 (cont'd)

The effect of parturition, milk fever, and ACTH on some constituents of blood

			Cells per 100 leucocytes								
				Neutrophils					Blood	Serum	
(Days)	*(Hours)*	Leucocytes per cmm.	Lymphocytes	Seg.	Stabs	Eosinophils	Monocytes	Basophils	sugar *(mg. %)*	calcium *(mg. %)*	Remarks
Prepartum						*Cow No. 22J*					
3		9,080	60.0	37.0	0.0	2.8	0.2	0.0	50.6		
2		7,840	63.1	33.4	0.0	2.8	0.7	0.0	50.4		
1		9,960	60.5	32.0	0.0	3.0	4.5	0.0	48.7		
	8.00	12,000	52.5	41.5	1.0	0.5	4.5	0.0	52.1		
	0.50	14,640	56.6	42.0	0.0	0.4	1.0	0.0	51.8		
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	4.50	15,960	37.5	54.0	3.5	0.5	4.5	0.0	50.2		
	13.25	17,320	35.5	52.2	3.5	0.0	8.5	0.0	61.8	5.7	Milk fever
2		10,600	69.0	29.5	0.5	0.0	1.0	0.0	36.4		
3		9,200	77.0	15.5	2.5	3.0	2.0	0.0	37.0		
4		8,800	87.0	10.5	0.5	1.0	1.0	0.0	51.3		
5		7,000	97.5	1.5	0.0	0.5	0.5	0.0	44.1		
Prepartum						*Cow No. 51J*					
5		7,100	51.5	27.0	2.0	17.5	2.5	0.0	50.6		
4		9,100	39.5	35.5	7.5	13.0	4.5	0.0	49.2		
3		8,050	42.0	24.5	5.0	19.0	4.0	0.0	49.9		
2		8,850	36.5	30.0	7.5	19.5	6.0	0.0	45.9		
	20.00	10,450	31.5	45.0	8.0	11.5	4.0	0.0	55.7		
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	1.00	13,350	42.0	38.5	10.5	6.5	2.5	0.0	72.7		
	12.25	10,400	26.5	53.0	8.0	2.0	10.5	0.0	54.7	5.5	Milk fever
1		7,800	75.5	17.0	0.5	3.0	4.0	0.0	51.3		
2		7,700	54.5	20.0	6.5	10.0	9.0	0.0	32.8	5.0	Relapse milk fever
3		7,800	54.0	31.0	1.0	9.0	5.0	0.0	53.8		
4		5,850	58.5	29.5	0.0	6.0	5.0	0.0	47.8		
5		6,900	59.0	28.0	0.0	7.0	6.0	0.0	55.8		

TABLE 1 (cont'd)

The effect of parturition, milk fever, and ACTH on some constituents of blood

(Days)	(Hours)	Leucocytes per cmm.	Cells per 100 leucocytes: Lymphocytes	Neutrophils: Seg.	Neutrophils: Stabs	Eosinophils	Monocytes	Basophils	Blood sugar (mg. %)	Serum calcium (mg. %)	Remarks
Prepartum					*Cow No. 14J*						
9		10,350	63.5	22.0	6.0	3.0	5.5	0.0	45.2		
7		10,800	72.5	14.0	0.5	4.5	5.5	0.0	40.7		
5		12,260	48.0	35.0	5.5	8.0	3.5	0.0	47.5		
4		10,850	51.5	33.0	2.5	8.0	5.0	0.0	46.8		
3		11,350	44.0	38.0	4.5	8.5	5.0	0.0	41.4		
	23.00	15,550	40.0	42.0	10.0	2.0	6.0	0.0	39.6		
	1.50	15,250	58.0	26.0	8.5	2.0	5.5	0.0	47.8		
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	3.25	16,250	53.5	29.0	10.5	0.0	7.0	0.0	48.9	6.5	Milk fever
	12.25	13,350	76.5	12.5	3.0	3.0	5.0	0.0	50.4		
1		8,350	76.5	11.0	2.0	6.0	4.5	0.0	38.3		
	34.00	7,050	64.0	23.5	2.0	7.5	3.0	0.0	49.4	5.2	Relapse milk fever
2		8,150	77.0	14.5	1.5	2.0	5.0	0.0	59.8		
3		9,350	56.5	25.5	2.0	8.5	7.5	0.0	49.6		
4		8,750	61.0	24.5	4.0	7.0	3.5	0.0	44.3		
5		8,250	63.5	21.5	1.5	10.0	3.5	0.0	43.9		
Prepartum					*Cow No. 40J*						
14		9,950	49.5	26.5	4.0	16.0	4.0	0.0	62.7		
11		8,750	49.5	33.0	1.5	11.0	5.0	0.0	48.0		
8		8,250	45.0	34.5	3.5	11.0	6.0	0.0	42.8		
5		9,200	35.5	38.0	7.5	13.5	5.5	0.0	49.4		
4		8,450	42.0	31.5	8.5	10.0	6.5	1.5	46.6		
3		8,300	33.5	40.5	5.5	13.5	6.0	1.0	45.0		
2		8,900	35.5	40.0	6.5	11.0	6.5	0.5	46.9		
1		9,650	37.0	47.5	1.5	8.5	5.0	0.5	53.0		
	10.25	11,150	28.5	53.0	6.5	7.0	4.5	0.5	65.5		
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	0.50	13,900	34.5	49.0	9.5	5.5	1.5	0.0	84.9		

TABLE 1 (cont'd)

The effect of parturition, milk fever, and ACTH on some constituents of blood

(Days)	(Hours)	Leucocytes per cmm.	Cells per 100 leucocytes						Blood sugar (mg. %)	Serum calcium (mg. %)	Remarks
				Neutrophils							
			Lymphocytes	Seg.	Stabs	Eosinophils	Monocytes	Basophils			
Postpartum					*Cow No. 40J (cont'd)*						
	11.25	11,400	35.0	47.5	10.0	3.0	4.5	0.0	57.8		
1		6,100	59.0	25.5	3.5	9.0	3.0	0.0	55.0		
	45.00	7,150	46.0	30.5	10.0	7.0	6.5	0.0	53.0	4.1	Milk fever
3		7,900	55.5	27.0	4.5	7.5	5.5	0.0	56.5		
4		7,350	52.5	29.0	3.5	9.5	4.0	0.0	55.3		
5		6,500	48.5	34.0	1.5	12.5	3.5	0.0	49.4		
6		7,750	48.0	17.0	6.0	12.0	17.0	0.0	49.4		
Prepartum					*Cow No. 31J*						
	4.50	15,700	27.0	47.5	10.5	10.0	5.0	0.0	61.9	7.6	
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	10.50	12,350	44.5	35.5	9.0	6.5	4.5	0.0	47.8		
	14.75	12,100	24.5	47.0	18.0	5.5	5.0	0.0	43.2	4.2	Milk fever
2		12,300	37.0	30.5	16.0	12.5	4.0	0.0	31.3		
3		10,600	38.5	33.0	12.5	8.5	7.5	0.0	28.7		
4		8,750	48.0	25.0	4.0	15.5	7.5	0.0	35.5		
5		8,350	56.5	21.5	7.5	11.5	2.5	0.5	45.2		
Prepartum					*Cow No. 40G*						
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	36.25	13,200	20.5	45.0	24.5	2.0	7.5	0.5	104.9		Milk fever
3		7,200	53.0	29.5	7.5	3.5	4.0	2.5	51.4		
	After ACTH										
4	0.00	5,150	50.0	32.5	3.5	5.0	7.5	1.5	42.5		250 I.U. ACTH
	8.00	9,100	27.5	50.5	12.5	2.0	7.5	0.0	40.8		
	16.00	11,500	28.5	58.0	9.5	0.5	3.0	0.5	63.6		
5	24.00	11,900	34.5	44.5	17.0	0.0	4.0	0.0	81.9		
6		8,400	50.5	35.5	8.0	4.0	1.0	1.0	44.8		
7		6,650	55.0	33.5	3.0	2.5	4.5	1.5	41.4		
8		7,850	54.0	31.5	8.0	4.5	2.0	0.0	55.6		

TABLE 1 (concluded)

The effect of parturition, milk fever, and ACTH on some constituents of blood

(Days)	(Hours)	Leucocytes per cmm.	Cells per 100 leucocytes						Blood sugar (mg. %)	Serum calcium (mg. %)	Remarks
				Neutrophils							
			Lymphocytes	Seg.	Stabs	Eosinophils	Monocytes	Basophils			
Prepartum						*Cow No. 48J*					
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	3.00	7,350	52.0	33.5	10.0	0.0	4.5	0.0	59.4	4.3	Milk fever
	13.25	6,700	40.5	44.5	7.5	4.0	2.5	1.0	44.6		
	After ACTH										
1	0.00	6,450	72.5	10.5	1.5	12.5	2.0	1.0	48.0		250 I.U. ACTH
	8.00	8,600	56.0	23.0	10.0	8.5	2.5	0.0	61.9		
	16.00	10,950	39.0	36.0	21.5	0.5	3.0	0.0	62.5		
2	24.00	5,600	40.5	39.5	13.0	4.0	3.0	0.0	48.7		
3		5,600	55.5	14.0	5.5	20.5	3.5	1.0	69.3		
4		5,200	65.0	15.5	1.0	24.5	4.0	0.0	52.3		
5		5,250	53.5	17.0	8.5	16.0	5.0	0.0	56.2		
Prepartum						*Cow No. 45J*					
6		13,150	68.0	17.0	0.5	11.5	3.0	0.0	44.2		
5		11,350	71.5	11.5	1.5	13.5	1.5	0.0	46.1		
4		17,300	69.0	16.0	1.0	10.5	3.5	0.0	44.0		
3		16,000	69.0	16.0	1.5	12.5	1.0	0.0	50.1		
2		14,500	70.5	16.5	0.0	12.0	1.0	0.0	47.2		
1		15,100	66.5	18.5	3.5	9.5	2.0	0.0	57.4		
	0.00	——	—	—	—	—	—	—	——	—	Calved
Postpartum											
	0.75	16,650	70.5	18.0	8.0	1.5	2.0	0.0	74.0		
	8.25	14,750	66.5	27.0	5.0	0.5	1.0	0.0	55.9	6.2	
	14.00	15,700	76.0	17.5	2.5	1.5	2.5	0.0	49.8	5.5	Milk fever
1		14,100	71.0	16.5	3.5	4.0	5.0	0.0	48.2		
	After ACTH										
	0.00	14,100	71.0	16.5	7.0	3.5	2.0	0.0	42.9		250 I.U. ACTH
	8.00	15,800	68.0	16.5	12.0	1.5	2.0	0.0	49.8		
2	14.00	15,900	61.5	21.0	13.5	0.5	3.5	0.0	89.7	4.4	Relapse milk fever
	24.00	16,650	53.0	24.5	19.5	0.0	3.0	0.0	69.8		
	32.00	16,700	67.5	18.0	8.0	0.0	6.5	0.0	45.6		
3		13,650	75.0	10.0	7.0	4.5	3.5	0.0	39.8		
4		14,200	68.5	10.5	6.5	9.0	5.5	0.0	48.9		
5		12,200	77.0	8.5	4.5	4.5	5.5	0.0	64.0		

these two cases there was not much of a change in the leucocyte ratios, but the blood serum calcium was considerably below normal. ACTH was administered to cow 45J 14 hours prior to a relapse. The shift in ratio of the neutrophils and leucocytes which occurred was probably the result of the ACTH administration, for there had been practically no shift either at parturition or the initial attack of milk fever. Cows 40G and 48J responded to ACTH injection after parturition and milk fever by an increase in the per cent of neutrophils, a decrease in the per cent of lymphocytes, and an eosinopenia.

DISCUSSION

The results of this study indicate that sufficient stress is caused by a majority of cases of milk fever to cause a hyperactivity of the adrenal cortex, as indicated by the leucocyte response test. In these 10 cases, there is a considerable variation in the degree of stress produced (and the increase in adrenocortical secretions) as measured by changes in the blood constituents under observation. Two of the cows that relapsed into milk fever showed a stress condition but the other two did not. Typical symptoms of milk fever were exhibited by both groups and serum calcium levels were approximately as low as other cases of milk fever in this study. Since the three cows which were injected with ACTH showed a typical reaction, the lack of response in the relapse cases may be attributed to a subthreshold stimulus. The fact that a response to ACTH administration occurred indicates that the adrenal cortex was not exhausted.

It is the opinion of the authors that the adrenal cortex is not involved in the physiological alterations causing the syndrome associated with milk fever but rather responds to the stress condition produced by them. This increased activation of the adrenal cortex is similar to that produced as a result of response to many other drastic changes in the animal's environment (stresses). From the known functions of the adrenal cortex, it is impossible to assign to it a specific role in correcting the metabolic disorders of milk fever. However, this does not mean that adrenocortical hormones are unimportant in conditions of stress such as parturition and milk fever.

SUMMARY

A study was made of the reaction of the leucocytes to milk fever. The leucocyte reaction is similar to that obtained by an injection of ACTH. These results indicate that the stress of milk fever causes an increased secretion from the adrenal cortex.

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THE YIELD AND PROTEIN CONTENT OF SILAGE CORN AS INFLUENCED BY FERTILIZATION

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The use of commercial fertilizers in the production of corn for grain is a generally recognized method of increasing yields. Dairy farmers who grow corn for silage or dry forage wish to know whether or not the larger yield of grain brought about by fertilization is accompanied by an increase in the yield of leaves and stalks and by an enhanced protein content of the grain and the leaf-stalk fraction of the forage. This paper reports a 5-year investigation which was designed to answer these questions. A few representative reports of previous investigations of the effects of fertilization on the yield and composition of corn and corn forage are briefly reviewed herewith.

Fertilization of soils that did not contain an adequate supply of plant nutrients in all cases increased the yield of corn forage or corn grain. In numerous instances investigators have reported *(1, 2, 5, 6, 7, 8, 10, 12)* a higher percentage protein content in corn forage grown on fertilized plots than in corn forage grown on comparable plots lacking fertilization. In some of these experiments *(1, 8, 10, 12)* the composition of the grain and stover was determined separately, with indications that fertilization had enhanced the percentage protein content of both portions of the crop. A favorable effect of nitrogen fertilization on the protein content of corn grain was reported by several investigators *(1, 3, 4, 8, 9)*, although in one instance *(11)* the report showed a reduced protein content of the grain when the soil was treated with manure. Hamilton *et al. (3)* investigated the composition of corn grain grown on plots which had been under the same system of soil treatments for 70 years. They reported that "fertilization applied to the soil in these plots definitely increased the weight of the kernel, and the (percentage) content of protein, fat, and total phosphorus." Whitson *et al. (11)* also found that the cropping system influenced the protein content of the corn crop.

In several of the investigations mentioned above, the conclusions were based upon yields and analyses of mature grain and stover. The objective of the experiment reported in this paper was to determine the effect of soil fertilization upon the yield and composition of corn forage at the silage-harvest stage.

EXPERIMENTAL

During the first 3 years of the trials, the field used was one which had grown chiefly corn and alfalfa and had received frequent heavy applications of barnyard manure. The field used in the last two seasons was part of a farm

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which had been operated for many years under a cash-grain system, and the crop yields from it were relatively low.

The corn was drilled in rows 40 in. apart. Each experimental block was 247 ft. long and contained four rows of each of five hybrids, or a total of 20 rows. The field was four blocks long by two blocks wide, and contained four replications of unfertilized and four replications of fertilized blocks. Fallow borders were maintained at sides and ends of the field.

The corn hybrids employed [Illinois Hybrids 206, 784, 972A-1, 2119(W), and U. S. Hybrid 13] had been shown by previous investigations to be adapted to east central Illinois for both silage and grain production. The order of planting the entries in the various blocks was randomized.

Alternate blocks were treated at planting time with 200 lb/A of 8-8-8 fertilizer and were sidedressed at the last cultivation with 200 lb/A of ammonium sulfate or ammonium nitrate.

Forage yields were measured by field-sampling harvests beginning shortly after the ears were well formed and continued at 7- to 10-day intervals for 3 to 4 weeks. Shortly after the last field sampling, the remaining forage was harvested for the silo. In sampling the forage, every 35th plant in each of four rows of each entry was removed by hand cutting. A sample of one entry contained from 20 to 30 plants. The sample was weighed, the ears were husked and placed on drying racks, and the residual forage (leaves, stalks, and husks) was chopped and sub-sampled for dry matter determinations. After several weeks of air drying, the ears were shelled, and dry-matter tests of grain and cobs were made. During the last 3 years of the study, the protein contents of both the grain and the leaf-stalk fraction were determined. In determining the effects of fertilizer application, average values of the five hybrids tested were used as a basis for the summary table. The data obtained by sampling the plots on a replicate basis were subjected to an analysis of variance.

RESULTS

The yields of fresh forage changed but little throughout the duration of the sampling period. The percentage dry matter content and total yield of dry matter in the forage, however, increased progressively during this period (Table 1). Yields varied from 50 to 80% each year, indicating a strong seasonal influence.

The yields of dry matter in forage from the fertilized blocks were larger than the yields from the unfertilized blocks. In the first 3 years fertilization caused an increase in forage yield (dry-matter basis) of about 8%, but for the last 2 years on the lower fertility soil the increase was approximately 33%. The difference in each of the first 3 years was not significant, but in the last 2 years, the difference was highly significant. In each season the part of the forage formed by ears increased rapidly during the 3 to 4 weeks during which sampling was done. For this factor, the difference between harvest dates was highly significant, as was also the difference between hybrids. In only one of the five seasons, however, was the effect of fertilization such that there was a marked

TABLE 1

Yield per acre, ear content, and protein content of corn forage grown on unfertilized and fertilized land

Date of harvest	Unfertilized					Fertilized				
				Protein content					Protein content	
	Fresh matter	Dry matter	Ear content[a]	Grain[b]	Leaf-stalk[c]	Fresh matter	Dry matter	Ear content[a]	Grain[b]	Leaf-stalk[c]
	(tons)	*(tons)*	*(%)*	*(%)*	*(%)*	*(tons)*	*(tons)*	*(%)*	*(%)*	*(%)*
8/28/47	9.9	1.72	11.0	——	——	10.8	1.89	11.8	——	——
9/ 4/47	9.7	1.90	25.3	——	——	10.8	2.12	26.4	——	——
9/15/47	10.3	2.62	41.2	——	——	11.1	2.79	41.6	——	——
9/22/47	10.1	2.82	48.9	——	——	10.9	3.00	47.8	——	——
8/16/48	18.8	3.14	22.9	——	——	19.5	3.35	22.2	——	——
8/24/48	18.0	4.07	37.5	——	——	19.5	4.28	36.1	——	——
8/31/48	17.1	4.64	48.5	——	——	19.6	4.95	47.6	——	——
9/ 7/48	16.4	5.22	54.8	——	——	17.6	5.48	54.9	——	——
8/16/49	16.9	3.39	25.4	13.31	7.47	19.8	4.01	26.0	12.49	6.99
8/23/49	16.2	3.74	33.8	10.69	6.90	18.3	4.30	34.7	10.21	6.47
8/30/49	16.0	4.35	42.8	9.56	5.49	18.4	5.00	40.8	9.44	5.42
8/22/50	10.9	2.16	15.1	14.68	6.18	15.3	2.96	20.7	15.06	8.42
8/29/50	11.3	2.43	25.2	10.39	5.80	15.6	3.36	30.4	11.48	8.06
9/ 5/50	11.2	2.62	33.1	8.63	5.64	15.8	3.68	39.3	9.89	7.61
9/12/50	11.3	3.02	44.1	7.78	4.67	15.6	4.19	48.7	9.28	6.48
8/21/51	12.5	2.59	21.3	14.94	7.22	16.4	3.33	24.7	14.07	8.26
8/28/51	13.4	2.75	29.2	12.42	6.48	18.2	3.76	33.2	11.91	7.30
9/ 4/51	13.5	3.43	43.5	10.14	6.01	17.7	4.29	38.3	10.50	7.02

[a] Dry matter of ears as percentage of total dry matter of forage.
[b] Shelled corn; air-dry basis.
[c] Leaf-stalk fraction of forage, including husks; air-dry basis.

and consistent difference between the treated and untreated blocks with respect to the part of the forage which consisted of ears. It should be pointed out that all of the seasons during which this experiment was in progress were highly favorable to corn forage production.

There was little change in the dry-matter yield of the leaf-stalk fraction during the 3 to 4 weeks of the sampling-harvest period. Fertilization, however, increased the yield of the leaf-stalk portion of the forage and for this factor the difference between the fertilized and unfertilized blocks in two seasons was significant and in two other seasons highly significant.

Analyses of the shelled corn from the field-sampling harvests showed that a marked decline in protein content occurred during the 3- to 4-week sampling period. In a few instances, the percentage protein content at the last harvest was only one-half as high as at the first. In two of the three seasons during which protein determinations were made, the percentage protein content of the shelled corn from the unfertilized blocks was higher than that from the fertilized blocks. In one season, the situation with respect to protein content was reversed. The difference between treatments in each of two seasons was not significant and in another season, significant (Table 2).

The percentage protein content of the leaf-stalk fraction of the forage from the unfertilized blocks was higher than that from the fertilized blocks in 1949

TABLE 2

Analyses of variance of percentage protein contents of shelled corn and leaf-stalk fractions of corn forage from unfertilized and fertilized blocks

Source	1949				1950			1951		
	Shelled corn		Leaf-stalk		Degrees of freedom	Mean squares		Degrees of freedom	Mean squares	
	Degrees of freedom	Mean squares	Degrees of freedom	Mean squares		Shelled corn	Leaf-stalk		Shelled corn	Leaf-stalk
Total	29	———	19	———	39	———	———	29	———	———
Hybrids	4	1.447	4	0.178	4	4.752	0.348	4	4.763*	0.525**
Treatments	1	1.661	1	0.403*	1	11.236*	42.890**	1	0.898	6.883**
Sample dates (stages)	2	30.770**	1	7.200**	3	80.127**	5.520**	2	57.508**	3.976**
Hybrid X treatment	4	0.092	4	0.033	4	0.174	0.142	4	0.228	0.169
Hybrid X sample date	8	0.611**	4	0.083	12	1.840**	0.114	8	1.125**	0.026
Treatment X sample date	2	0.299*	1	0.216	3	0.586	0.121	2	1.174**	0.035
Hybrid X treatment X sample date	8	0.047	4	0.038	12	0.214	0.147	8	0.109	0.046

* Significant at the 5% level of probability.

** Significant at the 1% level of probability.

but in the following 2 years the percentage protein content of the leaf-stalk fraction from the unfertilized blocks was not as high as that of the fertilized. It is probable that the application of fertilizer had a greater effect during the last 2 years because of low supplies of available plant nutrients in the field employed during the last 2 years of the trials.

SUMMARY

Under the conditions of these trials, the application of commercial fertilizers to soils for the production of corn forage resulted *(a)* in gains in tonnage of forage as represented by both ear and leaf-stalk fractions; *(b)* in little or no change in the proportion of the forage which consisted of ears; *(c)* in little change in the protein content of the grain (shelled corn) except as influenced by season; and *(d)* in an enhanced protein content of the leaf-stalk fraction of the forage when the crop was grown on soils low in available plant food.

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ANTIBIOTICS IN DAIRY CATTLE NUTRITION. IV. COMPARATIVE EFFECTS OF DIFFERENT LEVELS OF CRYSTALLINE AUREOMYCIN[1] AND A CRUDE AUREOMYCIN FERMENTATION PRODUCT (AUROFAC 2A) ON THE GROWTH AND WELL-BEING OF YOUNG DAIRY CALVES[2]

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Several investigators have shown that feeding aureomycin to young calves exerts a favorable influence on growth and well-being (reviewed by Bartley *et al. 1, 2)*. In those experiments the source of the antibiotic has been either a pure crystalline aureomycin salt or aureomycin contained in fermentation residues. The crude aureomycin fermentation residues or products probably contain, in addition to known amounts of aureomycin and vitamin B_{12}, other substances that could influence calf growth. The experiment reported herein was initiated to compare the effects of pure crystalline aureomycin HCl on the growth and well-being of young dairy calves with an equivalent intake of aureomycin in the form of a crude aureomycin fermentation product (Aurofac 2A).

EXPERIMENTAL PROCEDURE

In an experiment reported previously *(2)*, it was found that calves receiving Lederle's Aurofac by capsule from birth in amounts calculated to supply 45 mg. of aureomycin daily for each 100 lb. of body weight, grew at a significantly faster rate from birth to 25 weeks than calves receiving Aurofac in amounts calculated to supply 15 mg. of aureomycin daily for each 100 lb. weight. Therefore, in the experiment reported herein, one group of calves was fed Lederle's Aurofac 2A in amounts calculated to supply 45 mg. of aureomycin daily, while a second group received 45 mg. of pure crystalline aureomycin HCl daily. A third group received 90 mg. of pure crystalline aureomycin HCl daily, while a fourth group of calves was fed no aureomycin and served as a control. All feeding levels of aureomycin are quoted on a 100-lb. body weight basis. The aureomycin was administered orally once daily by capsule.

Thirty-two female calves of four breeds (Ayrshire, Guernsey, Holstein, and Jersey) were used. A randomized block design was employed. Four animals

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of one breed constituted a block. The animals in a block were randomized among the four treatments. Each block was replicated once, making eight calves in each treatment group.

All calves were born in the Kansas State College dairy herd. They were started on experiment at birth and continued until 25 weeks of age. The method of feeding and management was similar to that described in a previous paper *(2)*. The daily grain intakes were limited to 4 lb. for Jerseys and Guernseys; 4½ lb. for Ayrshires; and 5 lb. for Holsteins.

RESULTS AND DISCUSSION

The amount of sickness encountered in this experiment was slight and was similar in incidence to that reported in a previous paper *(2)*. Diarrhea, pneumonia, and other, undiagnosed, infections, when accompanied by a fever and requiring medication, were classified as severe. Infections of a slight nature not accompanied by a fever were classified as slight. The designation of medium was given to infections that could not readily be classified as slight or severe. The control calves had a moderate amount of infection during the experiment. The infections were classified as three severe, three medium, and six slight. One calf with a severe infection died. The calves receiving Aurofac 2A had one severe infection, two medium, and three slight. Those receiving 45 mg. of pure aureomycin had no severe infections, two medium, and two slight. Those receiving 90 mg. of pure aureomycin had no severe infections, two medium, and two slight. Since the calves in the three groups receiving aureomycin had a lower incidence of infection than the calves in the control group, it would appear that aureomycin had some influence in controlling the types of infections occurring in the environment of this experiment. This agrees with two previous experiments *(1, 2)* conducted at this station. Because of the low incidence of infection in all three groups receiving aureomycin, it is difficult to compare the effectiveness of pure aureomycin with Aurofac 2A in controlling calf infection. However, the limited data indicated little difference in incidence of infection to be ascribed to antibiotic source.

From birth to 25 weeks of age, the weight gains made by the three groups of calves that received aureomycin were superior to the gains made by the control animals (Figure 1). After the relatively slow growth rate during approximately the first 4 weeks after birth, the graph of weekly growth for each group was essentially linear. A statistical analysis, employing the regression coefficient b as the estimate of growth rate, revealed that all groups of calves receiving aureomycin grew at a significantly faster rate from birth to 25 weeks than the control group of calves in the same period (Table 1). There were nonsignificant differences between the group of calves receiving 45 mg. of pure aureomycin and the group receiving 45 mg. of aureomycin from Aurofac. Also, there were nonsignificant differences between the latter group of calves and those receiving 90 mg. of pure aureomycin. However, the difference between the calves receiving 45 mg. of pure aureomycin and those receiving 90 mg. was statistically significant. Although the 45 mg. level of aureomycin from Aurofac

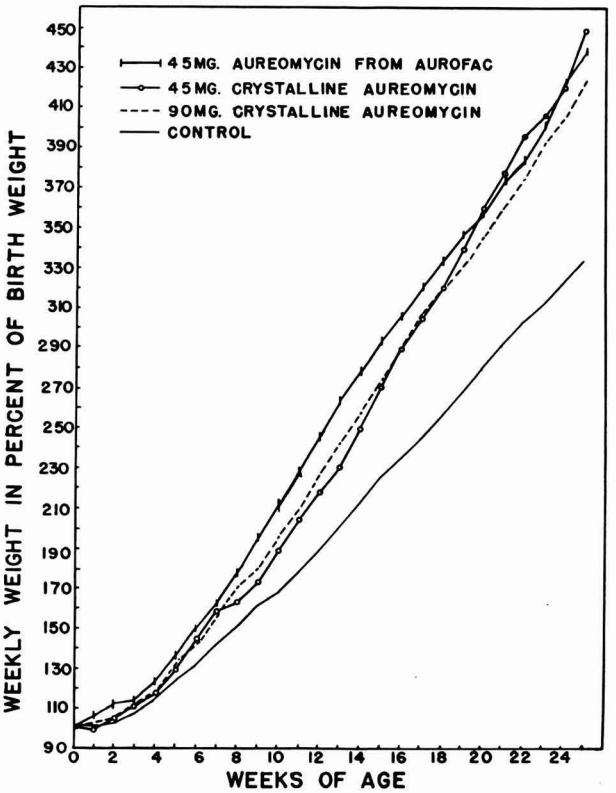

FIG. 1. Comparative growth response of two groups of calves receiving either 45 or 90 mg. of pure aureomycin HCl daily per 100 lb. body weight, of one group receiving 45 mg. of aureomycin from Aurofac 2A daily per 100 lb. weight, and of control calves.

produces a *b* which is slightly smaller than that for the 45 mg. level of pure aureomycin (Table 1), the growth curve for the group of calves receiving 45 mg. of aureomycin from Aurofac (Figure 1) is above all the other growth curves from birth to 19 weeks of age. The growth curve of the group of calves receiving 45 mg. of pure aureomycin lags behind all the other growth curves, except the control group, during the period from birth to 17 weeks of age and especially from 8 to 14 weeks, inclusive. From 20-25 weeks, inclusive, the growth curve for the group of calves receiving 45 mg. of pure aureomycin is above the other growth curves. It is this acceleration in growth following a previous lag that produces a large *b* for the calves receiving 45 mg. of pure aureomycin. To check this, an analysis of variance of the mean weights at 13 weeks of age was made. The analysis shows that the group of calves receiving 45 mg. of aureomycin from Aurofac had a mean weight significantly greater than the mean weight of the group of calves receiving 45 mg. of pure aureomycin.

Since there were some indications that the effects of the treatments differed during the first and second halves of the trial, the data were further analyzed

TABLE 1

Effect of pure aureomycin and Aurofac on the growth rate of calves as measured by the linear regression of weight per pound of birth weight on age

Birth to 25 weeks				Birth to 12 weeks				13 to 25 weeks			
Amt. aureomycin fed[a]	Source	Regression coefficient *b*		Amt. aureomycin fed	Source	Regression coefficient *b*		Amt. aureomycin fed	Source	Regression coefficient *b*	
(mg.)				*(mg.)*				*(mg.)*			
45	pure aureomycin	15.00		45	Aurofac 2A	13.16		45	pure aureomycin	17.51	
		< ns				< as				< ***	
45	Aurofac 2A	14.51	**	90	pure aureomycin	11.93	*	90	pure aureomycin	14.79	
		< ns				< ns				< ns	
90	pure aureomycin	14.10		45	pure aureomycin	11.07		45	Aurofac 2A	14.26	
		< ***				< ***				< ***	
None (control)		10.29		None (control)		8.41		None (control)		11.18	

[a] Per 100 lb. body wt. daily.

ns = difference not significant.

* = difference significant at the 5% level.

** = difference significant at the 1% level.

*** = difference significant at the 0.1% level.

as = difference approaches significance.

by ages of calves from birth to 12 weeks and from 13 to 25 weeks. From birth to 12 weeks, the growth rates of the three groups of calves receiving aureomycin were definitely superior to the growth rate of the control calves. Calves receiving 45 mg. of aureomycin from Aurofac were somewhat superior in growth rate to those receiving the two other aureomycin treatments, although the difference between the calves receiving 45 mg. of aureomycin from Aurofac and those receiving 90 mg. of pure aureomycin was not quite sufficient to be statistically significant. During this period the growth rate of the group of calves receiving 45 mg. of aureomycin from Aurofac was significantly greater than the growth rate of the calves receiving 45 mg. of pure aureomycin.

From 13 to 25 weeks, the three groups of calves receiving aureomycin were also definitely superior in growth rate to the control calves. The growth rate of the calves receiving 45 mg. of pure aureomycin was significantly ($P < 0.001$) greater than the growth rates resulting from each of the other treatments. The calves in the groups receiving 90 mg. of pure aureomycin were not significantly different in growth rate from those receiving 45 mg. of aureomycin from Aurofac.

In an attempt to explain the superior growth response during the first 12 weeks of life resulting from the feeding of 45 mg. of aureomycin from Aurofac, it may be postulated that there is a factor(s) in the crude fermentation product which is not present in pure aureomycin and which benefits calves until rumen synthesis provides this factor(s). Usually by 12 weeks of age a calf that has been consuming hay and grain has what might be considered a functional rumen. If the above postulate is correct, it would be expected that beyond 12 weeks of age the growth response to 45 mg. of pure aureomycin from Aurofac and 45 mg. of pure aureomycin would be similar, all other factors being equal. However, from 13 to 25 weeks the calves receiving 45 mg. of pure aureomycin grew at a faster rate than the calves receiving Aurofac. As explained above, this could be the result of an acceleration in growth following a previous lag from birth to 12 weeks of age of the calves receiving 45 mg. of pure aureomycin.

When Aurofac and pure aureomycin are compared over a feeding period from birth to 25 weeks of age, there appears to be no difference in the growth of calves due to differences in antibiotic source. However, it should be emphasized that the most critical period of a calf's life is the first few weeks and that it was in this period that the crude fermentation product was found to be superior to pure aureomycin.

In the previously-reported experiment *(2)* a level of 15 mg. of aureomycin per 100 lb. body weight was compared with a level of 45 mg. Aureomycin was administered orally by capsule once daily. It was noted that Holstein calves receiving aureomycin at the 45 mg. level grew as rapidly from 1 to 10 weeks as those receiving 15 mg., and both groups receiving aureomycin grew at a faster rate than the control calves. However, after 10 weeks the calves receiving 45 mg. of aureomycin grew at approximately the same rate as the control calves while those receiving 15 mg. grew at a faster rate than the control calves. In the Jersey breed the 45 mg. level of feeding produced a greater growth response than the 15 mg. level during the whole experiment. It was conjectured that since

Holsteins received considerably more aureomycin per calf than did Jerseys, 45 mg. for each 100 lb. of weight is an excessive intake for Holsteins after 10 weeks of age and may in some way interfere with rumen function.

The results of the present experiment and that previously reported *(2)* and discussed above seem to indicate that high levels of aureomycin feeding are of greater benefit than low levels during the first few weeks of life and that as a calf becomes older and more dependent upon its rumen the level of aureomycin feeding should be reduced to obtain a maximum growth response. It would appear that the best levels to use would be 45 mg. of aureomycin per 100 lb. body weight daily from birth to 12 weeks of age and 15 mg. of aureomycin per 100 lb. body weight from 13 to 25 weeks of age. There seems to be no advantage in increasing the level of feeding from 45 mg. to 90 mg. during the first 12 weeks of life. These suggestions may not apply under all conditions, especially if a large incidence of infection prevails during approximately the first 12 weeks of life. Under such circumstances higher levels of aureomycin feeding than those suggested may be needed to produce a response during the first few weeks of life.

TABLE 2

Effect of pure aureomycin and Aurofac on feed intake and efficiency of gain of calves from 1 through 16 weeks of age

Amt. aureomycin fed/100 lb. wt. daily	Source	No. of calves	Av. weekly intake/calf /100 lb. body wt.			TDN[a]/lb gain		Digestible protein[b] /lb gain	
			Skimmilk	Hay	Grain				
			(lb.)	*(lb.)*	*(lb.)*	*(lb.)*		*(lb.)*	
None (control)		7	46.9	5.1	9.6	2.77	<**	0.58	<*
45 mg.	Aurofac 2A	8	43.3	5.8	11.7	2.28		0.45	
45 mg.	pure aureomycin	8	44.9	7.0	8.8	2.22	ns	0.47	ns
90 mg.	pure aureomycin	8	43.8	5.8	11.4	2.32		0.46	

[a] Calculated from Morrison's *(3)* tables using the following values: whole milk, 16.3%; skimmilk, 8.7%; grain (equal parts by weight of corn and oats), 75.1%; alfalfa hay, 50.3%.
[b] Calculated from Morrison's *(3)* tables using the following values: whole milk, 3.3%; skimmilk, 3.4%; grain, 8.0%; alfalfa hay, 10.5%.
** = Difference significant at the 1% level.
* = Difference significant at the 5% level.
ns = Difference not significant.

The effects of the different treatments on the average weekly consumption of skimmilk, hay, and grain are shown in Table 2. The feed intakes were studied for the period from 1 to 16 weeks, inclusive. For purposes of comparison, the intakes are expressed on an equal body weight basis, computed by determining the geometric mean weight for each calf and using it to convert the average weekly feed intake to a 100-lb. body weight basis. An analysis of variance of these data showed that there were no significant differences among the groups in skimmilk, hay, and grain consumption. The whole milk intake was not

analyzed. The three groups of calves receiving aureomycin used significantly less total digestible nutrients and digestible protein per pound of gain than the control calves. The differences among the various aureomycin treatments were not significant. In two previous experiments *(1, 2)* conducted at this station, calves receiving aureomycin made more efficient gains than the control calves. These differences were not statistically significant because of the large amount of calf-to-calf variation. However, it is worth noting that in three consecutive experiments there has been some tendency for aureomycin-fed calves to make more efficient gains than control calves.

SUMMARY

This experiment was initiated to compare the effects of pure crystalline aureomycin HCl and a crude aureomycin fermentation product (Aurofac 2A) on the growth and well-being of young dairy calves.

Employing a randomized block design, 32 female calves of four breeds were divided into four groups. Calves in one group received Lederle's Aurofac 2A in amounts calculated to supply 45 mg. of aureomycin daily for each 100 lb. of calf weight, and a second group received 45 mg. of pure aureomycin HCl. A third group received 90 mg. of pure aureomycin HCl, and a fourth group received no aureomycin and served as a control.

The calves in the three groups receiving aureomycin had a lower incidence of infection than the calves in the control group. No difference in incidence of infection resulting from the difference in antibiotic source was observed.

From birth to 12 weeks the growth rates of the three groups of calves receiving aureomycin were significantly greater than that of the control calves. The growth rate of the calves receiving 45 mg. of aureomycin from Aurofac was significantly greater than that of the calves receiving 45 mg. of pure aureomycin and greater, though not significantly, than that of the calves receiving 90 mg. of pure aureomycin.

From 13 to 25 weeks the growth rate of the three groups of calves receiving aureomycin was also significantly greater than that of the control calves. The growth rate of the calves receiving 45 mg. of pure aureomycin was significantly ($P < 0.001$) greater than the growth rate resulting from all other treatments. The growths of the calves in the groups receiving 90 mg. of pure aureomycin and 45 mg. of aureomycin from Aurofac were not significantly different during this period.

From birth to 25 weeks of age the growth rate of calves receiving 45 mg. of aureomycin from Aurofac was not significantly different from that of calves receiving 45 mg. of pure aureomycin. Furthermore, there appeared to be no advantage in the use of 90 mg. of pure aureomycin because the growth rate of calves receiving 90 mg. was significantly lower than that of the calves given 45 mg. of pure aureomycin.

Feed intakes and efficiency of gains were studied for the first 16 weeks of the experiment. An analysis of variance of the feed consumption data showed

that there were no significant differences among the groups in skimmilk, hay, and grain consumption. The three groups of calves receiving aureomycin used significantly less total digestible nutrients and digestible protein per pound of gain than the control calves. The differences among the aureomycin treatments were not significant.

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PROCEEDINGS OF THE FORTY-NINTH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

P. R. ELLSWORTH, Secretary-Treasurer

The American Dairy Science Association met for its opening session in Schwab Auditorium, Pennsylvania State University, State College. Following the singing of the National Anthem, the invocation, and an address of welcome by Dean Lyman Jackson of the Pennsylvania State University College of Agriculture, D. V. Josephson, presiding officer, introduced President W. V. Price, who gave the following address:

IT'S YOUR ASSOCIATION

Dean Lyman Jackson, we thank you, Sir, for your friendly greetings. Members of the American Dairy Science Association are most happy to be here at Pennsylvania State University for our 49th Annual Meeting.

We are grateful for the warmth of your welcome; for the careful planning of your faculty, and for the hard work of all the folks here at State College who are making this meeting possible.

Walter V. Price

The events of this week at State College bring to a climax the first half century of progress of the American Dairy Science Association.

It's a privilege to talk to you today. We haven't seen much of each other since 1952 when you effectively limited my conversations at our sessions to the hardworking men on your Executive Board. So I speak now in part for them and in part for the 177 committee members who work for you in almost complete obscurity. They do have their rewards—they enjoy the cooperative effort, the spirit of teamwork, the personal friendships formed, and the pride of serving a great and respected Association.

Secretary-treasurer. I am personally sorry to announce that this is the last year of eminent service for our secretary-treasurer, Perry R. Ellsworth. In March of this year, Mr. Ellsworth told me he had decided to join the staff of the Milk Industry Foundation. He wrote—"I leave . . . with deep regret. My associations have been most cordial throughout the past six years, and I shall never be able to repay the organization and its officers, both past and present, for the invaluable experience I have gained. My sincere hope is that I have executed the job assigned in a satisfactory manner in the years past." You may want to tell Perry Ellsworth personally that his efforts have been sincerely appreciated by all of us. He took over the work at a difficult time. He has done a man-sized job in handling these responsibilities. Later, I am sure, you'll want to take some official action to express your sentiments.

Your Executive Board is considering several courses of action. One is to appoint a new secretary-treasurer to carry on as in the past. Another is to reduce the responsibilities of secretary-treasurer by employing professional services to handle advertising and subscription duties. The volume of our business operations at this time may justify the employment of a full-time manager with his own office. The decision will develop as we learn the facts of each possibility. We will keep you informed.

The scope of your activities, interests and problems increases year by year. Nearly two years ago I had decided that I wanted to talk with you about them today. It's your association! Most of your activities and problems originate in the declared objectives of your constitution. You remember the main points—stimulate research—improve teaching and extension methods — cooperate by educational methods to advance the welfare of industry—and to publish results of scientific work in the *Journal of Dairy Science.*

Constitution. A few years ago Past-President Bendixen began to modernize your constitution. This year E. L. Jack, I. W. Rupel, and Earl Weaver finished their study of it and registered their approval. The revision will be submitted to you. In its new form the constitution finally catches up with your wishes, especially in respect to the *Journal of Dairy Science.*

The new Journal. The *Journal* alone might provide inspiration for our entire discussion. Your original papers have made the *Journal* a leading publication in the field of dairy science.

The new popular section is attracting many new readers and apparently pleasing old ones. For the first time, the *Journal* is bringing to you each month the varied editorial opinions of leaders. These editorials and "Letters to the Editor" provide a new forum for open discussion. Don't expect to find unanimity of opinion in these free discussions. You will find expressions of deep concern and honest attempts to clarify the issues of the day. We salute these efforts in the search for truth. Recently in this section of the *Journal* you have seen descriptions of new analytical procedures and brief technical notes. This promises to be a valuable method of publishing brief scientific communications.

The section of abstracts has been undergoing a series of changes in form and content to make it conform more closely with your expressed desires and needs. Through the *Journal of Dairy Science* you are serving your fellow members and industry.

A moment ago I used the term "free" discussions. That was purely a figure of speech. To print our original articles costs about five cents a word; words in the popular section are a little less expensive—there are more on each page. But this leads us quite naturally to the knotty problem of "making ends meet."

Money. Your Association had an income in 1953 of approximately $43,000 — a 14% increase in income over 1952. Members, subscribers, and student affiliates paid 65% of the total; advertising contributed 16%. Expenses in 1953 approximated $47,000, or an increase of 35% over 1952. Printing the *Journal* took 64% of the total; editorial costs, 13% and secretarial services, 13%.

You have already estimated our loss per member at about $2. You won't be surprised to know that this has happened before in our 49-year history. While this is the time for your business managers—the Executive Board —to be concerned, remember that your Association at the end of 1953 had a net worth of $28,000. That is an unusual situation for comparable associations.

Balancing the budget is essential. Developing the objectives of this Association is the reason for our being. Can we accomplish both? Let's think first about *Journal* management.

Journal management. Scientific journals perform the primary objective of every research project. If scientists should bury their findings in a notebook, how could research be justified? Research is not completed until it is published. The scientific journal is the most powerful equipment at the command of the scientist. There has been a huge increase in volume of scientific material published in all journals. Costs of publishing have increased even faster than volume. More people are doing research; more money from many sources is being spent in research work.

From the National Science Foundation comes a survey on management problems of scientific journals. You should read this material and the series of papers on scientific journals in *Science* **119**: 357-9, and 529-39. 1954. The Foundation survey shows that membership dues provided generally over 45% of the support for publications the size of our *Journal.* Our membership dues gave us 36% of our income in 1953. Advertising revenues contributed 14% in all journals; our advertising gave us 16% of our income in 1953. Financial problems of these journals were reported as "critical" for some and of "serious concern" for all.

Shorter articles by authors might help the situation according to some suggestions. Consolidation of journal enterprises offers some possible economies. Additional support from advertising might provide relief. The survey showed that the journal with small circulation is handicapped in this field. Our circulation falls in that class. Other sources of income were proposed by the rugged individualists—higher subscription rates, higher reprint charges, page charges for publication, more promotional efforts. Individualists who weren't quite so rugged were in the minority; they hoped for support from a society, from a foundation, from the government, or from industry.

You will be interested to know that the members of your Board of Directors are still rugged individualists.

So much for the survey of the National Science Foundation. Let's consider for a moment the possibility of increasing sales of advertising space in the *Journal of Dairy Science.* Sale of advertising space in the *Journal* is one of the perplexing problems now confronting your Journal Management Committee. Advertising in the *Journal* now provides 16% of our income. It is exceeded only by revenues from membership dues and subscriptions. Potential sales of advertising space depend upon the editorial content of a journal, upon its influence with subscribers and with industry, upon its physical appearance, and upon its volume of circulation. Actual sales of advertising space depend upon sales effort. Our secretary-treasurer in years past has been largely responsible for selling advertising space. He has been aided at times by the editor and occa-

sionally by other members. These men have always regarded themselves as amateurs in a highly competitive and professional game.

We have been investigating the possibilities of engaging professional services. We are trying to weigh such facts as relation between advertising revenues and such things as dimensions of the *Journal*, the mechanics and costs of publication, flexibility of page arrangement, reader appeal, and total circulation.

Cooperation. Let's consider now the activities of our Association that tend to fulfill that objective of our constitution which mentions "cooperation." Your officers and committee members know that the spirit is willing—even though the checking account is sometimes weak.

Last fall we received a letter from a man who is noted, among other things, for his interests and achievements in the fields of cooperation. Secretary of Agriculture, Ezra T. Benson, asked the Association for suggestions to strengthen American agriculture through research and education. After talking over methods with Director N. N. Allen, and after testing them on our colleagues at Wisconsin, we put the problem up to you as individuals. You responded by submitting nearly 400 projects in research, extension, and education. Congratulations and thank you!

Last year you heard an excellent report on the work of the National Research Council by your representative, W. E. Krauss. He recommended that we become an associate of the American Institute of Biological Sciences, which is sponsored by the Council. This was done. This year Dr. Krauss recommends that we continue close relations with the National Research Council when the importance of the biological sciences seems dwarfed at the moment by the stature of the physical sciences.

Your Association cooperates with many other organizations. This is possible only by the cheerful, self-sacrificing efforts of certain ones of your fellow members. Truly, I say to you, they have their rewards—but they are not of this world's goods. I should like to recognize some of these cooperative ventures.

The Dairywide Coordinating Committee on Nutrition Research. Your representatives, R. G. Hansen and J. D. Ingle, are working with officials of leading dairy associations and the National Dairy Council. Their objectives are to make better use of scientific information on human nutrition and the nutritive value of dairy products; to encourage research efforts in these fields; and there are others.

The Dairy Remembrance Fund, Inc. Your representative is D. V. Josephson, who may help in the allocation of funds for research and the welfare of the dairy industry.

Public Health Service and Food Sanitation Advisory Board. W. M. Roberts is your first representative to be appointed to this board. The opinions he has advanced during his brief service indicate that we are fortunate to have a voice speaking for us with such an understanding of industry, science, and the public welfare. We agree with Surgeon General Leonard A. Scheele that this closer relationship between the Public Health Service and the Association should be mutually advantageous.

Committee on Cooperation with Regulatory Agencies. A. C. Dahlberg, J. T. Miles, and W. M. Roberts have some knotty problems in properly evaluating conditions for high quality milk production.

Committee on Inter-Society Cooperation. L. A. Moore is your representative. This may develop into an Institute of Agricultural Sciences comparable to the American Institute of Biological Sciences.

Public Relations. Let's consider another phrase in our constitution—that of "advancing the general welfare of the dairy industry." In line with the spirit of service, your Executive Board has caused to be created a committee on Public Relations under the leadership of I. A. Gould. Working with him are F. J. Arnold, H. A. Bendixen, R. E. Frost, H. B. Henderson, and G. E. Holm. These men propose a policy and program of public relations to strengthen our Association. They want to emphasize cooperation with industry, improvement of teaching methods, education of new leaders, and dissemination and use of scientific information. They suggest that each member can enjoy more fully the responsibilities, activities, and interests of the Association if he is completely informed on its policies and practices. The ultimate goal is greater participation in annual meetings, better internal communication, written instructions for officers and committees, and maximum utilization of committee studies.

When the proposals of this committee are presented at our business meeting we recommend vigorous discussion. Get all the facts, by questions or debate; if you do, you will probably approve the committee's work. Activation of such a program requires careful planning. Successful accomplishment depends, as always, on the efforts of members with a concern.

Student Affiliates. The activation of an improved public relations program might well begin with student affiliates. Our student affiliates are organized in 26 branches with 301

members. The *Journal* is offered to affiliates for $5. If the *Journal* is a part of his educational program, we believe the student tends to enter more easily into full membership after graduation. Our Committee on Student Affiliates with Chairman E. L. Thomas is trying further to increase this tendency by publishing a student "letter."

Recruiting of students. Attracting student affiliates and future leaders should logically begin at the high school level. I have looked with envy at student programs of some sections of the American Chemical Society. Harvey R. Russell (*Chem. & Eng. News,* **31**: 3358, 1953) advocates cooperation of the chemist with educational institutions in his local community. If we followed Russell's suggestions we would provide or share experiences with students and teachers and we would explain our work and tell the need for replacements in all fields of dairying. His program gives detailed methods for actions. Examine it, if you want to know how you can become a committee of one to attract new leaders to this field of work.

You have all noticed the self-critical, analytical editorials on student problems and careers that have been rumbling ominously in the *Journal* for the past 9 months. Does that 9 months period suggest to you that we ought to be looking for action of some sort at this time?

Industry might reexamine its policies of hiring, indoctrinating, and using its college recruits. It might offer summer jobs for pay that would approximate student earnings on a road gang. Industry might sponsor club activities and publications, as some concerns did this year for the Virginia Tech. chapter of A.D.S.A.

In this area of student encouragement we have the notable cooperation of the Dairy Industries Supply Association. The Student Judging Contests are soundly conceived in purpose and action. Again, we might point to the awards program of the Ralston-Purina Company. These awards offer strong incentives to young men interested in scientific work at the graduate student level. We welcome and acclaim such programs.

Universities might reexamine curricula in cooperation with industry. This leads to events like "Dairy Tech Career Day" at Ohio State University.

H. P. Davis of our Curriculum Committee says, "If the American Dairy Science Association is to maintain its rightful leadership in the dairy industry, it must take the lead in helping to guide educational policy."

Sometimes the teaching of dairy science has less glamour, if not less reward, than research work. Is it possible that we need to inspire more interest in teaching by some show of tangible approval? An Association committee headed by C. E. Wylie believes this is possible. This committee for nearly 2 years has been studying and developing the idea and technique of presenting awards to outstanding teachers of dairy science. This would be comparable to the awards now given for superior attainments in research fields. The idea is most welcome to some of us who know what we owe to such inspiring teachers as Eckles, Hastings, and Mortensen.

Finally, to help our student program, we need an enthusiastic, factual editorial explaining the opportunities, the hard work, and the rewards in the dairy industry. It should be reprinted by the thousands. You should have it to distribute when you are asked to talk about the dairy industry in your local high schools or service clubs, or to give to high school students who visit your universities or your plant operations.

We are deeply interested in the program of recruiting and training leaders for the important work of the dairy industry. We must recognize our student affiliate program as an integral part of that ultimate objective.

Conclusion. This is a very brief glimpse of some of the many and varied interests of your Association. I have tried to show you some of its objectives and problems—as they look to me. I hope you sense, as I do, the opportunities this Association affords its members to work with each other and with similar groups. Such cooperation aids us in our search for truth; it helps to improve educational methods. It strengthens us as we try together to use the information we have for the public good.

This morning the American Dairy Science Association meets in this room. It occupies your seat. How far it will go in the attainment of its ultimate objective depends only on how far you are willing to go.

It's YOUR Association!

Chairman Josephson then introduced Doctor Milton Eisenhower, President of the Pennsylvania State University, who introduced the Honorable Ezra Taft Benson, Secretary of Agriculture, United States Department of Agriculture, who delivered an address on the current dairy problems.

The opening session adjourned at the conclusion of Secretary Benson's address.

BUSINESS MEETING
THE AMERICAN DAIRY SCIENCE ASSOCIATION

JUNE 24, 1954

President Price called the meeting to order at 10:30 A.M. in Room 121, Sparks Building. There were 250 members present.

REPORT OF THE EXTENSION SECTION

At the first meeting of the Section, which was scheduled as a DHIA-IBM Committee meeting, a review of the use of IBM equipment in processing DHIA work in six states was presented. J. F. Kendrick discussed the new IBM machines which might make it possible to process DHIA records on a national basis.

The first regular sectional meeting was called to order by Chairman S. N. Gaunt on Tuesday morning, June 22. The scheduled program was followed. Thirteen exhibits were discussed by members who prepared them, and six others were on display as self-explanatory.

E. T. Itschner presided at the session Wednesday morning, June 23. Papers listed in the program were presented and discussed.

The business session was called to order by Chairman Gaunt at 11:00 A.M. After dispensing by vote with the reading of last year's minutes, the following committee reports were presented:

Teaching methods, by L. H. Stinnett, *Chairman.*

4-H Club, by C. W. Nibler, *Chairman*

Dairy Records, by M. E. Singer, *Chairman.*

Resolutions, by Delmar Young in the absence of Chairman Ramer Leighton.

A resolution commending the Pennsylvania State University staff for the fine facilities provided was presented and approved unanimously. A copy of the resolution was sent to the Chairman of Committee on Arrangements.

The Nominating Committee of Rich, Blackburn, and Heebink, with the latter acting as chairman, brought in three nominations for secretary of the Extension Section. James Burke was elected.

Before adjournment of the business session, Vice-Chairman Itschner made announcement of appointments to committees.

The Wednesday afternoon session was held jointly with the Production Section, and a report of the symposium on "Sire Evaluation" and the joint committee reports that followed are to be made by the secretary of the Production Section.

The Thursday morning session was devoted to 4-H club work, and papers as scheduled were presented.

Respectfully submitted, S. N. Gaunt, *Chairman;* E. T. Ischner, *Vice-Chairman;* George Werner, *Secretary.*

Upon motion duly seconded, the report was accepted.

REPORT OF THE PRODUCTION SECTION

The Production Section held eight sessions, which included Artificial Insemination and Reproduction, Calf Nutrition, Silage Production and Feeding, Physiology, Rumen Physiology, Pastures and Grazing, Genetics, and Nutrition and Management. Ninety-six papers were read as listed in the official program.

The Production Section business meeting was held at 11:00 A.M. Wednesday, June 23, with Chairman P. L. Kelly presiding. The report of the Joint Committee of the Manufacturing and Production Sections on Antibiotics in Milk was read by W. A. Krienke, *Chairman.* Krienke moved the reports be accepted. The motion was seconded and passed.

The report of the Resolutions Committee was presented by W. H. Riddell, who was assisted by I. W. Rupel and V. R. Smith. The resolution was as follows: "Whereas the officers of the Production Section of the American Dairy Science Association have arranged and conducted an excellent program for the members and guests of the Association: Therefore, be it resolved that we thank and commend those responsible for the quality of the papers presented, the efficient manner in which the meetings have been conducted and the excellent facilities provided for the comfort and convenience of the members while guests of the Pennsylvania State University."

A report of the Dairy Cattle Judging Committee was read by G. W. Trimberger, since none of the committee members were present. The sections concerned with the arrangements of classes for the contest, the availability and classification of original and amended rules for

conduct of the National Intercollegiate Dairy Cattle Judging Contest, the "Determination of Ratings," and the elimination from the contest of animals which have received wide publicity were recommended for adoption and duly seconded. After limited discussion of these sections they were passed. The section on "Eligibility of Contestants" was not passed. D. M. Seath moved that this section be tabled and receive additional study. G. W. Trimberger suggested the matter be referred to the Dairy Cattle Coaches conference held just prior to the Waterloo Contest. Their recommendations would be considered by next year's Dairy Cattle Judging Committee in making their report to the Production Section. D. M. Seath accepted the change in his original motion. After considerable discussion, the motion was seconded and passed. The section on "Method of Conduct" dealing with inspection of cattle was amended by I. W. Rupel. The motion as amended is as follows: "The number of participating contestants judging one ring of cattle at a time shall be limited to the number of teams entered in the contest. This procedure may necessitate more space for effective contest operation." The motion as amended was seconded and after discussion duly passed.

The section on Number of Contests in which a student should participate was amended upon the motion of W. W. Snyder, as follows: "A literal interpretation of the resolution passed in 1952 by the A.L.G.C.U. Association would arbitrarily limit a student to three dairy cattle judging contests in his collegiate career." A. I. Mann, representing the Resident Instruction Section of the A.L.G.C.U. Association, expressed the desire to work with the A.D.S.A. Dairy Cattle Judging Committee in this regard.

The Nominating Committee, composed of L. O. Gilmore, I. W. Rupel, and H. C. Dicke, *Chairman*, recommended the names of Glen Beck and G. W. Trimberger for nomination as secretary and moved that the nominations be closed. The motion was seconded and passed. G. W. Trimberger of New York was elected secretary. K. L. Turk moved that the section elect R. E. Erb, present vice-chairman, to serve as chairman and N. P. Ralston, present secretary, to serve as vice-chairman the next year, as had been the previous custom. The motion was seconded and passed.

At the 1953 session of A.D.S.A. it was moved that a committee be appointed to study the whole procedure of paper submission and policy for acceptance of papers for inclusion in the program of the production section, the committee to report by December 1, 1953. The new chairman, P. L. Kelly, was to work with this committee during the coming year. Chairman Kelly appointed N. N. Allen, G. W. Hyatt, Jr., and L. O. Gilmore, *Chairman,* to make recommendations for guidance in the conduct of the production sessions at annual meetings of the A.D.S.A. for the arranging of the programs to be presented. These recommendations were sent to each state dairy department. L. O. Gilmore, *Chairman,* reported on the recommendations of this committee and moved the acceptance of the report. The motion was seconded and passed.

After remarks of appreciation by P. L. Kelly for the fine cooperation he had received during his term of office, the meeting was adjourned.

The Production Section met for two joint sessions with the Extension Section. During the first session on Wednesday, June 23, a symposium on Sire Evaluation was held, with S. N. Gaunt serving as chairman. About 250 people were present. Papers were presented as follows:

Let's Look at the Record. J. F. Kendrick, USDA, Washington, D.C.

Limitations of Our Present Methods in Selection as Influenced by Environment. Robert Laben, Univ. of California.

New Tools as Aids in Sire Selection. J. E. Legates, N. C. State College.

P. L. Kelly served as chairman during the reading of the joint Production-Extension Section committee reports. Approximately 190 people attended this session. The following reports were given:

R. G. Connelly of Virginia reported for the Dairy Cattle Health Committee. Report adopted without discussion.

Ralph Corbett of Maine reported for the Dairy Cattle Breeding Committee. After discussion, it was voted to delete the first sentence under the section of "Reporting of Sire Proofs." The report was then approved.

In the absence of F. W. Atkeson, *Chairman,* Hilton Boynton of New Hampshire reported for the Dairy Cattle Type Committee. Report was adopted without discussion.

R. E. Erb of Washington reported for the Breeds Relation Committee. Report was adopted with some discussion concerning the feeding of sodium propionate.

R. F. Loree of New Jersey reported for the Purebred Dairy Cattle Association.

H. A. Herman of Missouri, Executive Secretary of N.A.A.B., reported for the National Association of Artificial Breeders.

Respectfully submitted, P. L. Kelly, *Chairman;* E. R. Erb, *Vice-Chairman;* N. P. Ralston, *Secretary.*

Upon motion duly seconded, the report was accepted.

REPORT OF THE MANUFACTURING SECTION

Papers and symposia were presented as listed in the official program of the Association. The business meetings were held at 11:00 A.M. and 4:30 P.M. on June 23, with Chairman A. J. Morris presiding.

L. K. Crowe, Chairman of the Nominating Committee, presented a slate of candidates from which the following officers were elected for the coming year: G. H. Hartman, *Chairman*; W. M. Roberts, *Vice-Chairman*; and H. L. Templeton, *Secretary.*

Reports of the following committees were presented:

1. Butter. G. H. Wilster, *Chairman.* The report of this committee was published in the May, 1954, issue of the *Journal.* Because of the national situation, the committee was asked to continue its major project "sponsoring activities that have for their purpose the improvement and standardization of the quality of butter as sold to the ultimate consumer."

2. Nomenclature and Methodology of Milk Proteins. A. M. Swanson, *Chairman.* A symposium on milk proteins was presented at the meeting. The committee is to make a comprehensive review of the literature for the purpose of assembling all of the known properties of the proteins obtained from milk. Such a review is to provide the necessary information for selection of a framework for classification.

3. Evaluation of Methods for Determining the Activity of Cheese Cultures. H. C. Olson, *Chairman.* No Report. The committee was discontinued with the provision that the incoming chairman could use his discretion as to the need for its reactivation.

4. Antibiotics of Milk. W. A. Krienke, *Chairman.* The need for a continuation of educational efforts pertaining to antibiotics was recognized. Continuance of the committee was approved with the recommendation that extension personnel be added.

5. Curd Tension. H. E. Calbert, *Chairman.* The recommendation that no action be taken on any modification of the Association's method for determining curd tension until present research has been completed and a report made available to the public was approved and the work of the committee continued.

6. Judging Dairy Products. G. M. Trout, *Chairman.* The section reaffirmed its belief that the annual dairy products judging contest furnishes a natural incentive in the training of dairy leaders and is most helpful in promoting the perpetuating standards of quality of dairy products. The section is also most appreciative of the fine cooperation of the Dairy Industries Supply Association for its continued support. The committee was commended and its work continued.

7. Uniform Procedure for Making Acidity Determinations of Fluid Dairy Products. J. G. Leeder, *Chairman.* The committee made recommendations on a technique for testing the acidity of chocolate milk. Recommendations of the committee were accepted and its work continued.

8. Practical Aspects of the Operations of the Dairy Industry to be Included in the Section Program. G. H. Hartman, *Chairman.* The committee arranged three practical panels for the 1954 program that were as follows: *(a)* Modern methods for increasing productivity in dairy plants, *(b)* In-plant training of supervisory personnel, and *(c)* Dairy waste. The work of this committee is to continue with the chairman to be appointed by the chairman of the section.

9. Resolutions. Burdet Heinemann, *Chairman.* No resolutions were submitted to the section and it was stated that section representatives were cooperating with the Association committee on join resolutions.

10. Score Card for Cottage Cheese. H. C. Olson, *Chairman.* A tentative score card for cottage cheese was presented. A committee is to be appointed to present a recommended score at the next meeting.

The section expressed its appreciation to the officers for their work during 1953-54.

Respectfully submitted, A. J. Morris, *Chairman;* G. H. Hartman, *Vice-Chairman;* W. M. Roberts, *Secretary.*

REPORT OF A.D.S.A. REPRESENTATIVE TO THE NATIONAL RESEARCH COUNCIL FOR 1953-54

Your representative to the National Research Council has maintained his usual associations with that organization throughout the year, chiefly in the capacity of Chairman of the Agricultural Board and as a member of the Executive Committee of the Division of Biology and Agriculture. It was impossible for your representative to be present at the annual meeting of the Division on May 15, but Dr. J. C. Shaw of the University of Maryland attended as observer for the A.D.S.A. and provided your representative with material from that meeting.

Biology Council

The most important new development within the Division was completion of membership on the Biology Council which will become the chief advisory body to the Division. The Biology Council is comprised of 16 eminent scientists representing all fields of biology. Paul Weiss, Chairman of the Division, is also serving as Chairman of the Biology Council. Members of this Council are for the most part biologists, geneticists, botanists, zoologists, bacteriologists, chemists, and physiologists. The following four members are associated with institutions with programs in or related to agriculture:

Stanley A. Cain, Chairman, Dept. of Conservation, School of Natural Resources, University of Michigan.

Sterling B. Hendricks, Head Chemist, Division of Soil and Plant Relationships, Agricultural Research Service, USDA.

Harold B. Tukey, Head, Dept. of Horticulture, Michigan State College.

Perry W. Wilson, Professor of Bacteriology, University of Wisconsin.

At its first meeting the Biology Council agreed to study trends of biological research and sociological factors affecting them, for example, biological education, communication, personnel, public relations, and support of research. The Council will receive information from a network of correspondents yet to be organized. These will be in groups of five, strategically located, and will be expected to cover developments in their territories and report to the Council through its secretariat.

Committee on Educational Policies

This new seven-man committee, with H. M. Phillips, Dean of the Graduate School of Emory University, *Chairman,* is intended primarily to study the needs and opportunities in biology so as to stimulate greater interest in the biological sciences and improve the teaching of biology at all levels. Precollege education, teacher training and recruitment, college education, general education, education for the biology major, preprofessional education and professional biologists, and technical training and techniques are the areas in which this committee will work.

Agricultural Board

The second joint meeting of the Agricultural Board with the Agricultural Research Institute was held at the National Academy of Sciences on November 22 to 24, 1953. Attendance was good; there was enthusiastic reception of the papers, and stimulating discussion. The Projects and Proposals Committee of the Agricultural Research Institute made numerous valuable suggestions regarding activities of the Board, some of which have already been followed. Copies of the Proceedings of this meeting may be obtained on request from the National Research Council. Committee activities of the Board are herewith briefly reviewed:

Committee on Animal Health. Two new subcommittees have been appointed: (1) Infertility in farm animals, (2) Bloat in ruminants. The latter committee will review critically new evidence and issue a revision of the first bloat report published in 1945.

Committee on Brucellosis and Leptospirosis. The name of the committee was changed to include leptospirosis because this disease is also transmitted to man from cattle and swine and produces clinical manifestations similar to brucellosis. During this year the committee promoted the adoption and commercial production of a standard Brucella antigen in order to establish uniform agglutination tests by standardized diagnostic procedures.

Committee on Animal Nutrition. The series of reports from this committee issued heretofore as Recommended Nutrient Allowances for Domestic Animals has been redesignated as Nutrient Allowances for Domestic Animals. Revised reports for swine and poultry have been published in this new series and new reports on dogs, foxes and minks, and rabbits are available. Revisions of the reports on dairy cattle, beef cattle, and sheep are in progress.

In response to a request from the Institute of Animal Resources, the committee has undertaken to develop nutrient requirements for laboratory animals including the rat, mouse, guinea pig, monkey, and hamster. The committee also is encouraging cooperative research and feeding trials for testing the efficacy of

nutrient formulations in producing the type of animals desired for specific purposes.

Committee on Feed Composition. Feed composition data in terms of 64 nutrient constituents for several thousand feedstuffs are being collected and recorded on cards adapted for I.B.M. mechanical sorting.

Committee on Preservation of Indigenous Strains of Maize. About 8,000 strains are now in storage in Mexico, Colombia, and Brazil, as well as in stand-by storage at Glenn Dale, Maryland. Collections in the United States and Canada are in active storage at Ames, Iowa.

Committee on Plant and Crop Ecology. Owing to termination of financial support, this committee and its six subcommittees, were dissolved.

As a result of a recommendation made by the American Dairy Science Association two years ago, an ad hoc committee on Animal Breeding and Genetics has been appointed consisting of J. L. Lush, *Chairman*, N. P. Ralston, T. C. Byerly, and L. M. Winters. This committee will prepare a report and submit recommendations to the Agricultural Board for areas of activity and personnel for a permanent committee on animal breeding and genetics.

The Board has taken steps to appoint new committees in the fields of water conservation and utilization, range and pasture problems, plant diseases and pests, fats and oils, and farm machinery and mechanization.

Food and Nutrition Board

Of greatest significance to this Association are the activities of the Food and Nutrition Board relating to its Committee on Food Protection and Committee on Food Fortification Policy. The Board has been called into consultation with the Food and Drug Administration for advice on principles which should govern the use of non-nutritive artificial sweeteners and of vitamin-mineral dietary supplements. The Committee on Food Protection will undertake the review of the subject of use of food chemicals. The Committee on Food Fortification Policy has issued a "Statement on General Policy in Regard to the Addition of Specific Nutrients to Foods," which is available in leaflet form from the National Research Council.

American Institute of Biological Sciences

During the year the National Association of Biology Teachers became a member of the American Institute of Biological Sciences and the American Physiological Society dropped from membership to affiliate status. Three affiliate societies were gained during the year. There are now 18 member societies, 12 affiliate societies, and 18 associates.

Your representative has recommended to the Board of Directors of the American Dairy Science Association that the American Dairy Science Association continue as an affiliate member of the American Institute of Biological Sciences.

The *Publications Committee* of A.I.B.S. is encouraging further development and completion of a commercial model of Shaw's Rapid Selector which will select and photograph at high speed abstracts of desired subjects from a reel of 35 mm. film. Ultimately it will be possible to gather subject matter material on a given subject by machine search and recording of abstracts identified through a code. This will save the time and labor of manually searching for and recording the desired information.

Progress continues in the Handbook of Biological Data. The first fascicle, Standard Values in Blood, published by W. B. Saunders Company, has had a distribution so far of almost 4,000 copies. The second fascicle, Standard Values of Nutrition and Metabolism, is now in press at Wright Field, Dayton, Ohio.

Users of small laboratory animals will wish to obtain a copy of a handbook on all phases of laboratory animals, to be made available by the Institute of Animal Resources, upon completion of analysis of questionnaire pertaining to production, needs for, uses, genetic characteristics, nutrition, and disease.

Fellowships

Undoubtedly many members of the American Dairy Science Association have applied or are planning to apply for various fellowships available through the National Research Council and the National Science Foundation. The following summary indicates that while many apply, few are chosen:

Graduate Fellowships (1954-55)

National Science Foundation	*Applications received*	*Recommended*	*Awarded*
Biology	769	200	152
Total	2,865	844	657

Postdoctorate Fellowships (1954-55)

National Science Foundation			
Biology	230	32	30
Total	461	80	80
National Research Council			
Biology	87	10	1
Total	176	59	6

In conclusion, may your representative say that he appreciates the opportunity to have served for three years as the representative of the American Dairy Science Association to the National Research Council and participating in the stimulating experiences that come with the association. It is suggested that the Board consider the advantages another member of the Association would gain by having this stimulating experience.

Respectfully submitted, W. E. Krauss.

Upon motion duly seconded, the report was accepted.

EDITOR'S REPORT FOR THE YEAR 1953

Volume 36 of the *Journal* contained 152 articles of original research (19 articles were rejected) and three review articles. There were 1,370 pages of scientific articles as compared with 1,152 pages for volume 35 and 186 pages of abstracts (1,144) as compared with 119 pages (651) for the preceding volume. The total of pages in People and Events was 52, and of Letters to the Editor, 8. The number of articles submitted each month varied from a low of 10 in December to a high of 20 in September.

There were 103 Dairy Production articles and 49 Dairy Manufacturing articles published in volume 36, a 2:1 ratio. On a subject matter basis the percentage distribution was as follows:

Nutrition (cattle)	21
Bacteriology	21
Chemistry	15
Artificial breeding	15
Physiology	11
Breeding	6
Technology	3
Animal diseases	2
Herd management	2
Nutrition (human), Sanitation, Engineering	4
Total	100

The Editor is indebted to Dr. W. O. Nelson for the excellent manner in which he has developed the abstract section of the *Journal* and for his careful preparation of the volume 36 index. Acknowledgment is made also of the helpful counsel and advice of the Journal Management Committee and President W. V. Price. The excellent help of the official newsgatherers is reflected in the general acceptance of the People and Events section just as the faithful service of the abstractors of literature has aided materially in building up this department of the *Journal*. Special tribute should be paid to members of the Editorial Board and those who have assisted them in the review of original articles submitted for publication. These people play an extremely important part in maintaining high standards for the *Journal*. They are to be highly commended for the excellent manner in which they have functioned and for the unselfish donation of their time in performing the duties asked of them by the Editor. I hope the members of the Editorial Board will appreciate the fact that it is not only a responsibility but also an honor to be invited to be a member of so important a group.

Lastly, acknowledgment is made of the invaluable service rendered by Rosamond M. Tracy in editing manuscripts and the excellent cooperation of James M. Hill of the Garrard Press in expediting the printing of the *Journal* in so satisfactory a manner.

The membership should realize that the printing of a journal, such as the *Journal of Dairy Science* now is, calls for the cooperation of all members. It takes team work to get the type of news necessary to make the "People and Events" section acceptable. It requires cooperation on the part of our members to provide the number and caliber of articles necessary to make "Our Industry Today" a worthwhile addition to the *Journal*. It requires teamwork to prepare the high caliber articles of original research written in a manner compatible with the adopted editorial standards of the *Journal*. The Editor wishes to congratulate the members of this Association for the excellent cooperation they have rendered this office in promoting a *Journal* acceptable to more readers without sacrificing editorial standards. It is a pleasure to work with a group that works with you.

To allay the fear of some, no articles reporting original research were rejected in order to make room for additions to the popular section of the *Journal*. The Editor is guided largely by the recommendations of the Editorial Board in the acceptance and rejection of submitted articles. Effort has been made to maintain the usefulness of the *Journal* as an outlet for worthwhile articles submitted for publication by the members.

Respectfully submitted, P. H. Tracy, *Editor*.

Upon motion duly seconded, the report was accepted.

SECRETARY-TREASURER'S REPORT

Fiscal Year 1953

The following is a summary of our gains and losses for 1953:

Membership, December 31, 1952		1,554
Gains:		
New Members	222	
Former Student Affiliates	49	
Total Gain	271	
Losses:		
Resigned	16	
Delinquent	77	
Deceased	6	
Total Loss	99	
Net Membership Gain		172
Membership, December 31, 1953		1,726
Honorary Members		11
Life Members		8
Grand Total		1,745

The year 1953 saw membership once again on the upswing with 271 new members offsetting our loss of 99 for a net gain of 172. As of June 1, 1954, our membership stood at 1,743 which compares with 1,643 for the same date in 1953. Included in these 1954 figures are 159 new members.

During the past five years our membership has been as follows:

1953—1,745	1950—1,703
1952—1,554	1949—1,725
1951—1,598	

We are now holding our highest membership in the Association's history, but we are still a long way from our goal of 2,000 members.

Foreign membership, a fairly new part of the Association membership, stands at 71 for 1953. This includes those members outside the United States and its possessions.

It might be interesting to note here that there are now twelve Honorary Members and seven Life Members.

The Honorary Members are as follows:

A. A. Borland	B. W. Hammer
H. P. Davis	C. C. Hayden
H. B. Ellenberger	O. F. Hunziker
J. B. Fitch	O. E. Reed
J. H. Frandsen	M. J. Prucha
E. S. Guthrie	C. L. Roadhouse

The Life Members are as follows:

Robert S. Breed	E. G. Hastings
O. L. Cunningham	L. A. Rogers
H. A. Harding	C. Albert Altweeg

C. W. Holdaway

Student Affiliate membership increased to total 294 in 1953 compared to 264 in 1952. As of June 1, 1954, there are 340 affiliates compared to 270 for the same date in 1953.

On December 31, 1953, there were 26 Student Affiliate chapters, an increase of three over the previous year. One request for a new chapter certificate has been received thus far in 1954. The Student Chapters Committee, under the Chairmanship of E. L. Thomas, through its excellent work, has definitely reversed the downward trend in affiliate numbers and accounted for a steady increase in student chapters. Dues statements and affiliate member cards have been instituted as a regular function of the Secretary's office to further the student program.

Journal circulation reached a total of 3,619 for 1953. This is an increase of 262 copies over 1952.

Your Association experienced an operating loss of $4,872.46 in the year just past. Although income totalled $41,711.35, up 13.7% over 1952, expenses for 1953 amounted to $46,583.69 which was an increase of 26% over 1952. Both income and expenses have reached an all-time high for the Association.

With expanded effort in committee activity, *Journal* innovations, and other programs there is bound to be an increase in cost. Such expanded activities are felt to be justified in the minds of your Executive Board. A certain period of "underwriting" will naturally be required before the fruits of such action can be realized. One concrete instance of this is the publishing of the new section of the *Journal*. Even in 1953 when *Journal* costs rose 19%, we experienced an increase in circulation of 262 copies. This increase must be attributed in part to the increased acceptance of the *Journal* in its new form. There is no reason to believe that circulation will not increase in the years to come. As of May 1, 1954, circulation has reached 3,301 copies compared to 3,182 copies on May 1, 1953.

During 1953 your *Journal* carried 96¾ pages of advertising, which brought in $6,491.04. Plans are under way to provide a means for increasing this all important source of revenue.

Back copies of the *Journal* sold to members and subscribers during 1953 resulted in income amounting to $1,555.55, an increase of $461.45 over 1952. Although there are some separate issues out of stock, it is possible to fill most orders. A request to the Secretary will bring these missing issues to complete your file.

Sales of the Decennial Index have moved forward steadily. During 1953, $1,732.35 was realized from this source. A second printing of this Index is not planned, but there is still a fairly good supply on hand. They will be sold at cost while the supply lasts.

A detailed audit of the Association's financial status was sent to all members of the Executive Board. The records and operation of the office of the Secretary-Treasurer were examined by the Auditing Committee.

The Nominating Committee nominated the following candidates in April, 1954: for Vice-President, I. A. Gould, Ohio, and F. E. Nelson, Iowa; for Directors, R. E. Hodgson, Washington, D. C., George Hyatt, Jr., North Carolina, H. A. Herman, Missouri, and G. E. Gordon, California.

On June 2, 1954, the Ballot Tabulating Committee announced the following results: Vice-President, I. A. Gould, Ohio; Directors, R. E. Hodgson, Washington, D. C., and George Hyatt, Jr., North Carolina.

On March 22, 1954, your Secretary submitted his resignation to President Price to be effective June 24. This was done in view of the fact that he had accepted a position with the Milk Industry Foundation that precluded his continuing to serve the Association in his present capacity. The cooperation extended by each and every member and especially the officers and directors during the past six years has made the job of Secretary-Treasurer a pleasant and rewarding experience that will never be forgotten.

Respectfully submitted, P. R. Ellsworth, *Secretary.*

Upon motion duly seconded, the report was accepted.

AUDITING COMMITTEE REPORT

To the Executive Board of the American Dairy Science Association.

Gentlemen:

On March 29, 1954, the Auditing Committee of the Association met with Mr. Walter C. Burnham, a Certified Public Accountant, who had audited the books of the Association for the year ending December 31, 1953.

The Committee reviewed the report with Mr. Burnham and asked him to explain numerous items in detail.

The Committee is satisfied that the statement of the Auditor is a correct statement of the financial condition of the Association.

We recommend that this statement be accepted by the Executive Board and the members of the American Dairy Science Association.

Respectfully submitted, J. F. Cavanaugh, J. T. Smith, C. L. Blackman, *Chairman.*

Upon motion duly seconded, the report was accepted.

REPORT OF THE JOURNAL MANAGEMENT COMMITTEE

The Journal Management Committee makes the following report of its activities for the year.

1. The committee recommended that the material, "Information for Authors" prepared by the editor be printed as a 4-page leaflet with 800 copies. Copies were made available to heads of dairy departments with the statement that the additional copies were available at cost.

2. The Committee recommended that authors of guest editorials be given 100 complimentary reprints of their editorial.

3. At the request of the president, the committee decided that the number of free pages permitted for papers remain at 12 and the cost for each additional page be increased to $18.00, effective with the January, 1954, issue of the *Journal.*

4. The Committee recommended the adoption of the Arnold Committee report of 1953 defining the responsibilities of the editor. This definition clearly and adequately described the duties of the editor.

5. The Committee recommended that the Association continue to make complimentary copies of the *Journal of Dairy Science* to Agricultural Index and to the American Institute of Biological Sciences.

6. The Committee recommended that the *Journal of Dairy Science* discontinue including in its abstract section those listings that include only the author's name, the title of the article, and the journal in which it was published.

7. The Committee recommended against including in the popular section space for a placement service.

8. The Committee recommended that the membership list be published in the January, 1954, issue of the *Journal.*

9. The Committee has studied throughout the year ways and means of increasing the amount of advertising in the *Journal* as one means of increasing the income of the Association. Contact was made with an advertising agency. A thorough study has been made of the contract proposal made by that agency for handling *Journal* advertising. As a result, the commit-

tee recommended to the Executive Board that they not accept the advertising agency proposal at this time. We could not see enough additional advantages over the present arrangement to justify the cost.

10. A study has been made of the acceptability of the new popular features of the *Journal* initiated this past year. Survey forms were sent to the membership along with the ballot this spring. The questions asked were designed to test the reaction of the membership to People and Events, Letters to the Editor, Our Industry Today, and the Abstracts. Of the forms sent out 837, or 42% of the membership, were returned. The results were published on page 902 of the July issue of the *Journal*.

It appears from the results of this survey that the membership like the addition of these new features about as they now appear in the *Journal*.

11. The Committee recommended approval of the Executive Board of the report of the Dahlberg Committee which recommended against setting up uniform rules for determining the order of authors on publications appearing in the *Journal*.

12. The Committee recommended that the Board authorize the *Journal* Editor to select an editorial board of twelve members each to serve for one year, subject to reappointment. The members of this Board will be approved by the Executive Board.

13. The Committee recommended the appointment of W. M. Roberts, North Carolina, as a member of the Journal Management Committee for a 3-year term and G. W. Trimberger of New York for a 2-year term to fill out the unexpired term of K. L. Turk.

Respectfully submitted, J. H. Erb, K. L. Turk, R. E. Hodgson, *Chairman*.

Upon motion duly seconded, the report was accepted.

REPORT OF THE COMMITTEE ON STUDENT AFFILIATE CHAPTERS

During the Association year 1953-54, there has been a gain of three Student Branches and 58 Student Affiliate members of the A.D.S.A. as compared with the preceding year. At present there are 27 Student Branches located at the following institutions:

Alabama Polytechnic Institute
University of Florida
University of Georgia
University of Kentucky
University of Massachusetts
Michigan State College
Pennsylvania State University
Clemson College
University of Tennessee
Texas Technological College
Virginia Polytechnic Institute
State College of Washington
University of Minnesota
University of Missouri
Montana State College
University of Nebraska
Rutgers University
Cornell University
Oklahoma A. and M. College
University of Wisconsin
West Virginia University
Ohio State University
University of Idaho
Texas A. and M. College
University of Maryland
Mississippi State College
Louisiana State University

As of May 1, 1954, there were 328 Student Affiliate members. This membership is distributed among 37 states, Canada, and Peru. The record of affiliate memberships for the past 6 years is as follows:

1949—859	1952—264
1950—750	1953—270
1951—340	1954—328

Your committee is pleased to report that all principal recommendations of previous Committees on Student Affiliate Chapters have been activated. During the past year our Secretary prepared and distributed Student Affiliate membership cards. The practice of sending dues renewal notices to affiliate members was inaugurated. Recently, the initial issue of a Student Affiliate newsletter was prepared and distributed. It is believed that these actions will result in giving the affiliate member a fuller sense of belonging to the Association and ultimately bring about a greater percentage of transfers from affiliate to regular memberships upon graduation.

The initial affiliate newsletter was prepared by the committee with final editing and printing arrangements handled by Secretary Ellsworth, in order to get it into the hands of students before the end of the school year. Single copies were mailed to individual affiliate members and additional copies were sent to student clubs for distribution to non-members.

On June 23rd, the committee met with faculty advisors and student affiliate members representing 14 student branches of A.D.S.A. A lively and fruitful discussion of the student

affiliate program resulted in unanimous agreement upon the following proposals and recommendations:

1. In view of a definite need for the revision of that portion of the constitution relating to the student affiliate program, suggested amendments have been formulated and forwarded to the Committee on Constitution and By-Laws.

2. It is recommended that a student affiliate news section be included in the *Journal of Dairy Science* rather than continue the affiliate newsletter in its present form. Such an arrangement would simplify the handling of news items and would materially reduce the cost of publication. Furthermore, it should serve to stimulate greater interest in the *Journal* among dairy students.

3. It is recommended that provisions be made for exhibits of local club activities at our annual meetings and that consideration be given to providing appropriate recognition for outstanding local club achievements. It is believed that such a project would serve not only to stimulate interest at the local club level, but in addition provide a means of better acquainting members of our Association with the worthwhile functions of our dairy student organizations.

Respectfully submitted, I. I. Peters, P. M. Reaves, W. L. Slatter, F. B. Wolberg, E. L. Thomas, *Chairman.*

On motion duly seconded, the report was accepted.

REPORT BY THE REPRESENTATIVE OF THE AMERICAN DAIRY SCIENCE ASSOCIATION ON THE RALSTON-PURINA FELLOWSHIP AWARDS COMMITTEE

As your representative on the Ralston-Purina Research Fellowship Awards Committee, I would like to express appreciation to the Ralston-Purina Company for their keen interest in our research programs, and in the training of outstanding young dairy scientists as exemplified by their Research Fellowship Awards program.

The number of fellowships available was increased during the past year from seven to ten. These fellowships were divided according to fields of interest as follows: three each in dairy husbandry, animal husbandry, and poultry husbandry, and one in veterinary medicine. Each fellowship currently carried a stipend of $1,560. Awards are made on an annual basis; however, fellowship winners may reapply during subsequent years of their graduate training.

A total of 29 applications were received for the 1954-55 awards. The general caliber of the applicants was high. The committee selected ten awards winners and five alternates. Acceptance has been received from the group selected for all ten fellowships for the 1954-55 school year.

When the fellowship winners complete their work they will be invited to visit the research laboratories and farm at St. Louis. This provides an additional fine experience for the recipients.

We commend the Ralston-Purina Company for this excellent program in promoting advanced training and research.

Respectfully submitted, J. W. Pou.

Upon motion duly seconded, the report was accepted.

TEACHING AWARD COMMITTEE REPORT

This committee made a progress report a year ago at the annual meeting at Madison, Wisconsin. Following this, President Walter Price enlarged the committee as listed below. This committee makes the following recommendations to the Board of Directors of the American Dairy Science Association:

(1) That the American Dairy Science Association give special recognition to outstanding teachers of dairy science.

(2) That the first recognition be made at the annual meeting in 1955.

(3) That a special rotating committee of five be appointed by the president to carry out the details of this award.

(4) That nominations for this award be made by members of the Association.

(5) That there be two awards according to the sponsorship as follows:
   (a) Award in dairy production.
   (b) Award in dairy products technology.

(6) That an announcement of the details and other information in regard to this award be made in the *Journal of Dairy Science.*

Respectfully submitted, H. P. Davis, H. B. Henderson, R. J. Werner, A. H. Rishoi, W. B. Combs, C. E. Wylie, *Chairman.*

At this point, on motion by Fordyce Ely, the Association voted to recommend that the Board take steps to follow the course of action as outlined in the Teaching Award Report. The motion was passed.

RESOLUTIONS COMMITTEE REPORT

WHEREAS, The 49th Annual Meeting of the American Dairy Science Association has been held on the campus of the Pennsylvania State University at State College, and

WHEREAS, The host institution undertook the task and responsibility of arranging the details necessary for the successful conduct of the annual meeting, and

WHEREAS, The arrangements that have been made by the local institution have been more than adequate in every detail, thus permitting this Association to hold one of its most pleasant and successful meetings enjoyed by men, women and children alike; therefore be it

Resolved, That the American Dairy Science Association express its appreciation for the courtesies extended and the services rendered by the Pennsylvania State University, to Dr. Milton Eisenhower, President, Pennsylvania State University, to Dean Lyman E. Jackson, Dean of the College of Agriculture, and especially to Dr. D. V. Josephson and Professor F. J. Doan and their associates who contributed so much toward making possible this sucessful meeting.

WHEREAS, Many commercial organizations have contributed greatly to the success and enjoyment of the 49th annual meeting; therefore be it

Resolved, That the American Dairy Science Association express to those organizations its appreciation.

WHEREAS, The Borden Company Foundation has for the eighteenth year made available for presentation by the American Dairy Science Association the Borden Awards for outstanding research in dairy production and dairy manufacturing; therefore be it

Resolved, That the American Dairy Science Association express its appreciation to the Borden Company Foundation for these Borden Awards by which the American Dairy Science Association may recognize achievement in the fields of dairy production and dairy manufacturing research.

WHEREAS, The American Feed Manufacturers Association has made available to the American Dairy Science Association the 7th American Feed Manufacturers Award for outstanding research in dairy cattle nutrition; therefore be it

Resolved, That the American Dairy Science Association express its appreciation to the American Feed Manufacturers Association for this award by which recognition is given to outstanding research in dairy cattle nutrition.

WHEREAS, The DeLaval Separator Company has again made available an award for outstanding achievement in the field of dairy extension; therefore be it

Resolved, That the American Dairy Science Association express its appreciation to the DeLaval Separator Company for the award by which outstanding work in the field of dairy extension may be recognized.

WHEREAS, The American Dairy Association through its advertising efforts and the National Dairy Council through its educational efforts are effectively engaged in a variety of activities to promote the consumption of milk and other dairy products, and

WHEREAS, The American Dairy Association and the National Dairy Council have provided funds to support research in various fields of dairy sciences currently and for a number of years in the past; therefore be it

Resolved, That the American Dairy Science Association go on record as commending the efforts of these organizations and other groups or agencies who seek to promote the wider use of milk and its products, and be it further

Resolved, That the American Dairy Science Association express its appreciation to these two organizations for their substantial and continued support of research in dairy science.

WHEREAS, During the past six years, Perry R. Ellsworth has served efficiently as Secretary-Treasurer of the American Dairy Science Association and has conducted the affairs of his office with faithfulness and distinction, and

WHEREAS, Perry R. Ellsworth has requested that he be relieved of his duties as Secretary-Treasurer effective at the termination of the 49th annual meeting; therefore be it

Resolved, That the American Dairy Science Association express its appreciation and thanks to Perry R. Ellsworth for his untiring and successful efforts as its Secretary-Treasurer.

WHEREAS, The Honorable Ezra Taft Benson, Secretary of Agriculture, U. S. Department of Agriculture, has taken time from the arduous and important duties of his office to address the opening session of the 49th annual meeting of the American Dairy Science Association, and

WHEREAS, The American Dairy Science Association has benefited immeasurably from statements included in the address of the Secretary of Agriculture; therefore be it

Resolved, That the American Dairy Science Association express its appreciation to the Honorable Ezra Taft Benson for the stimulating and inspiring address at the opening session of the 49th annual meeting.

Respectfully submitted, S. N. Gaunt, D. J. Hankinson, P. L. Kelly, A. J. Morris, J. J. Jezeski, *Chairman.*

Upon motion duly seconded, the report was accepted.

REPORT OF PUBLIC RELATIONS COMMITTEE

The Public Relations Committee report is divided into two sections: A. Proposed Public Relations Objectives of the American Dairy Science Association and B. Recommendation for the Activating of the Objectives Proposed by the Committee. Part A has been published in the June 1954 issue of the *Journal of Dairy Science*. Part B is submitted at this time.

Recommendations for Activating the Objectives Proposed

The following recommendations are made with the view of activating the proposed objectives:

1. *Public Relations Committee:*

The Committee recommends the establishment of a standing Public Relations Committee of the Association. This shall be a five-member committee, at least one of whom shall be a member of the Executive Board. The chairman and members shall be appointed annually by the President. The President, the Secretary, and the Editor of the *Journal* shall be ex-officio members of the Committee.

2. *Membership Committee:*

The Committee recommends the establishment of a standing Membership Committee of the Association. The Membership Committee will consist of five members, and the Chairman will be a member of the Public Relations Committee. The members shall be appointed on an annual basis.

Committee also recommends that the Chairman of the Student Affiliate Committee serve as a member of the Membership Committee.

The Committee suggests that one of the first assignments of the Membership Committee will be to develop a Membership Manual which will set forth in detail the procedures and practices of the Association in regard to membership solicitation.

3. *Internal Procedures:*

The Committee recommends the appointment of a Committee to serve one year only which will be assigned the responsibility of developing procedures for making more effective the communications between the various sections of the Association and the Executive Board. Specific responsibilities of this Committee will be *(a)* to develop and recommend procedures for handling sectional and intersectional reports which are deemed worthy of publication; *(b)* to develop procedural manuals which would include the procedures and practices of each Section, as well as those which involve a relationship between the Sections and the Executive Board.

The Committee suggests that the President, the Secretary, and the Editor of the *Journal* serve as ex-officio members of the Internal Procedures Committee.

Respectfully submitted, F. J. Arnold, H. A. Bendixen, R. E. Frost, H. B. Henderson, G. E. Holm, I. A. Gould, *Chairman.*

Upon motion duly seconded, the report was accepted.

DAIRY REMEMBRANCE FUND COMMITTEE REPORT

The Dairy Remembrance Fund, Inc., is a nonprofit organization formed during the past year to solicit and allocate funds for educational and research projects in the dairy field. The directors of the American Dairy Science Association approved the affiliation of this association with the Dairy Remembrance Fund, Inc., and delegated A. C. Dahlberg, J. C. Shaw, and D. V. Josephson to serve as a committee in the organizational program. Other sponsors are as follows: The Dairy Industry Committee, International Association of Ice Cream Manufacturers, Milk Industry Foundation, National Association of Retail Ice Cream Manufacturers, and National Dairy Council.

At a meeting in New York on April 9, 1954, the delegates representing the various sponsoring groups voted to approve the proposed by-laws with several modifications. The Dairy Science Association is represented on the Board of Directors, Allocations Committee, and Admissions Committee.

It is hoped that many other dairy organizations will affiliate with the Dairy Remembrance Fund. Several have indicated interest and are working out details with the membership of their respective organizations.

It should be pointed out that Dairy Remembrance Fund, Inc., is a nonprofit corporation whose sole purpose is to receive, administer, invest, allocate, and distribute funds to worthy educational and research projects. Membership in the corporation does not obligate the American Dairy Science Association financially. On the other hand, members and their institutions will be the primary beneficiaries through the grants-in-aid, etc., allocated in support of their projects.

It is anticipated that the program will have a very modest beginning but that with time it may become a very sizable project and of considerable importance to the dairy industry.

Respectfully submitted, A. C. Dahlberg, J. C. Shaw, D. V. Josephson, *Chairman.*

Upon motion duly seconded, the report was accepted.

REGISTRATION COMMITTEE REPORT

State	Members			Non-Members			Student Affiliate	Guest	Total
	Men	Women	Children	Men	Women	Children			
Alabama	2	1	2						5
Alaska									–
Arizona	2	2							4
Arkansas	1								1
California	6	3	3	1			2		15
Colorado									–
Connecticut	11	2	3	2	1		1		20
Delaware	3			1		1			5
Florida	9	3	5						17
Georgia	5	3	2						10
Idaho	1	1	3						5
Illinois	53	20	16	11	1		3	4	108
Indiana	8	4	4	3			1		20
Iowa	15	4	3	3			7		32
Kansas	6	2	1	2					11
Kentucky	10	2	2				9		23
Louisiana	6	3	3				1		13
Maine	3	2	2	1					8
Maryland	26	10	8	13	5	3	3	1	69
Massachusetts	15	7	6	6	1		1		36
Michigan	21	19	14	2	1		2	1	60
Minnesota	22	14	14	1	1		6		58
Mississippi									–
Missouri	10	2		1			4		17
Montana	4	1	4						9
Nebraska	9	6	3						18
Nevada									–
New Hampshire	5	3		2					10
New Jersey	18	7	6	7			2	1	41
New Mexico	1	1	3						5
New York	69	29	10	23	2	1	20	3	157
North Carolina	17	6	6	2			8	2	41
North Dakota	3	2	6						11
Ohio	42	22	18	8	2		14	7	113
Oklahoma	9	2	1	2	1				15
Oregon	1								1
Pennsylvania	58	43	38	28	11	5	9	7	199
Rhode Island	1	1	2						4
South Carolina	3	1							4
South Dakota	1	1	2						4
Tennessee	8	2		2					12
Texas	4	1		1					6
Utah	3	2	4						9
Vermont	9	6	1	3			1		20
Virginia	19	10	4	6	1	3	2	4	49
Washington	5	4	4				3		16
Washington, D.C.	12	5	1	3	1				22
West Virginia	9	2							11
Wisconsin	34	16	11	5			7		73
Wyoming	1								1
Canada	10	5	4	11	3		2		35
South Africa				1					1
India	1								1
England							1		1
Puerto Rico	1								1
Peru							1		1
Total	592	282	219	151	31	13	110	30	1,428

Total number in attendance: men—875 (22 guests); women—321 (8 guests); children—232.

EXECUTIVE BOARD MEETING

The Executive Board transacted the following business:

Approved the minutes of the 1953 annual meeting.

Approved the Editor's report.

Approved the Secretary-Treasurer's report.

Accepted the Auditing Committee report.

Accepted the Progress Report of the Historian.

Approved the selection of J. B. Fitch as Honorary Member for 1954.

Approved the report of the Student Affiliate Chapters Committee.

Accepted the Journal Management Committee report.

On the recommendation of the Journal Management Committee the Editorial Board was increased to twelve.

On the recommendation of the Journal Management Committee, George Trimberger was appointed to the Journal Management Committee for two years (July 1, 1954 to July 1, 1956) to replace K. L. Turk who will be out of the country on Point 4 assignment, and W. M. Roberts for a term of three years (July 1, 1954 to July 1, 1957).

Elected W. E. Krauss as representative to the National Research Committee for three years (July 1, 1954 to July 1, 1957).

Accepted with thanks the offer of the Borden Company Foundation to provide two $1,000 awards for 1955.

Accepted with thanks the DeLaval Separator Company offer of a $1,000 Extension Dairyman Award for 1955.

Confirmed the following locations for future annual meetings:

1955—Michigan State College
1956—University of Connecticut
1957—Oklahoma Agric. and Mech. Coll.
1958—North Carolina State College
1959—University of Illinois (tentative)
1960—Utah State Agric. College
1961—University of Wisconsin

Accepted the report of W. E. Krauss, representative to the National Research Council, with special thanks to Dr. Krauss for an excellent job.

Accepted the report of the Ralston-Purina Research Fellowship Award Committee.

Accepted the report of the Committee on Inter-Society Cooperation and instructed the president to appoint a representative to the above committee.

Accepted the report of the Representative to the Dairywide Coordinating Committee on Nutrition Research.

Accepted the report of the Representative to the Dairy Remembrance Fund.

Received and approved the Public Relations Committee report and approved the activation of the proposals contained therein.

Accepted the report of the Dairy Science Teaching Award Committee as a progress report and voted the continuance of this committee.

Accepted the report of the Committee on the Revision of the Constitution and extended a vote of thanks to the committee members for a job well done. Referred this report to a committee of the Executive Board for final study.

Accepted the progress report of the Regulatory Agencies Cooperating Committee.

Accepted the report of the Dairy Industries Committee Sub-committee on Education and Training and referred it to the Public Relations Committee.

Accepted the report of the Student Affiliate Chapters Committee and extended a vote of thanks to the committee for a job well done.

Approved renewal of student affiliate certificates for Alabama Polytechnic Institute, Michigan State College, University of Minnesota, Montana State College, University of Idaho, University of Wisconsin.

The Board went on record as commending President Price for his outstanding, scholarly, and excellent work on the A.D.S.A. projects submitted to the Secretary of Agriculture on "Strengthening American Agriculture Through Research and Education."

Voted, in view of the present financial status of the Association, that no funds shall be authorized from the Association for outside speakers on programs of the Association or its sections.

Went on record as favoring a business management approach involving a full-time Executive Secretary.

Elected P. H. Tracy Editor of the *Journal of Dairy Science* for 1955.

Adopted 1955 budget amounting to $49,600.00.

Voted to raise membership dues to $10.00 per year effective January 1, 1955.

Voted to raise subscription rates to $15.00 per year effective January 1, 1955.

Voted to raise advertising rates 25% effective with the January 1955 issue.

Voted to place the following reprint charges in effect at such date as details can be worked out satisfactorily.

$5.00 per page for the first 100 reprints.
$3.00 per page for the second 100 reprints
$1.00 per page for each additional 100 reprints.

Went on record with a vote of thanks to Ohio State University and the Department of Dairy Technology for cooperation in the work of the Secretary-Treasurer's office.

Elected Dr. T. D. Harman Acting Secretary-Treasurer.

Accepted and approved Resolutions Committee Report.

Respectfully submitted, P. R. Ellsworth, *Secretary.*

President Price called for any new business. G. W. Salisbury requested that President Price yield the chair to Vice-President Moore. This was done. G. W. Salisbury then made the following motion: "I move that the membership of the American Dairy Science Association extend to our retiring President, Walter V. Price, a vote of appreciation for his exemplary conduct of the office of President of the Association, in a most trying time in its history and for his guidance in formulating the future path of progress of the Association."

The motion, duly seconded, was passed. President Price then assumed the chair and the meeting was adjourned at 12:30 P.M.

NECROLOGY COMMITTEE REPORT

Members of the American Dairy Science Association who died since the 1953 annual meeting include the following:

John Howard Brock, Business Manager, Northern Illinois Breeding Cooperative, Hampshire, Illinois, died March 26, 1953. He was born October 1, 1902. Mr. Brock was graduated by the University of Illinois in June 1925, with a B.S. degree. He farmed for a year and then returned to his Alma Mater as Extension Dairyman for a term of four years. He served as Bond County Farm Adviser, Greenville, Illinois, for four years before moving on to McHenry County for nine years as Farm Adviser at Woodstock, Illinois. Later he was Will County Farm Adviser, Joliet, Illinois, for two years before going to his final position on August 1, 1946.

Edwin George Hastings, Emeritus Professor of Bacteriology, University of Wisconsin, died at home in Orlando, Florida, on September 29, 1953, at the age of 81 years. He was graduated by Ohio State University with the B.S. degree in 1898 and by the University of Wisconsin with the M.S. degree in 1899. He studied at the Royal Veterinary College, Munich, Germany, in 1901 and 1902. He rejoined the University of Wisconsin in 1902 and advanced to a full professorship in agricultural bacteriology in 1913, at which time he became chairman of the department. He served in that position for 30 years.

He was a successful teacher, an able scientist, a skilled writer and editor, and a capable administrator. He is known especially for his early work with H. L. Russell on the diagnosis of bovine tuberculosis and on the application of the tuberculin test to cattle. He was the first person in the United States to isolate the causative organism or Johne's disease and the first to manufacture johnin and to use it in testing for the disease.

Professor Hastings contributed much information on mastitis and brucellosis of cattle. He always was interested in the improvement of the quality of milk. His early work with H. L. Russell on the heat resistance of tubercle bacilli helped to establish the heat treatments now employed for the pasteurization of milk. His studies of the methylene blue reductive test aided in its acceptance as a simple method for testing the bacteriological quality of milk.

The early work of Hastings and Russell on the ripening of Cheddar cheese provided the basis for the widely used method of curing at low temperature. He also worked to improve the cultures used for Swiss cheese manufacture and ripening.

His publications in the scientific journals were many. With H. L. Russell he wrote *Agricultural Bacteriology,* first issued in 1909 and since revised twice; *Outline of Dairy Bacteriology,* which went through 12 editions; and *Experimental Dairy Bacteriology.* He was co-author of a laboratory manual of general bacteriology, and contributed to *Microbiology.*

Carl W. Larson was born at St. Ansgar, Iowa, May 29, 1881, the son of Henry and Minnie Larson. He died in Buffalo, New York, on June 13, 1954. He is survived by his wife and one daughter.

Immediately after receiving the degree of B.S. in Agriculture at Iowa State College in 1906, he studied creamery and cheese factory methods in Minnesota and Wisconsin for one year. He was instructor, assistant professor, and professor in charge, Dairy Husbandry Department, Pennsylvania State College from 1907 to 1915. In 1911 he was awarded a Master's degree at this institution. After teaching and earning a Ph.D. at Columbia in 1916, he was with the Dairy Division, Bureau of Dairy Industry, U. S. Department of Agriculture, from 1917 to 1928, the latter part of that time being chief of the new Bureau of Dairy Industry. He then served as managing director of

the National Dairy Council for one year. From 1930 to 1953 he was active in several commercial operations.

Director Larson was a U. S. delegate to the International Dairy Congress at Stockholm in 1911, and again at London in 1928. He was sent by Red Cross to France in 1918 to develop and improve milk supplies for hospitals. He was author of *Principles and Methods of Milk Cost Accounting,* and *Cattle Feeding and Management* (part author) in 1916. He was secretary of A.D.S.A. in 1913 and 1914 and was a life member.

Harrison A. Ruehe of Urbana, Illinois, died October 5, 1953. He earned his B.S. and M.S. degrees at the University of Illinois and his Ph.D. at Cornell University. After a year at the University of California, Davis, Doctor Ruehe joined the Staff at the University of Illinois in 1912. He served as head of the Department of Dairy Husbandry from 1921 to 1943, when he became executive secretary of the American Butter Institute. He returned to the University in 1945 as a member of the Department of Dairy Science. Doctor Ruehe was president of the American Dairy Science Association in 1935-36 and was associate editor of the *Journal of Dairy Science* for a number of years. He is survived by his wife and two sons.

Frank L. Seymour-Jones, director of the New Products Research Laboratory of the Borden Company, died July 2, 1953, at the Neurological Institute, New York City. He was 57 years old. Born in Wrexham, Wales, he attended Wrekin College in Wellington, Salop, England. His further studies at the University of Leeds, England, were interrupted with the start of World War I when he joined the Royal Welch Fusiliers. He also served with the Intelligence Corps and rose to the rank of captain. He saw service in Gallipoli, Egypt, and Palestine and received the Military Cross in 1918.

After World War I he continued his studies at the University of Leeds, where he earned his B.A. with honors and a Master's Degree in Science. Awarded the Le Blanc Medal, he was also named a Goldschmidt Fellow in 1921. In addition, he earned his A.M. degree in 1922 and Ph.D. in Chemistry in 1923 at Columbia University, New York.

After concluding studies at Columbia, he joined the Borden Company as a research chemist. He was shifted to the company's specialties division in 1926 and became assistant to the vice-president of the manufacturing department in 1928. Six years later he became assistant general superintendent of the specialties division. Named director of new products research 1941, he was responsible for the invention, development and improvement of many Borden food products and special items.

He was a member of the American Chemical Society and the American Dairy Science Association, as well as a Fellow of the American Association for the Advancement of Science. He was also a former councillor of the Institute of Food Technologists, and a former vice-president and president of the Metropolitan Dairy Technology Society.

He is survived by his wife and one son.

George C. White, Professor Emeritus, University of Connecticut, and a life member of A.D.S.A., died May 20, 1954, in Orlando, Florida. He was born at Harrisonville, Missouri, May 25, 1887. He received a B.S. degree from the University of Missouri in 1910 and an M.S. in 1912. He did graduate study at Cornell University in 1915 and again in 1926-27.

He served as assistant and instructor at the University of Missouri, 1910-1912; assistant professor at the University of Nebraska, 1912-13; and professor of dairy industry, University of Connecticut, 1913-1943. He retired in 1943 because of illness. Professor White was Dean of Agriculture, 1925-37; vice-Dean of Resident Teaching, 1937-43; acting Dean of Agriculture, 1940; and acting Dean of the Graduate School, 1940.

Professor White was secretary of A.D.S.A., 1926-28; president, 1928-30; and associate editor, *Journal of Dairy Science,* 1913-26.

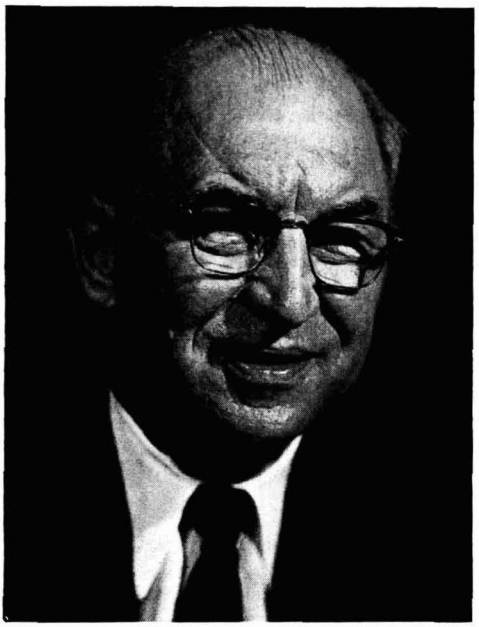
AWARDS PROGRAM THE AMERICAN DAIRY SCIENCE ASSOCIATION

The Association awards presentation took place in Schwab Auditorium, Pennsylvania State University, June 23rd at 7:15 P.M. President Price presided.

DeLAVAL EXTENSION DAIRYMAN AWARD

C. W. Reaves, member of the DeLaval Award Committee, presented the winner as follows:

"The 1954 nominee was raised on a farm in Pennsylvania, graduated from the University of Missouri, and began his Extension work in Kansas in 1920. He joined the Pennsylvania Extension Service in 1923 as an Extension Dairy Specialist in charge of the dairy herd improvement association work. He has devoted his life to dairy herd improvement, directing his efforts largely towards the development and



C. R. GEARHART

perfecting of a program that has been the basis of the improvement of the dairy herds in the nation. His work was on a state basis, but by providing a working state-wide demonstration of better methods of conducting this basic extension project, his accomplishments have influenced the dairy herd improvement program of the nation.

"He early developed a DHIA Calf Book providing positive identification of animals and the Life History Cow Sheets for the permanent DHIA herd records which were forerunners of the present national DHIA record keeping system and proved-sire program. The systematic plan of conducting DHIA work resulted in proving many bulls, and his records provided data for some of the early studies on repeatability of sire proofs. In the USDA Germ Plasm Survey of 1935 and 1936, over 26% of the herd data came from Pennsylvania. Since the establishment of the National DHIA Proved-Sire Program, Pennsylvania has continued in the lead, proving 629 bulls in 1953, and ranking second in the nation.

"Striving always toward quality as well as quantity, he initiated spring and fall conferences of test supervisors in 1924. He has personally supervised 125 short courses which trained 2,257 testers. The results of the thoroughness of his program include 204 associations comprising 114,997 cows in 4,603 herds, which are reaping the benefits of a well-planned and executed program. His carefully supervised DHIA program provides a service to the dairymen that makes it a model for other states. Pennsylvania leads the nation in the number of herds on DHIA test and ranks third in number of cows on test.

"He is a full professor of Dairy Husbandry Extension at the Pennsylvania State University. He served for 4 years as secretary of the Pennsylvania Dairyman's Association, is a member of Gamma Sigma Delta, honorary agriculture society, and a charter member and 8-year secretary of Epsilon Sigma Phi. He was given special recognition for DHIA work in Pennsylvania in 1931 and again in 1950.

"The DHIA program will stand as a monument in Pennsylvania to the work of this man, and its effect has extended to all parts of the country through the policies he has helped to form. He has twice served on the Executive Board of the American Dairy Science Association, has served as chairman of the Extension Section and on many committee assignments. The leadership, integrity, good judgment, loyalty, and good humor of the nominee are recognized by all who know him.

"It gives me very great pleasure to present C. R. Gearhart for the DeLaval Extension Dairy Achievement Award."

Mr. G. H. Hopson, representing the DeLaval Separator Company, presented Mr. Gearhart with a check for $1,000 and an inscribed, framed certificate.

BORDEN AWARD FOR DAIRY MANUFACTURING RESEARCH

H. L. Templeton, Chairman of the Borden Award in Dairy Manufacturing Committee, introduced the recipient of the award as follows:

"The 1954 recipient of the Borden Dairy Manufacturing Award was born in Wisconsin in 1911. This fact may have influenced him to make dairy problems his life work. After the usual secondary school education in Wisconsin and Iowa, he entered the University of Wisconsin, from which he received the B.S. degree in 1934, M.S. degree in 1935, and Ph.D. degree in 1937. He specialized in dairy bacteriology and dairy industry. Since then he has been associated with universities on both coasts and in the Midwest. In addition to his university duties, he has found time to act as a consultant to industry, and during World War II was in the Bacteriological Service of the Army.

"As a bacteriologist he has made many contributions to our knowledge. He is the author or co-author of numerous papers and of one

P. R. ELLIKER

book dealing with dairy bacteriology. His publications indicate that he has a wide knowledge of the lactic cultures, bacteriophage, cottage cheese, butter making, cheese making and plant sanitation. As a speaker on any of these subjects, he is in popular demand for university short courses and meetings sponsored by the dairy industry, at which his practical advice is valuable.

"He has directed the research of numerous graduate students. A review of the names of the co-authors of his many publications shows that there are a number of men in the dairy manufacturing and research fields who have been aided by his advice and guidance.

"He is a man who gives wholeheartedly of his time and energy to his many activities. He has served as an associate editor and an abstract section editor of the *Journal of Dairy Science*. He has been a member of the Executive Board of the American Dairy Science Association. He is a member of organizations dealing with the problems of bacteriology and sanitation.

"It is a real pleasure to present Dr. Paul R. Elliker, professor of bacteriology at Oregon State College, to receive the Borden Award in Dairy Manufacturing."

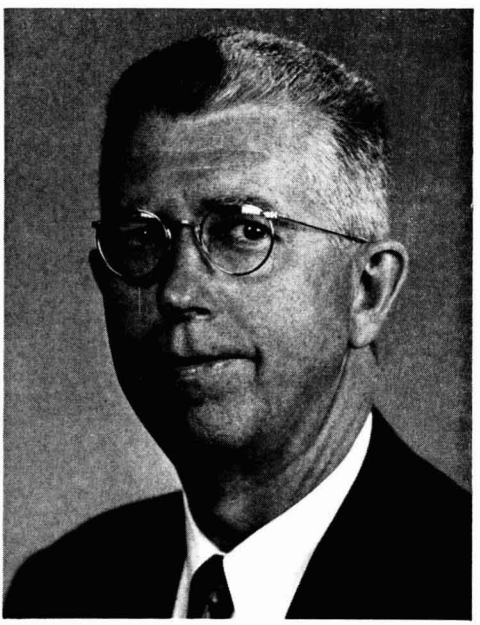
Mr. J. H. McCain, Secretary of the Borden Company Foundation, presented Dr. Elliker with a check for $1,000 and the gold Borden Award medal.

BORDEN AWARD FOR DAIRY PRODUCTION RESEARCH

Dr. C. F. Huffman, Chairman of the Borden Production Research Award Committee, introduced the recipient as follows:

"The Borden Production Research Award recipient for 1954 was born in Missouri in 1904. He took his undergraduate work at the Northeast Missouri Teachers College. He spent 2 years as a rural school teacher in Missouri, served one year as acting head of the Department of Biological Science of Arizona State Teachers College and one year as acting head of the Department of Agriculture of the Arkansas State Teachers College. He received the degree of Doctor of Philosophy in animal breeding at the University of Missouri in 1932. He was a National Research Council Fellow in the Biological Sciences, University of Wisconsin from 1932 to 1934. He has been on the staff of the Department of Genetics of the University of Wisconsin for the past 20 years.

"His chief area of research has been the physiology of reproduction, and he has made major contributions to this field from the standpoint of fundamental understanding of the physiological relationship involved in sterility. His discovery that early fetal death is an important cause of sterility in cows is outstanding. He has also been one of the major contributors in the areas having to do with



L. E. CASIDA

understanding the reproductive processes in livestock. He has published 93 scientific papers in the field of reproductive physiology, with 35 of these having been specifically related to the solution of problems in dairy cattle. Many of these papers have been published during the past 5 years. The recipient is not only an outstanding scientist but also a distinguished teacher and editor of the *Journal of Animal Science*.

"In behalf of the Borden Production Research Award Committee for Dairy Production, it is a pleasure to ask Dr. Lester E. Casida to come forward to receive the award for 1954."

Mr. J. H. McCain, Secretary of the Borden Company Foundation, presented Dr. Casida with a check for $1,000 and the gold Borden Award medal.

AMERICAN FEED MANUFACTURERS ASSOCIATION AWARD

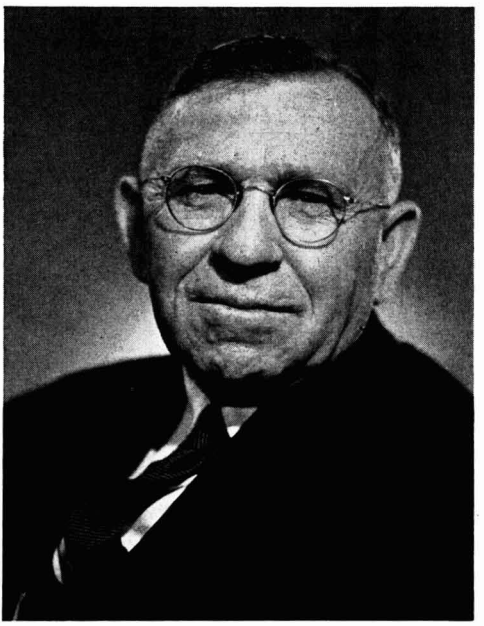
T. W. Gullickson, Chairman of the Award Committee, introduced the recipient as follows:

"The man selected as the candidate for this award has through early associations, experience, education, perseverance, and accomplishments attained an enviable and undisputed position of leadership in his chosen field of study and research. He is a man of striking and sterling personality and character, a teacher and research leader, and a prodigious worker.

"Born on a farm in the wide plains country at Tanganoxie, Kansas, he has had intimate contact from early childhood with problems incident to the production of plants and animals. He worked his way through Kansas State College, from which he was graduated in 1917, after which he served in the Air Service of his country until 1918.

"Having gained his early experience in the West, he added to his practical experience with work on dairy farms as far south as Florida and as far north as Minnesota. Before becoming engrossed in research, he gained considerable renown as a showman and judge of dairy cattle.

"After receiving the Master of Science degree from the University of Minnesota in 1922, he joined the Dairy Husbandry Staff at Michigan State College and, except for a brief leave during which he acquired the Ph.D. degree from the University of Wisconsin in 1933, he has served continuously at that institution. He has served under and worked with such able teachers and administrators as J. B. Fitch, C. H. Eckles, O. E. Reed, Earl Weaver, and G. Bohstedt. In turn he has been a constant source of inspiration to his students, both undergraduate and graduate, a fact reflected by their many and varied later achievements.



C. F. HUFFMAN

"In 1937 he was awarded the first Borden Award in Dairy Production based chiefly on his work relating to mineral metabolism in dairy cattle. Since that time he has continued his interest in that field with his most recent studies concerning cobalt toxicity and its alleviation.

"In addition to studies with minerals, his investigations reported during 1952 and 1953 include: rumen synthesis of protein, amino acids and B-vitamins in calves fed natural and purified diets, effect of aureomycin on rumen digestion, rumen synthesis and rumen bacteria, effect of fineness of grinding and water content of concentrates on the eating and milking time of lactating cows, vitamin B_{12} requirement of the calf, and evaluation of roughages for milk production. These studies not only have added much to our fundamental nutritional knowledge and stimulated a new interest in the evaluation of feedstuffs for ruminants but also have brought about the formulation of new and better methods of feeding dairy cattle.

"On behalf of the Award Committee, it is a great pleasure for me to present Dr. Carl Fountain Huffman as the candidate of the American Dairy Science Association for the 1954 American Feed Manufacturers Association Award."

Dr. Raymond T. Parkhurst, Chairman of the A.F.M.A. Nutrition Council presented Dr. Huffman with a check for $1,000.

ASSOCIATION HONORARY MEMBER AWARD

R. B. Becker, Chairman of the Honors Committee, introduced the recipient as follows:

"This man, after being active for 8 years on the staff, was advanced to head of the Dairy Department in one of the ten leading dairy states. A new dairy building and an adequate dairy barn were part of the facilities for teaching, research and demonstration which resulted from his efforts. He became head of the Dairy Department in another of the leading dairy states and has served their signally for the past 20 years.

"He served the American Dairy Science Association on important committees over the past 30 years, as secretary from 1921 to 1925, and as president in 1927. He has been an official judge of dairy cattle at state, regional, national and Canadian shows from coast to coast. He helped to organize type classification with the Holstein and Jersey breeds. He was an official delegate to the World's Dairy Congress in London in 1928; served on the Feed Survey Committee of the American Feed Manufacturers Association, and in many other activities.

"Many students, graduate students, and former staff associates in dairy production and dairy manufactures, under his direction, now are in leading positions as dairy producers and breeders of purebred dairy cattle or hold important and key positions in dairy manufactures and related fields. Many of his students have gone into dairy extension, research, teaching, and professional fields related to the dairy industry from coast to coast and in some countries overseas. National and international acclaim have been given to the staff which he heads. His influence has been widespread by lighting the candle and serving as an inspiration to further efforts. He sponsored and fostered state breed organizations and industry short courses to promote and develop further both dairy production and manufactures.

J. B. FITCH

"The nominee of your Association for distinguished honorary membership in 1954 is Professor J. B. Fitch.

"President Price, the Committee wishes to present to you as the candidate for Honorary Membership in the American Dairy Science Association in 1954, Professor J. B. Fitch."

President Price awarded the certificate in the name of the American Dairy Science Association.

INSTALLATION OF OFFICERS

President Price installed the following officers-elect:

"Ralph E. Hodgson and George Hyatt, Jr., according to our established custom, it is my great privilege as president of the American Dairy Science Association to declare that you have been duly elected by our members to be directors of this Association for the next 3 years.

"As you assume the duties, responsibilities, and privileges of this office we know you will conduct the affairs of this Association according to its Constitution and By-Laws."

"Lane A. Moore, in accordance with our traditional custom, it is now my privilege to inform you in the presence of these members of our Association that you will, for the coming year be our president.

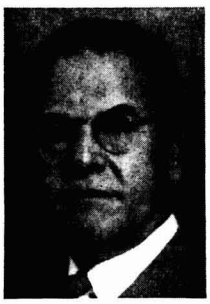
"We give into your trust the duties and responsibilities of this, our highest office, which you will conduct according to the instructions of the Constitution and By-Laws of the American Dairy Science Association."

"Ira A. Gould, by virtue of the established custom of our Association it is now my privilege and pleasure to give you this official welcome to the duties and responsibilities of the vice-president of the American Dairy Science Association. In accepting this office you agree to act according to the Constitution and By-Laws and, after one year, to become the president of this Association."

PEOPLE and EVENTS
in the Dairy Science World

Pioneers in the Dairy Industry

OLLIE E. REED was born on a farm near Fayette, Mo., August 19, 1885. He attended a country school, then continued his education at the grade and high school in Moberly, Mo. He entered the Univ. of Missouri in 1903 and was graduated with a B.S. degree from the College of Agriculture in 1908. In 1910 he received an M.S. from Missouri. He was awarded an honorary degree of Doctor of Science from Purdue Univ. in 1947.



O. E. Reed

Dr. Reed's experiences have been wide and varied. During the summer of 1904 he was employed in the dairy demonstration barns at the St. Louis World's Fair under E. H. Farrington of the Univ. of Wisconsin. He was an assistant in dairy production at the Univ. of Missouri in 1909, and the next year he was an instructor in milk production at Purdue. At Kansas Agricultural College he was professor of dairy husbandry from 1911 to 1918, and for the first 3 years he was also head of the poultry husbandry department. From 1918 to 1920 he served as professor of dairy husbandry at Purdue. In 1919 he was employed by the French Food Commission to purchase cattle in the United States. In 1921 he managed the Gossard Breeding Estates—a dairy and hog farm in Indiana—a wheat and livestock farm in Kansas, and a cattle ranch in Colorado. He was professor of dairy husbandry, Michigan State College, from 1921 to 1928 and was chief of the Bureau of Dairy Industry, USDA, from 1928 to 1954. Since January, 1954, he has been director of livestock research in the Agricultural Research Service.

Dr. Reed was elected vice-president of the American Dairy Science Association in 1920 and 1924 and was president in 1925 and 1926. He served as chairman of the committee to organize and publish the USDA yearbooks in 1936, 1937, and 1939.

For his many services to the government, Dr. Reed was given a Distinguished Service Award by the U. S. Department of Agriculture in 1952.

On June 8, 1910, he married Lucy Ann Lee of Moberly, Mo. They have three children, Rosa Lee (Kime), Olive E. (Boyle), and Wilber Jackson Reed.

Dr. Reed has influenced the lives of many young men in the dairy field. His activities in educational fields and his many accomplishments have earned for him recognition as one of our outstanding dairy leaders.

Loomis Burrell Retires

LOOMIS BURRELL has ended his long distinguished career as director and chairman of the Board of Directors of the Cherry-Burrell Corp. He has served continuously in these capacities since the company was incorporated in 1928. Mr. Burrell's father started in the dairy supply and equipment business at Little Falls 85 years ago, and 59 years ago Loomis Burrell joined his father's company, the D. H. Burrell Co., which in 1928 became one of the major components in the formation of Cherry-Burrell.

His interest in science, which increased during his college years at Yale Univ., found great potentials and applications in the rapidly developing dairy industry. Through his efforts and work with his company's engineers, came many of the great advances that have been made from the tin plate and soldered copper batch equipment of the early 1900's, to the continuous process stainless steel equipment of today.

Many well merited honors have been given Loomis Burrell during his career, among them being his appointment in 1932 as Consultant in Milk Sanitation by the U. S. Public Health Service. He was made an official delegate to the World Dairy Congress at Berlin in 1937 by Cordell Hull, then Secretary of State. In 1941 he was made a member of the General Board for Dairy Research of the Dairy and Ice Cream Supplies Association. In 1949 he was elected a member of the Scientific Research Society of America, and in 1952 he received a bronze plaque and citation from Cornell University Dairy Science Association for outstanding work in connection with the dairy industry.

His social attributes, civic activities, and industrial management abilities have been commensurate with his scientific achievements. Mr. Burrell's career has been filled with well rounded accomplishments, and many honors have been given him. He will continue to serve as a consultant to the company's research department.

Happenings in Oregon State

J. H. BYERS has accepted a position as assistant professor in the Dairy Science Department at the Univ. of Illinois. Dr. Byers has been a research assistant with the Oregon Agricultural Experiment Station for the past 6 years and has recently completed his work for the doctorate degree.

C. M. VON KROSIGK has accepted a graduate assistantship in Animal Breeding at Iowa State College. Mr. von Krosigk had previously been doing graduate work at Oregon State College.

A nonprofit organization called the Oregon Milk Producers was incorporated in Salem recently, with ARTHUR IRELAND of Forest Grove as president. The group was formed to promote the sale of milk and is an outgrowth of the efforts of a committee of 1,800 milk producers in the Portland milkshed who have been voluntarily promoting milk sales for several years. LESTER ADAMS, once publisher of the San Francisco Bulletin, was named manager. Offices have been established at 527 Pacific Building, Portland.

Alterations in the Dairy Products Plant Act of 1953 are being considered. The principal change offered would permit use of the Vacreator for pasteurization of Grade A milk. Also proposed is the allowance of a direct opening between milk house and milking parlor. U.S.P.H. Service has approved both items.

The Jackson County Pamona Grange and the Medford Milk Producers League have promoted a plan for boosting milk sales. They have sold eight of the city's largest restaurants on the idea of serving milk with meals at no extra cost. Reasons given were the rising price of coffee and the decreasing cost of milk and the fact that coffee was given with the meal with no additional charge. Newspaper advertisements listed the names of the cooperating restaurants.

Parfitt Becomes Evaporated Milk Association Secretary

FRANK E. RICE, executive secretary of the Evaporated Milk Association, retired from that position on July 1, and E. H. PARFITT has been named as his successor. Although Dr. Rice is relinquishing the executive secretaryship, he will remain as an active consultant of the Association for at least 3 years.

A Hoosier by birth, schooled at Indiana Univ. and Cornell, Dr. Rice joined the Evaporated Milk Association in 1927. To determine the value of evaporated milk in infant feeding and to interest the medical profession in its use was one of the principal activities of the Association at that time.

Dr. Parfitt came to the Association from Purdue University in 1938 to head up the newly formed Sanitary Standards Program. He was made assistant executive secretary 4 years ago.

Dr. Parfitt has long been prominent in the dairy industry. For 19 years he was on the staff at Purdue. He has published many articles in the field of bacteriology and milk sanitation.

Pluto Is Dead

The Holstein sire, Pabst Burke Pluto, Reg. No. 874002, died June 21 at Michigan Artificial Breeders Cooperative, East Lansing. This gold medal sire, classified "excellent," was brought to Michigan as a calf. His record shows 18 daughters with an average of 14,540 lb. milk with 3.58% test, and 521 lb. butterfat.

In January of 1950, Pluto was acquired by Michigan Artificial Breeders. This popular bull was the focus of attention to the many thousands of visitors to Michigan Artificial Breeders bull barn each year.

Illinois News Items

L. B. HOWARD, former head of the Food Technology Department, will become dean of the College of Agriculture September 1. R. T. MILNER, former director of the Peoria Regional Laboratory, succeeds Howard as head of Food Technology.

The Chicago Dairy Technology Society will sponsor the dairy products judging contest to be held by the International Dairy Show at Chicago in October. The committee in charge is made up of former college judging team members.

The Beatrice Creamery of Champaign has discontinued the manufacture of butter from gathered (sour) cream. After 40 years operating as a centralizer, the plant will process whole milk, manufacturing condensed milk, ice cream mix, nonfat dry milk solids, and sweet cream butter. A new 650 lb. per hr. spray drier was recently installed, according to C. N. HANSEN, vice-president of Beatrice Foods Co.

M. PURKO of the Dairy Science Department has accepted a position as bacteriologist with the Kraft Cheese Co., at Glenview, Ill.

ELAINE NELSON has accepted a post doctorate fellowship in the Dairy Science Department. Dr. Nelson, who comes from Iowa State, will work on vitamin synthesis.

F. N. BAKER, former graduate assistant in dairy cattle physiology, has accepted a position as assistant dairyman at the North Louisiana Hill Farm Experiment Station of L.S.U.

ROGER W. HEMKEN, graduate assistant in dairy cattle nutrition and feeding, has accepted a graduate assistantship at Cornell Univ.

JAMES F. D. GREENHALGH, Wright fellow in dairy cattle nutrition and feeding, returned July 12 to his home, "Rydal" Frodshans, Cheshire, England.

Former Vermont Dean Dies

JOSEPH LAWRENCE HILLS, dean of the college of Agriculture at the Univ. of Vermont from 1898 until his retirement in 1942, died at Burlington, July 8, at the age of 93. Since his retirement, Dean Hills has been engaged in the preparation of a history of the Univ. of Vermont. He is a past secretary-treasurer and president of the Assoc. of Land Grant Colleges and Universities and served as editor of the Association's publications from 1910 to 1919. He was the recipient of many honors and awards, including the degree of Honorary Doctor of Science from Massachusetts State College, Rutgers Univ., Rhode Island State College, and the Univ. of Vermont.

Completed Theses

M.S. Degree:

J. C. WILCOX—Fatty acid chain length specificity of some microbial lipases. Univ. of Illinois.

J. F. D. GREENHALGH—Effect of heavy concentrate feeding prior to calving upon lactation and upon mammary edema. Univ. of Illinois.

W. T. AKERS—Effect of physical form of hay upon hay consumption and growth of young dairy calves. Univ. of Illinois.

R. W. HEMKEN—The use of calcium formate in preservation of alfalfa silage. Univ. of Illinois.

JAMES R. LODGE (Dairy Husbandry)—Influence of aureomycin on *in vitro* cellulose digestion by bovine rumen microorganisms. Iowa State College.

ERLING BRANDSAETER (Dairy Bacteriology)—Growth of psychrophylic bacteria in raw milk. Iowa State College.

DEMETRI C. PAPADOPOULOS (Dairy Industry)—Effects of warm-up treatments on psychrophilic bacteria in pasteurized milk. Iowa State College.

Ph.D. Degree:

FOREST N. BAKER—The effect of frequency of ejaculation and epinephrine injection on the semen production and libido of young bulls. Univ. of Illinois.

RUDY KOVACHEVICH — Degradation of 6-phosphogluconate to pyruvate and glyceraldehyde-3-phosphate by pseudomonas fluorescens. Univ. of Illinois.

DALE E. MADDEN (Animal Breeding) — Relations between parts of lactations and the real producing ability of Holstein cows. Iowa State College.

WALLACE C. LAWTON (Dairy Bacteriology)—Influence of certain factors on growth of bacteria in refrigerated dairy products. Iowa State College.

LAURENCE G. HARMON (Dairy Bacteriology)—Interrelationships of microorganisms in cream. Iowa State College.

W. G. JENNINGS—Studies of certain red pigments derived from 11-thiobarbituric acid and their relation to oxidized flavor. Univ. of California, Davis.

L. F. EDMONDSON—The effect of heat and certain salts on the centrifugal sedimentation rates of milk proteins. Univ. of California, Davis.

News from Iowa State College

HOWARD LARSON has been appointed to the dairy husbandry staff at Iowa State College as Associate in teaching and research.

C. Y. CANNON, on leave from Iowa State College, has returned to Lebanon for another year as agriculture advisor, after visiting in the United States during May and June.

Construction has begun on a dairy calf nutrition barn at the dairy husbandry farm at Iowa State College. Completion is expected during the late fall. Facilities for digestion work, radioactive tracer studies, and chemical work will be included.

R. SCOTT ALLEN (Animal Husbandry and Chemistry), L. D. MCGILLIARD (Animal Husbandry), and V. H. NIELSEN (Dairy Industry Extension) have been promoted to the rank of associate professor.

D. E. MADDEN, who recently received his doctorate in animal breeding from Iowa State College, has joined the staff of the Dairy Department at Michigan State College.

EARL O. WRIGHT joined the Dairy Industry Extension staff as assistant professor on June 1. He formerly was a member of the staff at the Univ. of Wisconsin.

Professor Sammis, Cheese Specialist, Dies

JOHN L. SAMMIS, 81, a retired Univ. of Wisconsin staff member, died July 16 at his home in Madison. Professor Sammis was connected with the Department of Dairy Industry at Wisconsin from 1906 to 1940. He obtained his B.S. and M.S. degrees from the Univ. of Illinois and his Ph.D. degree from Wisconsin, in 1897, 1899, and 1906, respectively. For some time he was associated with DR. STEPHEN M. BABCOCK in research on the chemical properties of milk.

Dr. Sammis was the author of *Cheese Making*, a textbook for practical cheesemakers. In 1912, assisted by A. T. BRUHN, he developed a method for manufacturing Cheddar cheese from pasteurized milk. For many years he was secretary of the Wisconsin Cheese Makers Association.

Surviving are his wife, three daughters, and one son, John C., a reporter for the Capital Times of Madison.

Student Affiliates and A.D.S.A.

A Guest Editorial

We have witnessed within the past six years a marked decline in student affiliate memberships of the A.D.S.A. It is the considered opinion of those who have been studying the problem that this reflects an unhealthy situation which, if not remedied, may have far-reaching effects upon the future welfare of the Association and the entire dairy industry. The record of student affiliate memberships for the past six years is as follows: 1949—859; 1950—750; 1951—340; 1952—264; 1953—270; 1954—301.

The most apparent explanation of the decline in affiliate members is the marked decrease in the number of dairy students that has occurred since 1949. Also, there is an indication that the increase in student affiliate annual dues from $3.00 to $5.00 has materially contributed to this decline in memberships. Without minimizing the importance of the above factors, it is clear that the full potentiality of the student affiliate program is far from being realized.

Student affiliate memberships were originally established as a means of inducing students to become regular members of the A.D.S.A. after graduation. College graduates have been, and still are, a primary source of new members for the Association. Yet, during the peak year of student affiliate memberships (1949), only 17 assumed regular membership after graduation. Recent efforts to gain more members from this source have yielded promising results. During 1952, 40 of the 92 new members were former student affiliates. Here is concrete evidence of what a more active student affiliate program can achieve. The importance of dairy graduates as a fruitful source of new members for the Association should not be underestimated. These are professionally trained individuals to whom the Association and the industry must one day look to assume much of the responsibility for leadership and continued service.

E. L. Thomas

The committee on student affiliate chapters of the A.D.S.A. has surveyed student and faculty opinion regarding present weaknesses of the student affiliate program and what might be done to bring about a stronger tie between dairy students and the Association. An analysis of the facts and opinions revealed by the study leads to two principal conclusions regarding the steps necessary to stimulate the interest of dairy students toward more active participation in the student affiliate program. First, the benefits to be derived from affiliation must be increased and, secondly, any plans for a more active student affiliate program should include as a primary objective the strengthening of local dairy student organizations.

Many of the previous benefits of student affiliation have ceased to exist. The principal benefit at present is the opportunity to receive the JOURNAL OF DAIRY SCIENCE at reduced cost. Some faculty members believe that students should be strongly encouraged to obtain the Journal in order to keep abreast of current scientific developments. Others feel that the Journal is too technical for student use at the undergraduate level and that we are not justified in urging the undergraduate to become a student affiliate for the sole purpose of receiving the Journal. Many students have expressed the view that it is not necessary for them to have personal copies, as the Journal is accessible in the library. The usefulness of the Journal to the graduate student has not been questioned. But in order to interest the majority of undergraduate students in becoming student affiliate members, additional benefits must be forthcoming. Undoubtedly, the inclusion of the "People and Events" section and the other popular sections in the Journal has enhanced its interest to the undergraduate student. Recently, it has been proposed that a periodic student newsletter be published either as part of, or separate from, the Journal. Students in general appear to be enthusiastic regarding the potential merits of a newsletter as a medium for exchanging ideas and disseminating information regarding activities in the dairy field which are of direct concern to them. Plans are currently being made for activating this project which, if successful, can serve materially to increase the benefits of student affiliation with A.D.S.A.

At present there are 26 dairy student clubs which possess charters designating them as student branches of A.D.S.A. A number of other clubs have never applied for such a charter. Several of these local clubs are extremely to moderately active—many others have practically ceased to exist either because of lack of students or lack of interest. It appears highly desirable that serious consideration should be given to providing worthwhile incentives which would serve to stimulate greater activity among our dairy clubs. There is ample evidence that the activities of a properly functioning student organization can effectively complement the formal teaching program. Past members of active dairy clubs frequently express the belief that club activities were an important part of their college education. Membership in the dairy club is often the first opportunity offered the student whereby he may experience the sense of belonging to a profession. Club activities also provide the opportunity for exer-

cising leadership and the chance to gain other valuable experience which can serve to better prepare the dairy student for a professional career in the dairy industry.

Much has been written concerning the causes of the small enrollment of dairy students—especially in the field of dairy industry. It appears that this situation is in large part due to a lack of knowledge and understanding regarding the present needs of the dairy industry and the opportunities available to the properly trained individual in this most important branch of our expanding food industry. The A.D.S.A. has played a dominant role in the scientific and educational advances in the dairy field. However, during the past decade there has been a substantial increase in the emphasis on the scientific phase of the Association's program and a marked slackening of emphasis on educational activities. No one can truthfully deny that the expansion of research activities in the dairy industry has been necessary and must be continued. However, it is undoubtedly true that the ultimate effectiveness of research will depend, to a major degree, upon the availability of adequately trained individuals who are able to make practical application of the results of research. Many of the members of A.D.S.A. who are directly concerned with the student problem believe that if the Association is to maintain its leadership in the dairy field there must be a vigorous revival of activity in the educational phase of its program. It is realized that the student affiliate question is but one phase of the over-all student problem. However, it is highly probable that a well coordinated student affiliate program can effect an improvement in the status of our present students and, at the same time, stimulate the interest of others in preparing themselves for a career in the dairy industry.

E. L. THOMAS
University of Minnesota
Chairman, Committee on Student Affiliate Chapters, A.D.S.A.

OUR INDUSTRY TODAY

Brief Reviews of Current Topics

AUTOMATIZATION OF DAIRY PROCESSING OPERATIONS

The Dream Plant of Tomorrow

DALE A. SEIBERLING
Department of Dairy Technology
The Ohio State University

Process instrumentation, a fast growing branch in the field of engineering, deals with the complete automatic control of various processing operations. The oil and chemical industries, among others, have rapidly taken advantage of this technical advance, not because of the feature of push-button control by operators, but because automatization can achieve smoother integration of processing operations than is possible with human control. The dairy plant of the future should lend itself to this development.

Many of our plant operators, perhaps without realizing it, already employ some process instrumentation in controlling HTST pasteurizers. No man could maintain the precise control over the temperature and path of milk as is done by the automatic temperature and flow diversion valve instrumentation.

Recently, we have witnessed the introduction of bulk tank pick-up, C.I.P. cleaning, automatic casing and uncasing equipment, automatic case stackers, paletized systems of materials handling, and continuous standardization of milk. Continuous pasteurization of milk and continuous freezing of ice cream have long been practiced. Continuous butter making operations have proven successful, and recently we have observed the introduction of continuous cheese making processes. Ice cream is hardened and mixes are processed by more or less continuous techniques. The definite trend to continuous operation of many phases of our processes, made possible by newer techniques, allows the consideration of the possibility of integrating the complete operation into an automatically controlled process. The key is process instrumentation — the end result will be complete automatization of entire processes.

Process instrumentation is now available to measure and control such variables as flow, liquid level, moisture content, pH, pressure, and temperature. Exploratory work conducted in cooperation with the Ohio State University has indicated that determination, recording, and control of ice cream overrun — in the line — is possible through application of radiation energy measurements. Reports of the development of an instrumental method for determining fat and total solids allow the consideration of automatic control of even these variables.

Complete Automatic Control Possible

Well within the realm of possibility is a dairy process operation in which the processing and packaging of the product and cleaning and sanitizing of the equipment may be completely

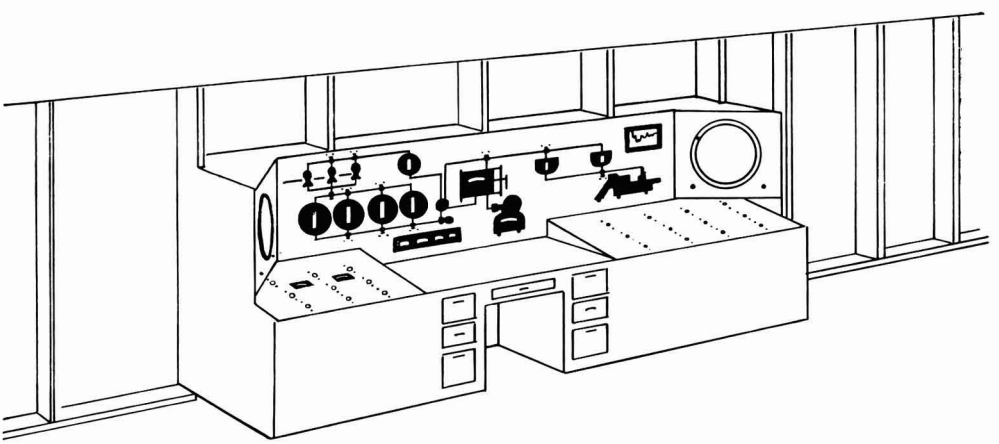


FIG. 1. A schematic diagram of a theoretical fluid milk processing operation equipped for complete automatic control.

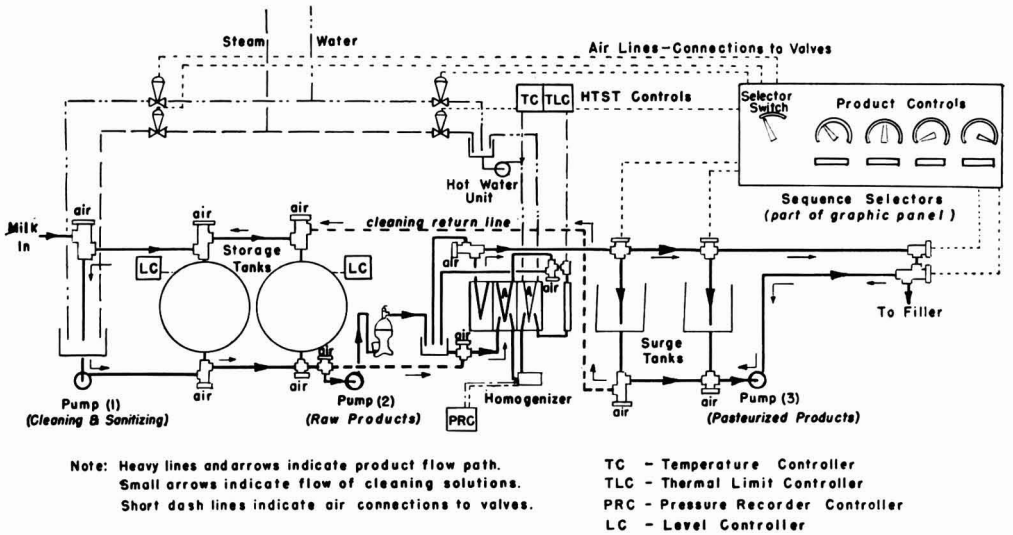


FIG. 2. Possible appearance of a graphic control panel installed in a glass window-wall allowing visual observation of the process in addition to instrumental observation.

under automatic control. Such a "dream plant" may consist of a system similar to the one presented schematically in Figure 1. Storage and surge tanks with level alarms and indicators, a HTST unit with conventional temperature and thermal limit controls, a homogenizer with pressure control, and perhaps in the future, a standardizer-clarifier equipped for fat content measurement and control comprise the basic items of equipment. These could be connected with air-operated valves and sanitary piping to form circuits suitable for both processing operations and circulation cleaning operations. The "nerve center" of this installation would be a sequence controller which could be preset to provide proper valve positions, start and stop pumps and other machines in proper order, apply homogenizer pressure, or in short, conduct all operations now done by human hands. Turning the selector switch to "clean" could position all valves to make up a C.I.P. circuit consisting of the pipe lines, HTST system, and homogenizer. Timing cams would control the addition of water and detergents and time of circulation. Tanks could conceivably be cleaned by recirculation methods, even during processing, if the necessary spray equipment was permanently installed and connected to the cleaning unit with air-operated valves. A complete line of fluid products could be processed continuously. Chocolate drink, for instance, might be handled by utilizing the standardizer to reduce the fat content of the whole milk to 2.0%, then combining the milk with liquid sugar and chocolate in the proper ratios in the balance tank. In case of failure of packaging or bottling equipment, automatic control could place the circuit in a "standby" recirculation operation until the difficulties were corrected. If the trouble was not remedied within a predetermined maximum time period, the processing operation would shut down until more product was needed.

Operations Will be Controlled from One Panel

Such an installation could become quite extensive and still remain under control of one trained technician. He would not be in the plant proper but would be situated at a graphic control panel (Figure 2) perhaps overlooking the plant. He could observe from one position

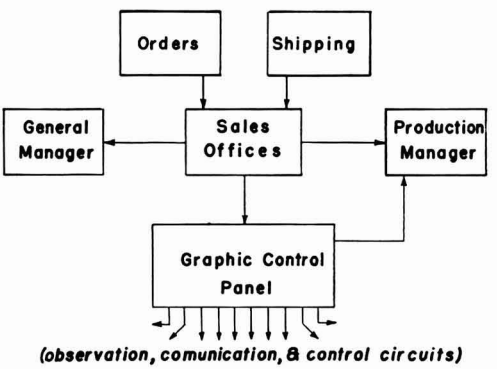


FIG. 3. Channels through which information regarding sales, production, and inventory might flow by use of punched cards and electronic computers.

every variable in the process, ascertain the position of every valve, and determine the flow of every product or other liquid medium. Controls for every operation would be placed at his finger tips. Industrial television could be employed to enable him to observe tank truck receiving operations or cold storage handling operations. This man would be responsible for considerable product processing yet could have his responsibilities eased — for automatic interlock circuits would prevent him from making costly mistakes. An installation of this type could provide a steady flow of the desired products of high uniformity to filling equipment nearly 24 hours a day.

Sales and Accounting Procedures Included

To complete the automatization program, consider the inclusion of another new technique in the sales and accounting areas of the business. As daily orders come into a plant, the information could be placed on punched cards. Shipping information might be handled in a similar manner. Card sorting mechanisms could tabulate, compute, and supply information regarding sales, production, and inventory at a mere push of a button. Illustrated on Figure 3 is a block diagram indicating the channels such information might follow in keeping management posted on business conditions, production people up to date on completed production, and the process operator informed as to what is still needed. Such an electronic device could even have a "memory" and perhaps could adjust for holidays, weekends, etc., if previous year's histories were also provided.

We may consider, and perhaps must consider, the above as only a dream. But — we should realize that much of it is technologically possible now.

Recent publications have pointed out that process instrumentation is not a stand-in for human beings. It can do things that would be impossible for any combination of human beings to handle; acting continuously, rapidly, and tirelessly — forever monitoring the product and maintaining its quality. However, regardless of all the capabilities of mechanical control, human ingenuity and judgment will remain essential in its application in the dairy plants of tomorrow.

EVALUATION OF COLLEGIATE STUDENT DAIRY PRODUCTS JUDGING SINCE WORLD WAR II

P. A. Downs, E. O. Anderson, C. J. Babcock, F. H. Herzer, and G. M. Trout

Committee on Judging Dairy Products, A.D.S.A.

Since the resumption of the Collegiate Students International Contest in the Judging of Dairy Products in 1947 after a lapse of 5 years due to World War II, seven annual contests have been held in which 163 teams of three men each representing 37 colleges have participated.

The contest continues to be sponsored jointly by the American Dairy Science Association and the Dairy Industries Supply Association and is conducted under the supervision of the United States Department of Agriculture. Recognized quality-minded, commercial leaders in the dairy products field have served as official judges of the butter, milk, cheese, and ice cream used in the annual contest. In addition, chosen coach judges have served as check judges for each of these products. In all, the scores and criticisms given the products should represent the cross section opinion of competent judges on the qualities of dairy products throughout the country. Thus, in time a dairy products quality pattern will be established.

The coaches of judging teams participating in the contest soon acquire an awareness of this pattern to the extent that this experience-gained information unconsciously becomes a part of their teaching and, thus, this knowledge of quality evaluation is passed on to the students and to succeeding coaches.

The coaches may gain from a knowledge of the quality patterns and trends as established in previous contests. To this end, the committee on Judging Dairy Products, A.D.S.A., has made available through studies of various phases of judging dairy products specific information *(1, 2, 3, 4, 5, 6, 7, 8, 9 and 10)* which will aid in increasing their knowledge of dairy products judging, particularly as related to the Collegiate Students International Contest.

A study of the data presented shows certain trends not only in flavors but in their evaluations. Changes in processing as a result of technological development may result in slight but significant influences on the appearance, feel, odor, and taste of dairy products. Accordingly, studies of the evaluation of the various organoleptic qualities of these products must be made from time to time if judging progress is to be achieved. The studies reported herein will be helpful to all the coaches of dairy products judging teams and will indicate to the industry the relative values accorded products having certain organoleptic defects.

Flavor Scores and Criticisms of Butter, Milk, Cheese, and Ice Cream

The official flavor criticisms and scores for the 70 samples each of butter, cheese, milk, and ice cream used in the contests from 1947 to 1953 inclusive are presented in Tables 1, 2, 3, and 4. The flavor criticisms are listed alphabetically as they appear on the contestant score cards. In addition, the associated flavor criticism is listed alphabetically. The score for the specific flavor or combination of flavors, as well

TABLE 1

Official flavor scores and criticisms of butter judged from 1947 to 1953 inclusive

Flavor criticism [a]	Evaluation of flavor	Times noted	
	(points)	*(No.)*	*(%)*
None	38.0	7	10.0
Acid (alone)	—	0	—
and coarse	36.0 to 36.5	3	4.3
coarse, cooked	36.0	1	1.4
and cooked	36.0	1	1.4
and malty	35.5 to 36.0	3	4.3
and old cream	35.5 to 36.0	3	4.3
Cheesy (alone)	33.0	1	1.4
and old cream	33.0	1	1.4
old cream, rancid	32.0	2	2.9
Coarse (alone)	36.5 to 37.5	9	12.9
and cooked	37.5	1	1.4
and feed	37.0	1	1.4
and old cream	35.0 to 36.0	3	4.3
Cooked (alone)	38.0	3	4.3
and feed	37.5	1	1.4
Fishy (alone)	32.0	1	1.4
Garlic (alone)	32.5 to 33.0	4	5.7
and neutralizer	32.0	1	1.4
Metallic (alone)	—	0	—
and fishy	32.0	2	2.9
and old cream	32.5 to 33.0	2	2.9
and tallowy	31.0	1	1.4
Musty (alone)	34.0	1	1.4
and old cream	34.0	1	1.4
and weedy	32.0 to 34.0	2	2.9
Neutralizer (alone)	34.0	2	2.9
and old cream	34.0 to 35.0	5	7.1
Old cream (alone)	34.0 to 35.5	8	11.4

[a] The flavor defects "bitter, briny, feed (alone), flat, malty (alone), oily, oxidized, rancid (alone), storage, tallowy (alone), unclean, weedy (alone), woody, and yeasty" were not found in the butter samples used in the last seven contests.

TABLE 2

Official flavor scores and criticisms of cheese judged from 1947 to 1953 inclusive

Flavor criticism [a]	Evaluation for flavor	Time noted	
	(points)	*(No.)*	*(%)*
None	40.0 to 41.0	18	25.7
Acid (alone)	37.5 to 39.0	9	12.9
bitter	36.5	2	2.9
bitter, unclean	37.0 to 38.0	7	10.0
feed	39.5	2	2.9
unclean	36.0 to 37.0	2	2.9
Bitter and unclean	35.5 to 39.0	5	7.1
fruity, yeasty	37.5	1	1.4
fermented	35.5	1	1.4
Fermented (alone)	36.5	1	1.4
unclean	36.0 to 38.5	2	2.9
Flat (alone)	38.5	1	1.4
Fruity (alone)	37.0	1	1.4
unclean	37.0	2	2.9
yeasty	36.5	1	1.4
yeasty, unclean	37.0	1	1.4
Unclean (alone)	35.5 to 39.5	13	18.6
fermented	36.0	1	1.4

[a] The flavor defects "feed (alone), heated, moldy, rancid, weedy, whey taint, and yeasty (alone)" were not found in the cheese samples used in the last seven contests.

TABLE 3

Official flavor scores and criticisms of milk judged from 1947 to 1953 inclusive

Flavor criticism [a]	Evaluation for flavor	Time noted	
	(points)	*(No.)*	*(%)*
None	40.0	1	1.4
Barny (alone)			
feed, unclean	34.0	1	1.4
Bitter (alone)			
rancid	32.0	1	1.4
Cooked (alone)	34.5 to 39.5	16	22.9
feed	37.0 to 39.0	16	22.9
flat, oxidized	36.0	1	1.4
Cowy (alone)	35.0	1	1.4
Feed (alone)	34.0 to 39.0	11	15.7
flat	38.5	1	1.4
garlic	33.0	1	1.4
unclean	36.0	1	1.4
Flat (alone)	39.0	1	1.4
Garlic or onion (alone)	32.0 to 35.0	2	2.9
Malty (alone)	35.0	2	2.9
Oxidized (alone)	30.0 to 37.0	11	15.7
Rancid (alone)	30.0	1	1.4
Salty (alone)	35.0	1	1.4
Unclean (alone)	28.0	1	1.4

[a] The flavor defects "barny (alone), bitter (alone), foreign, high-acid, metallic, musty, and weedy" were not found in the milk samples used in the last seven contests.

as the number and percentage of times the flavors recur, is given.

An examination of the tabular material shows several striking, but expected, trends in judging dairy products. Probably the first observation of note is that not all the flavor defects listed on the contestant score cards are used. However, a closer scrutiny may reveal their usage in combination with another flavor defect. Nevertheless, the question of the desirability of their being deleted arises. However, advantageous as their deletion would seem to be, it must be borne in mind that the up-to-date yearly rules of the contest, in which the contestant-score-card-listed criticisms are included identically, serve also as a guide for all judging of dairy products — commercial, sectional, and vocational. Furthermore, the flavors listed may be noted occasionally in routine grading of dairy products.

It must be understood that the samples used, with or without specific flavor defects, were selected for contest use for the most part because they possessed certain contest-desired flavor qualities. Hence, the percentage distribution of the samples above flavor criticism or having specific flavor defects cannot apply to the quality of commercial dairy products in the United States as a whole.

The Tables also show that several individual or groups of flavor defects occur more frequently than others. Furthermore, these defects are generally specific to the product. For example, "acid," "coarse," "neutralizer," and "old

TABLE 4

Official flavor scores and criticisms of ice cream judged from 1947 to 1953 inclusive

Flavor criticism [a]	Evaluation for flavor	Time noted	
	(points)	*(No.)*	*(%)*
None	40.0	2	2.9
Cooked (alone)	36.0 to 39.5	10	14.3
lacks fine flavor	37.5 to 39.0	5	7.1
lacks flavoring	37.5	2	2.9
old ingredient	34.0 to 36.5	4	5.7
storage	36.0 to 38.5	2	2.9
too high flavor, old ingredient	36.5	1	1.4
unnatural sweetener	38.0	1	1.4
Flavoring lacks	36.0	1	1.4
lacks, unnatural sweetener	38.0	1	1.4
too high	37.5 to 39.5	2	2.9
too high, lacks fine flavor, unnatural sweetener	38.0	1	1.4
unnatural	34.0 to 36.0	9	12.9
Lacks fine flavor (alone)	37.5 to 39.5	9	12.9
too high flavor	38.0 to 38.5	2	2.9
unnatural sweetener	27.5	1	1.4
Metallic (alone) unclean	32.0	1	1.4
Neutralizer (alone) old ingredient	32.0 to 34.0	3	4.3
Old ingredient (alone)	33.5 to 37.0	7	10.0
too high flavor	36.0	1	1.4
unnatural flavor	34.0	1	1.4
Oxidized (alone)	33.5	1	1.4
metallic	34.0	1	1.4
Storage (alone)	35.0 to 37.0	2	2.9

[a] The flavor defects "egg, high acid, lacks freshness, metallic (alone), rancid, salty, lacks to high or unnatural sweetener (alone), and unclean" were not found in the ice cream samples used in the last seven contests.

cream" are specific to butter; "cooked," "feed," and "oxidized" to milk; "cooked," "unnatural flavoring," "lacks fine flavor," and "old ingredient" to ice cream; and "acid," "bitter," and "unclean" to cheese.

The numerical evaluations of the flavor criticism reveal remarkable consistency on the part of the judge. The report of previous studies *(4, 5, 8, 9)* has been helpful in lending stability to flavor evaluation. Although specific scores were suggested for the various intensities of off flavors in the several dairy products *(8)*, not all judges agreed perfectly on the intensity of the defect; hence the factor of interpretation of intensity in score evaluation enters into the final judgment. Also, another factor, that of multiple flavors, as well as intensities, makes a suggested scoring guide difficult to follow. Individual judgment of flavor and its intensity will always be a nonmeasurable quality. Nevertheless, suggested guides and records of judgments such as reported herein, will be of inestimable value in establishing a pattern or norm that dairy products coaches may use with confidence.

Judgment on the Physical Characteristics of Butter, Cheese, and Ice Cream and on the Container and Closure for Milk

The body and texture scores of cheese and ice cream and of container and closure for milk and their evaluations are given in Tables 5, 6, and 7. Although the rules for the contest and the contestants' butter score card list eight possible body and texture defects for butter, not one of the 70 samples was scored down for this item.

TABLE 5

Official body and texture criticism of cheese judged from 1947 to 1953 inclusive

Body and texture criticism [a]	Evaluation of body and texture	Time noted	
	(points)	*(No.)*	*(%)*
None	29.5	6	8.6
Crumbly (alone) gassy	26.5	1	1.4
Curdy (alone) gassy	26.0 to 26.5	2	2.9
Gassy (alone)	26.5 to 27.0	3	4.3
mealy	26.0 to 27.0	3	4.3
open	26.5	1	1.4
pasty, sw. curd holes	26.0	1	1.4
sw. curd holes, weak	27.0	1	1.4
Mealy (alone)	27.5	1	1.4
open	27.0	2	2.9
pasty	27.0 to 27.5	2	2.9
short	27.0	1	1.4
weak	28.0	1	1.4
Open (alone)	27.0 to 29.0	15	21.4
pasty	27.0 to 28.0	4	5.7
pasty, weak	26.5 to 28.0	2	2.9
short	28.5	1	1.4
sweet curd holes	26.5 to 28.5	2	2.9
weak	27.5 to 28.5	6	8.6
Pasty (alone)	27.0	1	1.4
open, weak	28.0	2	2.9
short	26.5	2	2.9
sw. curd holes	28.0	1	1.4
sw. curd holes weak	25.5	1	1.4
weak	27.0 to 28.5	2	2.9
Short	28.0 to 28.5	4	5.7
Weak	29.0	2	2.9

[a] The body and texture defects "corky, crumbly (alone), curdy (alone), spongy, sweet curd holes (alone), and yeasty" were not found in the cheese samples used in the last seven contests.

Conversely, the body and texture of cheese plays such a major role in its utility and sale that only a small percentage of American Cheddar cheese escapes criticism from cheese judges in this respect (Table 5). Fifteen, or 21.4% of the 70 samples of cheese were criticized for having an "open" body. This defect, often encountered with other criticisms, such as "gassy," "mealy," or "pasty," was noted in a total of 35 of the samples, or 50%. A "gassy" texture, either singly or in combination, was found in 12 or 17.1% of the samples.

TABLE 6

Official body and texture and melting quality criticisms of ice cream judged from 1947 to 1953 inclusive

Criticism	Evaluation	Time noted	
	(points)	*(No.)*	*(%)*
Body and texture:[a]			
None	29.5	9	12.9
Coarse (alone)	27.0 to 29.0	15	21.4
icy[b]	27.5 to 29.0	35	50.0
soggy	27.0 to 28.5	2	2.9
weak	28.0 to 28.5	6	8.6
Soggy (alone)	29.0 to 29.5	2	2.9
gummy	29.0	1	1.4
Melting quality:			
None	5.0	44	62.9
Curdy (alone)	4.0 to 4.5	22	31.5
does not melt	4.0	2	4.3
Does not melt	4.0	1	1.4

[a] The body and texture defects "crumbly, fluffy, gummy (alone), icy (alone), sandy and weak (alone)" were not found in the ice cream samples used in the last seven contests.

[b] This defect was listed on the contestant's score card in 1947 and 1948 as "coarse or icy."

TABLE 7

Official container and closure criticisms of milk judged from 1947 to 1953 inclusive

Criticism	Evaluation	Time noted	
	(points)	*(No.)*	*(%)*
Container and closure:[a]			
No criticism	5.0	26	37.1
Closure:			
Not sealed (alone)	4.75	21	30.0
chipped lip	3.75	1	1.4
not full	4.25	1	1.4
not protected	3.75	4	5.7
not protected, chipped	3.5	2	2.9
not protected, chipped lip, poorly seated or leaky	3.0	1	1.4
not protected, not clean inside	2.75	1	1.4
not protected, not clean inside, poorly seated or leaky	2.25	1	1.4
partly protected	4.25	7	10.0
partly protected, leaky	3.25	1	1.4
Container:			
Not clean inside	4.0	2	2.9
Not full	4.5	2	2.9

[a] The container and closure defects "cover torn, poorly seated (alone), dented, leaky, chipped lip (alone), cover not waterproof, not protected (alone), and partly protected (alone)" were not found in the milk samples used in the last seven contests.

"Mealy," "pasty," "short," and "weak" defects also were noted rather frequently, being found in 14.3, 25.7, 11.4, and 21.4% of the samples, respectively.

Likewise, the body and texture of ice cream have lacked considerable of attaining perfection. Of the 70 samples, 58 or 82.9% were criticized for being "coarse" and/or "icy." Furthermore, 37.1% of the samples failed to show good melting quality.

The container and/or closure for milk samples used in the contest have been subject to criticism. Of the 70 samples, 67.1% were faulted for being "not sealed" either with this shortcoming alone (30%) or in combination with some other defect.

Minor Score Card Items

With the possible exception of color in cheese, which was criticized occasionally for being "acid-cut," the minor score card items for butter, cheese, milk, and ice cream generally were not criticized. However, the proficient judge of dairy products is always conscious of possible defects in these areas. For example, "gritty" salt in butter, once encountered frequently, is comparatively unknown in creamery butter today. Yet the competent butter judge always is conscious of the possibility of the defect. So it is with potential defects in other minor items as well.

Suggested Guides for Teaching Dairy Products Scoring

Based upon *(a)* trends in judging, in part as shown herein; *(b)* improvement in processing

TABLE 8

Suggested flavor scores for butter showing designated intensities of flavor defects

Flavor criticisms	Scores[a] for flavor having defects of the following intensities		
	Slight	Distinct or definite	Pronounced or strong
Acid	36	35	34
Bitter	36	35	34
Briny	37	36	35
Cheesy	34	33	32
Coarse	37	36	35
Cooked	38	37	36
Feed	38	37	36
Fishy	33	32	31
Flat	37	36	35
Garlic	34	33	32
Malty	36	35	34
Metallic	34	33	32
Musty	34	33	32
Neutralizer	35	34	33
Oily	34	33	32
Old cream	35	34	33
Oxidized	34	33	32
Rancid	33	32	31
Storage	37	36	35
Utensil (unclean)	35	34	32
Woody	36	35	34
Yeasty	34	33	32

[a] Range of score for each class of butter:

Excellent	38 (no criticism)
Good	36 -37.5
Fair	34.5-35.5
Poor	31 -34

TABLE 9

Suggested flavor scores for cheese showing designated intensities of flavor defects

Flavor criticisms	Scores[a] for flavor having defects of the following intensities		
	Slight	Distinct or definite	Pronounced or strong
Acid	38.5	37	35.5
Bitter	38.5	37	35.5
Feed	38.5	37.5	36.5
Fermented	37	36	35
Flat	39.5	39	38.5
Fruity	38	37	36
Heated	39	38	37
Moldy	37	36	35
Rancid	37	36	35
Unclean	38	37	36
Weedy	38	37	36
Whey taint	38	37	35
Yeasty	37	36	35

[a] Range of score for each class of cheese:

Excellent	40 (no criticism)
Good	38-39
Fair	36-37
Poor	35

and manufacture, and *(c)* market demands, the suggested scores for slight, distinct, and pronounced flavor criticisms for butter, cheese, milk, and ice cream are presented in Tables 8, 9, 10, and 11, respectively.

The data in Tables 5, 6, and 7 relative to scores for physical defects of cheese, ice cream, and of container and closure of milk, respectively, might well serve as a guide in these areas.

TABLE 10

Suggested flavor scores for milk showing designated intensities of flavor defects

Flavor criticisms	Scores[a] for flavor having defects of the following intensities		
	Slight	Distinct or definite	Pronounced or strong
Barny	35	30	—
Bitter	36	32	—
Cooked	39	38	37
Cowy	36	33	30
Feed	39	37	35
Flat	39	38	37
Foreign	35	33	30
Garlic or onion	35	33	30
High acid	33	30	—
Malty	36	33	30
Metallic	36	34	32
Musty	35	33	30
Oxidized	35	33	30
Rancid	33	30	—
Salty	38	36	34
Unclean	35	30	—
Weedy	35	33	30

[a] Range of score for each class of milk:

Excellent	40-45
Good	37-39.5
Fair	34-36.5
Poor	30-33.5

TABLE 11

Suggested flavor scores for ice cream showing designated intensities of flavor

Flavor criticisms	Scores[a] for flavor having defects of the following intensities		
	Slight	Distinct or definite	Pronounced or strong
Cooked	39.5	38	36
Egg	39	38	37
Flavoring —			
Lacks	39	38	37
Too high	38	37	36
Unnatural	36	34	33
High acid	35	32	30
Lacks fine flavor	39	38	37
Lacks freshness	38	37	36
Metallic	36	34	32
Neutralizer	35	33	31
Old ingredient	37	35	33
Oxidized	36	34	32
Rancid	35	32	30
Salty	38	37	35
Storage	37	36	35
Sweetener —			
Lacks	39	38	37
Too high	39	38	37
Unnatural	38	37	35
Unclean	35	33	31

[a] Range of score for each class of ice cream:

Excellent	40 (no criticism)
Good	37.5-39.5
Fair	34.5-37
Poor	30 -34

These guides will aid the dairy products coach in his teaching and be helpful to the student in gaining confidence in dairy products judging.

Summary

Percentage distribution studies have been made on the flavor and physical-quality criticisms of the butter, cheese, milk, and ice cream samples used in the Collegiate Students International Contest in the Judging of Dairy Products from 1947 to 1953, inclusive.

The predominating flavor criticisms noted in butter were "acid," "coarse," "neutralizer," and "old cream"; of cheese, "acid," "bitter," and "unclean"; of milk, "cooked," "feed," and "oxidized"; and of ice cream, "cooked," "unnatural flavoring," "lacks fine flavor," and "old ingredient."

The chief physical defects of cheese were "open," "pasty," and "weak"; those for ice cream were "coarse" and "icy." The most commonly used criticism of the container and closure of milk was "not sealed."

Suggested scoring guides for various intensities of off flavors in butter, cheese, milk, and ice cream were presented.

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(8) TROUT, G. M., DOWNS, P. A., MACK, M. J., FOUTS, E. L., AND BABCOCK, C. J. The Evaluation of Flavor Defects of Butter, Cheese, Milk and Ice Cream as Designated by Dairy Products Judges. *J. Dairy Sci.*, **25**: 557. 1942.

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JOURNAL OF DAIRY SCIENCE

ABSTRACTS OF LITERATURE

W. O. Nelson, Abstract Editor

ANIMAL DISEASES

707. Extermination of bovine brucellosis by preventive inoculation and diagnostic methods studied with reference to a plan of campaign on a broad basis. R. SCHEELJE, Inst. für Milchhygiene der Bundes-Versuchs-und Forschungsanstalt für Milchwirtschaft, Kiel, Germany. Kieler Milchwirtschaftliche Forschungsberichte, 6: 91. 1954. (English Summary).

Various possibilities of combatting bovine brucellosis by preventive inoculations of living cultures are discussed. Best results were obtained with faintly virulent 19 (X) strains.

Diagnostic procedures such as the "ring test" and a rapid agglutination test with gradually reduced quantities of serum were also evaluated. Both methods, on the whole, were found adequate in detecting infected stocks. 285 references. J. Tobias

BOOK REVIEWS

708. Advances in Enzymology, vol. 15. Edited by F. F. NORD. Interscience Publishers, Inc., New York 1, N. Y. 533 pp. $11.00. 1954.

The chapters included are: The mechanisms of enzymic oxidoreduction, by S. J. Leach (Australia); Thermodynamique des réactions immunologiques, by René Wurmser (France); Chemistry, metabolism, and scope of action of the pyridine nucleotide coenzymes, by T. P. Singer and Edna B. Kearney (Wisconsin); Alternate pathways of glucose and fructose metabolism, by E. Racker (Connecticut); Enzymic mechanisms in the citric acid cycle, by S. Ochoa (New York); The mechanism of action of hydrolytic enzymes, by H. Lindley (Australia); Enzymic synthesis of polysaccharides, by M. Stacey (England); Urea synthesis and metabolism of arginine and citrulline, by S. Ratner (New York); Thiaminase, by Akiji Fujita (Japan); Rennin and the clotting of milk, by N. J. Berridge (England); and Die Struktur des Tabakmosaikvirus und seiner Mutanten, by G. Schramm (Germany). The well-written chapter by Berridge will be of particular interest to those in the dairy industry; this chapter summarizes material from 108 references, many of which are recent foreign publications. F. E. Nelson

709. Laboratory Instruments. Their Design and Application. A. ELLIOTT and J. HOME DICKSON. Chemical Publishing Co., Inc., 212 Fifth Avenue, New York. 414 pp. $7.50. 1953.

Many laboratory technicians, particularly those living in this country, depend to a large extent on the manufacturer of scientific instruments to provide their needs in laboratory apparatus. Occasionally, however, a new instrument for a particular task must be designed and it is then that a knowledge of design, materials and processing is desirable. The subject mattter in this book is treated under the following chapter headings: (1) General Considerations, (2) The Accuracy Attainable in Machining Operations, (3) Properties of Materials Used for General Construction of Instruments, (4) Casting and Jointing Metals, (5) Preparations of Drawing, (6) Constrained Motion and Constraints, (7) The Magnification of Small Displacements, (8) Sensitivity and Errors of Instruments, (9) Isolation of Apparatus from Disturbing Influences, (10) Damping, (11) Tests for Straightness, Flatness, and Squareness, (12) Glass, (13) The Working of Glass, (14) Lenses, Mirrors, and Prisms, (15) Optical Instruments, (16) Photography in Research. Four appendices are included: (1) Computations of a Corrector Plate for a Schmidt Camera, (2) A Note on Crystals, (3) Notes on Ray Tracing and (4) Angular Measurement, Conversion Factors.

The material is presented in simple but concise language and is well supplemented by references on related subjects. The nomenclature and selection of materials is somewhat slanted toward British usage which detracts to some small extent from its usefulness to the American technician.

A research laboratory may find it advantageous to have this book in its library as it does contain under one cover information which would be time consuming to obtain from other sources. J. Tobias

BUTTER

710. In butter it's flavor that counts. N. E. FABRICIUS and R. J. NELSON. Milk Prod. J., 45, 7: 24. 1954.

The use of culture gives butter of superior

flavor quality, better keeping quality with improved body and texture, and will increase butter sales. Of prime importance in the manufacture of uniformly good culture are the temperature of setting both the mother culture and big cultures with the recommended difference in inoculation and proper temperature control. The proper cooling of culture with vigorous agitation, as well as the recommended manner of use, will insure a uniform degree of flavor throughout the year. J. J. Janzen

CHEESE

711. Something new in cheese salt. J. M. PAGE, Morton Salt Co., Chicago. Milk Prod. J., **45**, 7: 27. 1954.

This article describes the general objectives, results and conclusions of a project initiated to test the use of high purity vacuum pan salt in the manufacture of American Cheddar cheese when applied in a similar manner as coarse flake salt.

The following factors have been studied and are briefly discussed: (1) effect of propylene glycol and spray dried whey on cheese quality, (2) fat, moisture, and salt loss, (3) dissolving rate, (4) spreading quality, (5) the effectiveness of propylene glycol and spray dried whey solids as anti-hardening materials.

The results give substantial evidence that propylene glycol would be very effective and acceptable as a non-hardening agent in cheese salt; also, there are strong indications that high purity vacuum pan salt can be used successfully in the manufacture of American Cheddar cheese when applied in the normal manner. J. J. Janzen

712. Method for the control of the process of acidification in cheese curd. M. E. SCHULZ, H. KAG, G. MROWETZ, U. KOCH, and H. SIEGFRIED, Chem. Inst. der Bundesversuchs-und Vorschungsanstalt für Milchwirtschaft, Kiel, Germany. Milchwissenschaft, **9**: 20. 1954. (English Summary).

Various methods for the control of acid development in cheese curd have been examined. It is proposed to introduce the determination of the degree of acid in draining whey as a uniform method for the control in dairies. According to the Authors' proposal, the pH determination, which is not as sensitive due to buffering by calcium salts, be only applied in order to determine the final pH before and after the salt bath. For a subsequent control of the process of acid development, e. g. by means of specimens of draining whey taken at different times, the analytical determination of calcium is regarded the most appropriate. For the development of automatic indicator or registration devices, it is recommended to measure the conductivity of the draining whey.
J. Tobias

713. Use of paper chromatography in tests for amino acids in cheese. W. CLEMENS, Zentrallaboratorium der Margarine — Union, Hamburg — Bahrenfeld, Germany. Milchwissenschaft, **9**: 195. 1954.

The study included Dutch, Tilsit, and Limburger cheese. By melting the raw material with 3% Joha S-9 the free amino acid increased considerably. A method was developed by means of which a one-dimensional chromatogram could be evaluated quantitatively.

The flavor of cheese was not affected by any specific amino acid. There was no direct relationship between the amount of soluble nitrogen, pH, and the amino acid content.
J. Tobias

714. Antibiotic properties of cheese. I. EMANUILOV and L. NATSCHEV. Bull. Inst. of Microbiol., Bulgarian Academy of Sci., Sofia, **4**: 33. 1953. (In Bulgarian with German summary).

The antibiotic properties of a white "country cheese" from several locations as well as that of other varieties was determined. It was found that the several varieties of cheese tested possessed antibiotic properties. The white "country cheese" possessed a higher antibiotic titer than Katschkawalj cheese, Roquefort, Dutch varieties of cheese, "Cheese No. 13," and cottage cheese. J. Tobias

DAIRY BACTERIOLOGY

715. The new plate count media in routine plate counts on milk. F. W. BARBER, H. FRAM, and R. M. DEBAUN, Natl. Dairy Research Lab., Inc., Oakdale, L. I., N. Y. J. Milk and Food Technol., **17**, 6: 176. 1954.

A comparison was made on the bacterial counts using a new "milk-free" medium with the standard TGEM agar. The authors report that the bacterial counts compare favorably on the two media. However, there were marked differences in the counts on raw, pasteurized, good milk and poor milks, probably due to bacterial flora and response to the nutrients available in the new medium. H. H. Weiser

716. A comparison of six methods of preparing and using the methylene blue stain for bacterial counts by the direct microscope method. N. MANTEL, N. I. H., Bethesda, Md., and A. H. ROBERTSON, State Food Lab., Dept. of Agr. and Markets, Albany, N. Y. J. Milk and Food Technol., **17**, 6: 179. 1954.

A comparison of the direct microscopic counts in milk, using the methylene blue stain, was made by 12 federal, state, local, and private laboratories. There was a general agreement that Levine and Black's Acid-and-Water-Free Stain, North's Aniline Oil Stain, and Anderson's Polychrome Stain were superior to the stains recommended in the 9th edition of Standard Methods for the Examination of Dairy Products. H. H. Weiser

717. Symbiosis experiments concerning the production and biosynthesis of certain amino acids and vitamins in associations of lactic acid bacteria. VEIKKO NURMIKKO. Ann. Acad. Sci. Fennicae, Ser. A II, No. 54. 58 pp. 1954.

Lactobacillus arabinosus 17-5, *Lactobacillus casei* Bc-1, *Lactobacillus fermenti* 36, *Streptococcus faecalis* R, *Leuconostoc mesenteroides* P-60, *Leuconostoc citrovorum* (ATCC 8081) and *Lactobacillus leichmannii* (ATCC 4797) were used. Chemically defined media were employed for growth studies. When the medium was deficient in two or more compounds (amino acids or vitamins), two cultures which could not be grown on the deficient medium separately sometimes could grow together. This occurred when the compound needed by each organism was produced and secreted by the other organism, thus providing a nutritionally complete medium for both organisms.

F. E. Nelson

718. Microbiological factors in the treatment of phenolic wastes. M. K. HAMDY, E. L. SHERRER, H. H. WEISER, and W. D. SHEETS, Dept. of Bact. and Waste Treatment Lab., Eng. Expt. Sta., Ohio State Univ., Columbus. Applied Microbiol., **2**, 3: 143. 1954.

Three strains of bacteria, isolated from domestic sewage, were capable of active reduction of phenolic solutions in concentrations up to 400 ppm at a rate of 0.9 to 1.2 lb. per sq. yd. of filter stone per d. Lactose was detrimental to the reduction of phenol while the presence of salt solution of ammonium nitrate, potassium phosphate, ferric chloride, and magnesium sulfate stimulated the organisms for phenol destruction. Vigoro, a commercial fertilizer, used in 0.1% concentration gave comparable results as the above salt solutions. A temperature around 55° C. gave the most destruction of phenol under aerobic conditions.

Manometric studies indicate that these bacteria produce an adaptive enzyme or enzymes for the metabolism of phenol at 48° C.

H. H. Weiser

719. Use of ultraviolet irradiation in a room air conditioner for removal of bacteria. J. B. HARSTAD, H. M. DECKER, and A. G. WEDUM, Chem. Corps, Camp Detrick, Frederick, Md. Applied Microbiol., **2**, 3: 148. 1954.

A room air conditioner which utilizes 100% fresh air, and equipped with slimeline ultraviolet lamps using 420 milliamperes, will markedly reduce the number of airborne microorganisms in room air. The conditioner will maintain constant temperatures and relative humidities during its operation. The system is more economical than one which requires complete make-up air. H. H. Weiser

720. Recent developments in radiation sterilization of foods. W. C. MILLER, B. E. PROCTOR, and S. A. GOLDBLITH, Mass. Inst. of Technol., Cambridge. J. Milk and Food Technol., **17**, 5: 159. 1954.

The cold sterilization of foods, drugs, and pharmaceuticals by ionizing radiations has been studied. The mode of action is discussed. Successful sterilization of meat, fish products, vegetables, spices, and liquid whole eggs inoculated with *Salmonella* has been accomplished by using high voltage cathode rays. Insects and Trichinae in pork can be destroyed. However, milk and milk products are extremely sensitive to ionizing radiations and many undesirable changes in flavor result.

The application of ionizing radiations in the cold sterilization of heat-labile drugs, biologicals, and blood may have great possibilities, although more research work must be conducted before commercial applications can be made.

H. H. Weiser

DAIRY CHEMISTRY

721. The chemical basis for producing milk emulsions containing Osmaron B. E. BENK, Chem. Landesuntersuchungsamt, Reutlingen, Germany. Milchwissenschaft, **9**: 121. 1954. (English Summary)

Osmaron B (benzoate of fat amines) is considered a cation-active compound intimately connected with the sapamines. It is therefore incompatible with all anion-active emulsifiers, stabilizers, and germicides such as soaps, sulphonates, fatty acid condensation products, and protein-fatty acid condensation products, sodium alginate, cellulose glycolic acid sodium, ultraamylopectin, polycrotonic acid sodium, chloramine, pentachlorophenol–sodium and alkali rhodanide. Osmaron B is compatible with cation-active substances (sapamine salts, quaternary ammonium compounds, ampholyte soaps) and non ionogenic compounds. The following non-ionogenic emulsifiers and stabilizers may be used for producing milk fat emulsions containing osmaron: monofatty acid esters or difatty acid esters of diethylene glycol, of propylene glycol, of polyethylene glycol, of sorbitan, of mannitan, of polyoxyethylene sorbitan, and especially of glycerine as well as methyl cellulose and polyvinyl alcohol.

J. Tobias

722. Noninterference of phosphate in an ethylenediamine tetraacetate method for serum calcium. A. D. KENNY and S. U. TOVERUD, Biological Research Lab., Harvard School of Dental Med., Boston, Mass. Analyt. Chem., **26**, 6: 1059. 1954.

In this method for determining calcium, interference by orthophosphate was reported by others when the ratio of P to Ca is 0.1 or greater. For milk this ratio is approximately 0.8. With rat serum when the P to Ca ratio was adjusted by addition of calcium salts to provide a range of from 4 to 8, no evidence of interference by phosphate was disclosed. When

the ion products were well below the solubility product of calcium diphoshate there was an absence of interference by phosphate.
B. H. Webb

723. Flame photometric determination of calcium in wet-process phosphoric acid. J. A. Brabson and W. D. Wilhide, Div. of Chem. Development, T. V. A., Wilson Dam, Ala. Analyt. Chem., **26**, 6: 1060. 1954.

An internal standard method is described which cuts hours from the usual time required for the determination of Ca in wet-process phosphoric acid. This flame photometric method is practically as precise as the chemical method and determinations can be made in 1 hr.
B. H. Webb

724. Magnesium determination in bovine blood serum. M. Okamoto and J. W. Thomas, Bur. Dairy Ind., U. S. D. A., Washington, D. C. Analyt. Chem., **26**, 6: 1072. 1954.

Results are given of a comparative study of the three most widely used methods for the determination of Mg in serum. The method preferred and slightly modified by the authors is that which employs a dye, titan yellow, which forms a colored lake with magnesium hydroxide. The intensity of this lake is measured by a photoelectric colorimeter. B. H. Webb

725. Symposium on boiler water chemistry. Ind. and Eng. Chem., **46**, 5: 953. 1954.

Boiler water chemistry is discussed in 12 papers by 15 authors. New developments in water analysis, interpretation of water analysis, water conditioning, feed water make-up, deposits, and corrosion are reported.
B. H. Webb

726. Forage crop constituents. The isolation and analysis of hemicelluloses from orchard grass. H. P. Binger and J. T. Sullivan, U. S. Reg. Pasture Research Lab., State College, Pa., and C. O. Jensen, Pa. State Univ., State College. J. Agr. Food Chem., **2**: 696. 1954.

Polyuronide hemicelluloses, isolated from orchard grass (Dactylis glomerata L.), comprise up to 20% of the dry weight. Holocellulose was prepared by treatment of the fat- and pectin-free grass with sodium chloride and this was extracted successively with hot water, 0.5% KOH, and 1.5% KOH. Hemicelluloses were obtained from these extracts as precipitates upon acidification, addition of alcohol, and finally by evaporation of the alcoholic solution. The precipitates were hydrolyzed to yield reducing sugars which were separated by paper chromatography and estimated by electron reflection densitometry. Xylose, glucose, arabinose, galactose, and uronic acids were found in almost all hemicellulose fractions, with the first two sugars comprising the major portion of the carbohydrates. Over 70% of all hemicelluloses obtained were from the water extration of the holocellulose, and these contained lower percentages of pentose than those which were alkali-extracted. S. Patton

727. A modified lignin procedure. E. J. Thackler, U. S. Plant, Soil, and Nutrition Lab., Ithaca, N. Y. J. Animal Sci., **13**, 2: 501. 1954.

A modified procedure for the determination of lignin is presented. It is reported to be faster and more convenient than the original procedure. O. T. Stallcup

728. Refractive index of concentrated protein solutions. R. Barer and S. Tkaczyk. Nature, **173**, 4409: 821. 1954.

Bovine serum albumin and peptone exhibit a constant specific refraction increment (α) over a wide range of concentration. Protein decomposition products of low molecular wt., such as bovine serum albumin digested with pepsin, have the same α as the protein.
R. Whitaker

729. The estimation of copper in dried milk. W. Mohr and H. Gerauer, Physikalisches Inst. der Bundesversuchs — und Forschungsanstalt für Milchwirtschaft, Kiel, Germany. Milchwissenschaft, **9**: 201. 1954.

A comparison was made of the American Standard method, Schwarz's method, and Hänni's method. The American and Hänni's methods gave comparable results. A maximum copper content of 3γ/g. for whole milk powder is considered justified. J. Tobias

730. Comparative examination of various phosphatase tests in relation to the international phosphatase unit. Part II. Mahmoud Mohazzeb, Inst. fur landwirtschaftliche Technologie der Landwirtschaftlichen Hochschule, Hohenheim, Germany. Kieler Milchwirtschaftliche Forschungsberichte, **6**: 109. 1954. (English Summary).

The maximum color intensity in the reaction between phenol separated from phenol esters by milk phosphatase and the phenol reagent dibromoquinonechlorimid is obtained at a pH value between 9.30 and 9.35 independently of the composition of the buffer solution. The optimum reaction temperature ranges between 27 and 30° C.

The tests of Schwarz and Fischer, Kay and Graham, Andersen, Sanders and Sager and Scharer were compared as to their sensitivity and factors were computed which make it possible to convert the results found by any one of the tests with those which would be found by any of the other tests. The factors for the various tests are: Schwartz and Fischer = 1; Kay and Graham = 1; Andersen = 1.6; Sanders and Sager = 2.3; and Scharer = 5.6.
J. Tobias

731. "SAL," a practical procedure for determining the butterfat content of milk. N. DIMOV. Bulletin of the Inst. Animal Husb., Bulgarian Academy of Sciences, (Sofia, Bulgaria), **3** and **4**: 207. 1952.

The "SAL" reagent is prepared by dissolving 80 g. of NaOH and 40 g. of NaCl in a liter of water. To this solution 450 ml. of ordinary alcohol and 45 ml. of amyl alcohol are added.

The test for the butterfat content is performed as follows: A mixture of 11 ml. of reagent and 11 ml. of the milk is placed in a Gerber butyrometer. The butyrometer is well shaken and placed in a water bath at 60 to 70° for 6 to 7 min. for cow's milk and 7 to 8 min. for sheep or buffalo milk. The material is agitated again and centrifuged as in the acidometric procedure.

More than 850 samples were analyzed by this method with 225 of the analyses repeated by the acidometric procedure. The results are reported on cows, sheep and buffalo milk as well as skimmilk, buttermilk, and cream.

The authors claim that the method is as exact as the acidometric procedure and is less expensive and less dangerous. R. McL. Whitney

732. Determination of the percentage of fat and water in milk powder. W. MOHR and D. MERTEN, Physikalisches Inst. der Bundesversuchs — und Forschungsanstalt für Milchwirtschaft, Kiel, Germany. Milchwissenschaft, **9**: 153. 1954.

The results of moisture determinations in milk powder by several methods are compared. It is pointed out than an agreement should be reached as to whether the water of crystallization of lactose should be considered as moisture. Comparisons are also made of three different tests for fat in dry milk. J. Tobias

733. Concerning the content of unsaturated acids in milk fat. A. LEMBKE and W. KAUFMANN, Bacteriologisches Inst. der Bundes-Versuchs — und Forschungsanstalt fur Milchwirtschaft, Kiel, Germany. Milchwissenschaft, **9**: 113. 1954.

Studies were conducted on milk from individual cows and mixed milk from both pasture and barn fed cows. It was found by ultraviolet spectrum analysis that the content of diene acids tripled during the summer while that of triene acids doubled. J. Tobias

DAIRY ENGINEERING

734. A vapor barrier of laminated Mylar and aluminum. J. G. MACORMACK, Alumiseal Corp., New York, N. Y. Refrig. Eng., **62**: 58. 1954.

A new polyester film called Mylar (Dupont) is applied in 0.5 mil thicknesses to 1 mil thickness of aluminum foil. The aluminum foil furnishes practically zero permeability to vapor while the polyester film furnishes protection against pinholing of the aluminum foil, tensile strength, and protection against corrosive action as the polyester is inert to water, salt water, salt spray, wet concrete, alkalies, caustic washes, and the many elements corrosive and deteriorating to metals, papers, or other materials. Polyester film is highly resistant to attack or penetration by solvents, greases, and oils. The highly flexible characteristic of Mylar allows its application to all surfaces by means of a special methylethylketone-type adhesive. Joints are overlapped 1.5 to 2 in., and sealed by brushed-on adhesive. Under some circumstances requiring it, heat sealing can be carried out after the adhesive has set. The same adhesive is employed by cold brushing to apply the vapor barrier on masonry walls or slabs, on metal surfaces, or on wood. In many industrial installations of pipe covering, color codes employed to identify lines require initial painting and subsequent repainting. Colors can be incorporated in the adhesive in manufacturing the laminate, thus providing permanent colored coverings, the color being preserved and protected by the exposed transparent film. The vapor barrier is commercially available in rolls 36 in. wide by 200 ft. long and soon will be available in widths up to 60 in.

L. M. Dorsey

735. Ice cream packaging machine. S. H. BERCH and M. C. LUTERICK (assignors to Diced Cream of America Co.). U. S. Patent 2,679,966. 2 claims. June 1, 1954. Official Gaz. U. S. Pat. Office, **683**, 1: 158. 1954.

Construction details are given for a filler which places ice cream from a continuous freezer in small individual size cubical shaped ice cream packages. R. Whitaker

736. Butter and oleomargarine cutting machine. R. S. EDMUNDS, JR. U. S. Patent 2,678,493. 1 claim. May 18, 1954. Official Gaz. U. S. Pat. Office, **682**, 3: 602. 1954.

A device for cutting butter and oleomargarine into individual size portions.

R. Whitaker

737. Bottle filler valve. H. H. FRANZ (assignor to The Creamery Package Mfg. Company). U. S. Patent 2,679,347. 1 claim. May 25, 1954. Official Gaz. U. S. Pat. Office, **682**, 4: 913. 1954.

A milk bottle filler valve is described which fills to a predetermined level in the bottle.

R. Whitaker

DAIRY PLANT MANAGEMENT AND ECONOMICS

738. Super market survey on fluid milk and other milk products. ANON. Ice Cream Trade J., **50**, 5: 20. 1954.

Operators of super markets believe they can increase the sale of milk products by increased

promotional activities on the part of producers of milk and milk products.

The average store now sells milk, buttermilk, chocolate milk, sweet and sour cream, and cottage cheese valued at $35,000 annually.

The average gross margin obtained by super markets on milk is 11-11.5%; buttermilk, 12-12.5%; sweet cream, 13-13.5%; sour cream, 14.5-15%; and cottage cheese, 19-20%.

The dairy department accounts for 9.3% of the sales, 10.4% of the profit, but requires only 4.2% of the total selling area.

Milk dispensing cabinets are owned outright by the stores in 95% of the cases. The cabinets are serviced by routemen in 42.5% of the stores, by store clerks in 41.6%, and by both in 15.9% of the stores. W. H. Martin

739. How to reduce operating costs. R. T. SMITH, Scranton, Pa. Ice Cream Trade J., **50**, 6: 30. 1954.

Key men in the ice cream industry were asked how to reduce operating costs. They reported a 6.5% increase in production costs since 1952, with labor rising 10.37%; maintenance, 8.37%; packaging, 4.56%; flavoring, 10.89%. Butterfat costs declined 14.33%, and serum solids, 11.97%. Cost reduction since 1952 has been made possible by reduced ingredients' cost, larger capacity equipment, and automatic equipment. Methods responsible for reduced costs are listed. By keeping manpower busier, reducing the number of items produced, and reduction in the number of deliveries and small accounts, lower costs have resulted.

W. H. Martin

740. Engineering needs of the dairy and ice cream industry. J. H. ERB, The Borden Co., Columbus, Ohio. Ice Cream Trade J., **50**, 5: 30. 1954.

By applying careful analytical methods to industrial operations, engineers can develop greater utilization of labor-saving machinery and reduce man hours required for production.

A well organized maintenance program is needed in dairy plants to prevent costly breakdowns and delays in production-line functioning. Attention should be given to plant design as a means of achieving maximum efficiency of operations.

Areas in production where improved equipment and processing methods would be desirable are presented. W. H. Martin

741. Is profit sharing for you? I. C. MILLER, Food Eng., **26**, 6: 229. 1954.

In the profit sharing plan of Sunrise Dairies, Hillside, N. J., the employees' share is determined partly by seniority and partly by merit. An advisory board, representing management, plant, and drivers, reviews complaints and problems of personnel. Only this board may discharge a comany employee. The plan has enlarged the employees' understanding of business operation and has increased profits.

T. J. Claydon

742. Full-flavored maple syrup process puts idle dairy units to work. W. K. JORDAN, F. V. KOSIKOWSKI, and R. P. MARCH, Dept. of Dairy Husbandry, Cornell Univ., Ithaca, N. Y. Food Eng., **26**, 5: 20. 1954.

In experiments directed at utilizing dairy plant equipment in slack seasons, sap from trees was collected in 50-lb. cottage cheese cans or chocolate syrup pails. On collection days, it was filtered through farm-type milk filter pads and hauled to the dairy plant in 40-qt. milk cans. Sap was stored at 40° F. while accumulating enough for operation of the vacuum pan. In concentrating, the sap was handled in much the same way as milk, but no foaming was experienced. The most satisfactory procedure was to concentrate to 45% solids in the pan and finish off to 65.5% in an open steam heated kettle. This method gave the most desirable flavor. The finished product was packaged hot in gallon jugs. Although it is considered that the milk evaporator may be slightly more costly to operate than the typical open kettle sap evaporator, the system offers various advantages. T. J. Claydon

743. Some trends and characteristics of the dairy industry in Florida. W. K. MCPHERSON and R. F. LUCKEY, JR., Fla. Agr. Expt. Sta., Gainesville. Bull. 539. 1954.

The volume of milk sold to dealers increased 78% between 1940 and 1951. As a result of this increase and the general use in the price of milk, cash receipts from the sale of milk increased 262%. Markets for whole milk produced in the state differ from many other markets in three ways: (1) at least 80% of the milk sold by Fla. farmers is distributed as whole milk, (2) producers' prices are generally higher than in other markets due to the increased production costs found within the state, and (3) butterfat content of whole milk is high. R. W. Hunt

744. Milk bottle carrying device. L. K. GRIBSKOV and O. N. PETERSON. U. S. Patent 2,680,041. 2 claims. June 1, 1954. Official Gaz. U. S. Pat. Office, **683**, 1: 180. 1954.

A hand carrier for one or more glass milk bottles. The carrier consists of a base plate with holes slightly larger than the top lip of the bottles. Hinged flanges press the neck of the bottles against the side of the holes when the carrier is placed on the bottles and lifted, thus securely gripping the bottles.

R. Whitaker

745. Carrier for paper milk cartons. L. K. GRIBSKOV and O. N. PETERSEN. U. S. Patent 2,680,040. 4 claims. June 1, 1954. Official Gaz. U. S. Pat. Office, **683**, 1: 180. 1954.

A hand carrier for one or more Canco type paper milk bottles. The cartons are supported by parallel flanges on the carrier which slide under the lateral flanges on the top of the cartons. R. Whitaker

746. Trend to night openings by supers. Ice Cream Trade J. **50**, 5: 58. 1954.

The increasing trend for super markets to remain open in evenings may be an important factor in the increased sales of ice cream through these outlets.

According to the 4th annual Super Market Institute report issued in 1952, all but 7% of their members are open at least one night a week after 6 P. M., 36% are open every evening, 29% from two to five evenings, and 28% are open one evening per week. In addition, about 360 stores are open on Sunday.

W. H. Martin

FEEDS AND FEEDING

747. Feed analysis. Determination of free gossypol in mixed feeds. R. W. Storherr and K. T. Holley, Dept. of Chem., Ga. Expt. Sta. J. Agr. Food Chem., **2**: 745. 1954.

As less toxic cottonseed meals are becoming commercially available methods for free gossypol assay in mixed feeds are needed for experimental use and for control. The method proposed is based on the color development in the reaction of phloroglucinol with gossypol in strong acid at room temperature. The extracting solvent excludes many substances that react with phloroglucinol. Interference by reactive substances brought in by the solvent is minimized by carrying out the reaction at room temperature. S. Patton

748. Availability of amino acids to microorganisms. II. A rapid microbial method of determining protein value. M. J. Horn, A. E. Blum, and M. Womack, Bur. of Human Nutrition, Agr. Research Adm., U. S. D. A. J. Nutrition, **52**, 3: 375. 1954.

A method is described for rapid determination of the nutritive value of processed cottonseeds by means of a microbiological assay of an enzymatic digest of the meal as the only source of protein. The method is based on the observation that the growth of the microorganisms is determined by the sum of the available amino acids. O. T. Stallcup

749. The effect of alfalfa ash upon the digestibility of prairie hay by sheep. A. D. Tillman, C. F. Chappel, R. J. Sirny, and R. MacVicar, Okla. Agr. Expt. Sta., Stillwater. J. Animal Sci., **13**, 2: 417. 1954.

Two digestibility trials involving 52 sheep were conducted to determine the effect of supplementing a ration containing low quality prairie hay with a complete mineral mixture or alfalfa ash. In an initial trial the basal ration contained natural feedstuffs in addition to the hay. A second trial tested a semi-purified diet in which the prairie hay was the only natural feedstuff. In both trials neither alfalfa ash nor a complete mineral mixture was found to increase the apparent digestibility of the ration or any of its components. O. T. Stallcup

750. Diurnal variation in the estimates of digestibility of pasture forage using plant chromogens and fecal nitrogen as indicators. B. F. Soni, F. R. Murdock, A. S. Hodgson, T. H. Blosser, and K. C. Mahanta, State Coll. of Wash., Pullman. J. Animal Sci., **13**, 2: 474. 1954.

From the data presented the authors conclude that there is no diurnal variation in the estimates of digestibility using either the chromogen or fecal-nitrogen techniques for determining digestibility. They further concluded that the fecal-nitrogen method gave equally as good results as an indicator of dry matter digestibility as did the chromogen method.

O. T. Stallcup

751. The controlled feeding of fluorine, as sodium fluoride, to dairy cattle. H. J. Schmidt, G. W. Newell, and W. E. Rand, Stanford Research Inst., Stanford, Cal. Am. J. Vet. Research, **15**, 55: 232. 1954.

In order to determine the safe border-line level of soluble fluoride intake, 20 uniform Holstein heifers were divided into 5 groups of 4 receiving 0.15, 1.0, 1.5, 2.0, and 2.5 mg. of fluorine per kg. of body weight per d. Observations are presented through the first two lactations and the experiment is being continued. There were only slight differences in milk production between the groups in the first lactation. In the second lactation the two lowest fluorine levels gave less milk than in the first, while the higher fluorine groups all increased slightly, but were not significantly different from the control group. No effects upon body weight, rates of gain, or general health have developed after three years of fluorine feeding. Definite effects have been noted on the teeth which were in the formative stage when fluorine feeding began. The 4th incisors all showed mottling, staining and marked wear in groups receiving more than 1.0 mg. fluorine per kg. body weight daily. Biopsy rib samples showed that the fluorine-fed cows had 6 to 9 times normal fluorine levels in their bones. Fluorine was excreted in the urine in proportion to the doses. Some exostosis was noted in cows on the highest fluorine level. E. W. Swanson

752. Experiments with legumes at the Northeast Louisiana Experiment Station. C. B. Haddon, La. Agr. Expt. Sta., Baton Rouge. Bull. 477. 1953.

These experiments were conducted to evaluate the use of legume as green manure crops.

Hairy vetch, smooth vetch, wollypod vetch, southern winter peas, and southern bur and manganese clovers gave the best results. Crimson clover showed promise but further tests are needed to complete the evaluation.

R. W. Hunt

753. Diseases of forage grasses and legumes in the Northeastern States. K. W. KREITLOW, J. H. GRAHAM, and R. J. GARBER, Penn. Agr. Expt. Sta., State College. Bull. 573. 1953.

Several pictures of diseased plants are included. R. W. Hunt

754. Penn State mechanical dairy feeder. E. F. OLVER and R. N. JONES, Penn. Agr. Expt. Sta., State College. Prog. Rpt. 110. 1953.

This bulletin tells of the progress made at Penn. State in the construction and use of automatic concentrate feeders for stanchioned cows. R. W. Hunt

755. High quality roughage reduces dairy costs. C. R. HOGLUND, Mich. Agr. Expt. Sta., East Lansing. Special Bull. 390. 1954.

Feed costs/100 lb. of milk can be reduced as much as 20-25% on the average Mich. dairy farm; first, by improving the quality of the roughage, and then by feeding more roughage and less protein and grain. On the farms producing excellent roughage, 33% of it was harvested as grass silage or barn-dried hay. Only 18% was harvested by these methods on farms producing poor quality roughage. Almost 1/3 of the poor quality hay was harvested by the field-cured hay-loader method. Producing excellent roughage cost about $8.00 more per acre, but the 1/3 greater yield of feed nutrients resulted in lower cost/ton. R. W. Hunt

756. Food product for animals. M. A. LANDAU (assignor to Leon Lewkowicz). U. S. Patent 2,680,075. 6 claims. June 1, 1954. Official Gaz. U. S. Pat. Office, **683**, 1: 189. 1954.

An animal food in flake form consisting of acid ppted. casein, neutralized with $NaHCO_3$ and gelatin from fresh wet bones. The product is flavored with sweet fennel oil and preserved with 0.03 to 0.15% formaldehyde based on dry gelatin wt. R. Whitaker

757. Investigation of the quality of sperm from bulls taken as an indicator from which to judge the influence of feeding and management, III. The effect of a meal ground from artificially dried green fodder and of a vitamin A preparation on the quality of sperm from two year old twin bulls. E. KORDTS, Inst. für Milcherzeugung der Bundes— Versuchs — und Forschungsanstalt für Milchwirtschaft. Kiel, Germany. Kieler Milchwirtschaftliche Vorschungsberichte, **6**: 75. 1954.

Two pairs of red-and-white lowland twin bulls were made the subject of feeding tests under absolutely identical conditions of management for a period of six months. An investigation was made of the effect of a meal made from artificially dried green meadow fodder and "Rovimix" (Hoffman La Roche) vitamin A preparation on the quality of sperm. As a result of these tests the suggested daily doses for full grown bull sires is between 150 mg. and 200 mg. carotine or between 40,000 and 60,000 I. U. vitamin A. Since ample fresh green fodder is available during the six summer months attention should be given to fortification with vitamin A or carotine particularly during the winter months. J. Tobias

GENETICS AND BREEDING

758. Bactericidal activity of the uterus in the rabbit and the cow. W. G. BLACK, J. SIMON, H. E. KIDDER, and J. N. WILTBANK, Wis. Agr. Expt. Sta., Madison. Am. J. Vet. Research, **15**, 55: 247. 1954.

The estrus uterus had been shown to be very resistant to infection, but the relative effects of drainage and bactericidal action had not been determined. In this study, estrous, spayed, and pseudo-pregnant rabbits were inoculated with identical doses of *E. coli* in each uterine horn. One horn was ligated and the other left open. After 24 hr. the number of bacteria recovered from the pseudo-pregnant horns was about the same as the number inoculated with no difference between the ligated and open horns. Most of the bacteria from the estrous and spayed uteri were gone with little difference between the ligated and open horns. Some pus was found in all ligated horns and definite pyometra occurred in both horns of the pseudo-pregnant rabbits treated. Another experiment was conducted with 8 pairs of cows consisting of apparently normal 1st service cows compared with repeat breeder cows both in the luteal phase. One horn of each cow was inoculated and ligated while the other was a control. Very few bacteria were found in the control horns. Bacteria were recovered from the ligated horns of first service cows in large numbers, from 2 to 600 times as many as from the repeat breeders. Bactericidal activity occurred in both groups of cows but it was stronger in the repeat breeders. It is suggested that this difference between normal and hard breeding cows may be responsible for their lowered fertility.

E. W. Swanson

759. Factors affecting reproductive efficiency in dairy cattle. D. OLDS and D. M. SEATH, Ky. Agr. Expt. Sta., Lexington. Bull. 605. 1954.

A review of various aspects of artificial breeding in Ky. is presented. Some of the specific points discussed are factors affecting fertility in local units, time of breeding following calving, number of heat period following calving before breeding, effect of age and size

of heifers on fertility, level of milk production vs. fertility, what is a normal estrus cycle, effect of age on fertility of bulls, evaluation of bull semen, and methods of inseminating cattle.
R. W. Hunt

HERD MANAGEMENT

760. Quality and flavor of milk as received at the plant as affected by methods of handling milk at the barn, cleaning procedures, and feeding management of the cows. R. Y. CANNON, Ala. Agr. Expt. Sta., Auburn. 62nd and 63rd Ann. Rpt. 1954.

Five methods of handling milk on the farm were employed. Two of these used a combine milker and two involved carrying the milk to the milk room in the pails. The fifth involved pouring the milk into cans in the barn, then transferring the cans to an immersion cooler. No differences were noted in flavor, sediment, or coliform count of any of the milks. However, a significant increase was noted in the standard plate count of the milk poured in the barn when incubated at 21° C. for 6 hr.
R. W. Hunt

761. Spray-type expansible milk cooler. R. E. WALLENBROCK and E. E. KIGHTLY (assignors to International Harvester Co.). U. S. Patent 2,680,356. 12 claims. June 8, 1954. Official Gaz. U. S. Pat. Office, **683**, 2: 344. 1954.

Milk in cans is cooled by a film of refrigerated liquid which is sprayed around the top of the cans and allowed to flow down into a collecting trough from which it is returned to a supply tank for recirculation after recooling. Refrigeration is provided by cooling coils in the tank. The number of cans to be cooled may be easily increased by adding additional sprays to the system. R. Whitaker

762. Diaphragm milk releaser. H. W. HEIN (assignor to International Harvester Co.). U. S. Patent 2,680,411. 1 claim. June 8, 1954. Official Gaz. U. S. Pat. Office, **683**, 2: 360. 1954.

Details are given for the construction of a device for releasing milk under reduced pressure from a vacuum type milking machine to atmospheric pressure. R. Whitaker

763. Pressure equalizing device for continuous milk delivery systems. H. W. HEIN (assignor to International Harvester Co.). U. S. Patent 2,680,553. 5 claims. June 8, 1954. Official Gaz. U. S. Pat. Office, **683**, 2: 401. 1954.

An arrangement of any number of milk cans whereby milk from a milking machine is delivered to the series of cans to a predetermined level. R. Whitaker

764. Milking apparatus. T. W. MERRIT and C. A. THOMAS (assignors to Babson Bros. Co.). U. S. Patent 2,680,452. 2 claims. June 8, 1954. Official Gaz. U. S. Pat. Office, **683**, 2: 372. 1954.

A vessel for collecting milk from a vacuum type milking machine. A ball floats on the surface of the milk in the vessel, sealing the outlet when the tank is empty. A three-way valve controls flow of milk when filling and emptying.
R. Whitaker

765. Flushing apparatus for milking systems. R. S. HEMMINGER (assignor to Berry Milking System). U. S. Patent 2,680,445. 8 claims. June 8, 1954. Official Gaz. U. S. Pat. Office, **683**, 2: 370. 1954.

A system for washing milking machines is described. The rinsing, washing, and sanitizing sequence is automatically timed by a suitable controlling mechanism. R. Whitaker

766. Milking machine. J. A. KINGSTON (assignor to Gascoignes (Reading) Ltd. U. S. Patent 2,678,627. 2 claims. May 18, 1954. Official Gaz. U. S. Pat. Office, **682**, 3: 641. 1954.

A complete milking machine, mounted on wheels featuring a platform for carrying milk cans and extendible arms for supporting the hose lines to the teat cups. R. Whitaker

ICE CREAM

767. Standards for cream used in ice cream. H. S. ADAMS, Dept. of Pub. Health, Indiana Univ. Med. School, Indianapolis. Ice Cream Rev., **37**, 11: 121. 1954.

A survey conducted in 1949 and 1950 for The National Research Council by the Committee on Milk Production, Distribution and Quality revealed that only 24 of 87 cities with a population >100,000 had ice cream ordinances. Ten of the 48 states had no sanitary ice cream legislation, and pasteurization requirements for ice cream mix varied from 142° F. for 30 min. to 170° F. with no time specified.

As a means of improving the quality of milk and cream used in ice cream the author stresses the importance of frequent sampling for laboratory examination. Tests suggested for evaluating milk and cream quality include direct microscopic examination, standard plate count, sediment test, and organoleptic tests. A maximum of 2,000,000 bacteria per ml. of milk is suggested for use at the start of a control program.

The author points out the need for the adoption of standards which would apply to cream used in the manufacture of ice cream. Such standards are lacking in most areas of the United States at the present time.
W. J. Caulfield

768. Frozen confection sandwich container. W. H. MADDEN. U. S. Patent 2,680,557. 2 claims. June 8, 1954. Official Gaz. U. S. Pat. Office, **683**, 2: 402. 1954.

A single piece open top paper container for holding ice cream sandwiches is described. Two sides are gusseted to permit providing the container in collapsed form until ready for use.

R. Whitaker

769. Base materials for frozen desserts. J. R. KATZ. U. S. Patent 2,679,458. 2 claims. May 25, 1954. Official Gaz. U. S. Pat. Office, **682**, 4: 946. 1954.

A powdered material suitable for making a frozen dessert, consisting of nonfat milk solids, sugar, hydrogenated vegetable oils, flavor, stabilizer, and a mixture of mineral salts.

R. Whitaker

770. State regulations for cream used in ice cream. ANON. Ice Cream Rev., **37**, 11: 97. 1954.

The state regulations of Conn., N. Y., N. J., Pa., and Md. as they pertain to cream used in the manufacture of ice cream are presented.

In Conn. cream suppliers must receive only whole milk from producers who are registered, inspected, and approved. Laboratory examination on official samples of imported cream include phosphatase test, flavor, odor, oiling off, neutralization, acidity, pH, microscopic clump count, plate counts at 4, 20, 35, and 45° C., and coliform counts. Approximately 40% of all cream shipments into the state are sampled.

N. Y. regulations do not set up specific standards for the dairy products used in ice cream manufacture. Primary emphasis has been placed on proper pasteurization of the mix, plant sanitation, and proper handling of the product during and after pasteurization.

Mass. maintains a single set of standards for all milk produced for fluid milk or ice cream and other dairy products. A maximum bacterial count of 100,000 per g. applies to pasteurized cream and ice cream mix.

N. J. has a bacterial standard of 250,000 per ml. for raw cream which is not otherwise processed whereas raw cream which has been shipped to a processing plant may contain up to 500,000 bacteria per ml. Pasteurized cream may contain up to 100,000 bacteria per ml. Two inspections per year of milk plants are required and inspection of a number of dairies selected at random supplying each plant are made.

In Pa. the milk used in the manufacture of ice cream must be produced and processed under the same requirements as for fluid milk. All dairy farms must be inspected twice each year by approved plant inspectors. Permit holders are responsible for maintaining the quality of the milk supply received at their plants. State enforcement officials only check a percentage of the farms to determine the efficiency of the approved inspector.

The Md. milk law of 1941 makes provision for only one grade of milk which may be used either for bottled fluid milk or for manufactured dairy products. W. J. Caulfield

771. Pre-dipping bulk for greater sales in cafeterias. L. J. COUGHLIN, Slater System, Inc. Ice Cream Trade J., **50**, 6: 14. 1954.

Predipped bulk ice cream in cafeterias has brought an increase of 100% in ice cream sales during the test period and has provided portion and cost control. Bulk ice cream for dipping is conditioned at 8 to 10° F. for 24 hours. Trays 20″ x 10″ with a 1″ turn-up on sides and 2½″ on the ends, which hold 14 — 5 oz. flat-bottomed paper or china sundae dishes are used. A No. 12 ice cream scoop is used to fill the sundae dishes. The trays are stacked on top of each other in the service or line cabinets, and the customers are allowed to help themselves. An analysis of the types of customer and his preferences will aid in selection of the proper size of serving and the flavor which will sell best. W. H. Martin

MILK AND CREAM

772. This problem of watered milk. T. W. ALBRECHT, Univ. of Tenn., Knoxville. Milk Prod. J., **45**, 7: 32. 1954.

Adulteration of milk with water has become quite a problem in recent years. The processing plants are usually held responsible for any products sold by the plant, hence, detection of adulteration must be done at the plant. The two methods for detecting watering are 1. specific gravity of milk, 2. freezing point of milk.

The base-surplus plan of payment for milk has been suggested as possibly contributing to this practice by unscrupulous producers. Besides the watering effect, this practice may result in bacterial problems. If watering is widespread in a given area it may affect the estimation of total solids in the ice cream mix, physical quality of the cultured buttermilk and the yield and quality of the cottage cheese.

J. J. Janzen

773. Milk souring. Effect of 2-methyl-1,4-naphthoquinone on the rate of souring of milk. G. G. KELLEY and K. DITTMER, Dept. of Chem., Fla. State Univ., Tallahassee. J. Agr. Food Chem., **2**: 741. 1954.

As 2-methyl-1,4-naphthoquinone (menadione) is known to be bacteriostatic in very low concentrations, the effect of relatively low doses administered orally to lactating cows was investigated. Menadione, added at a concentration of 0.1γ/ml of milk, significantly retarded the rate of souring of milk at 37° C. Milk from cows not fed menadione generally soured in about 12 hr. when incubated at 37° C. Milk from cows that received 25 mg. of menadione/day remained sweet for 18-24 hr. During one period the feeding of menadione or its addition to milk did not retard the rate of souring.

The nature of the compound secreted with the milk after feeding menadione has not been established. The milk from cows which received these relatively low doses of menadione had no

detectable "off-flavor"; when it finally became sour, no hard curds were formed and the milk had a clean sour odor. Pasteurized milk from menadione-treated cows remained sweet about 20% longer. When milk was stored at 20, 10, or 5° C., the effect of menadione was more pronounced. S. Patton

774. Double stage sediment tester. T. J. CLAYDON and J. J. SMALTZ (assignors to Research Corporation). U. S. Patent 2,679,158. 3 claims. May 25, 1954. Official Gaz. U. S. Pat. Office, **682**, 4: 858. 1954.

A sediment tester using filter material in roll form. R. Whitaker

775. Why coffee sometimes turns grey when adding condensed milk or cream. W. MOHR and D. MERTEN, Physikalisches Inst. der Bundes — Versuchs — und Forschungsanstalt für Milchwirtschaft, Kiel, Germany. Milchwissenschaft, **9**: 106. 1954.

Condensed milk was found to dissolve sufficient iron from imperfectly tinned cans to cause a grey discoloration in coffee. J. Tobias

776. Treating milk with oxygen. H. LÜCK, Dairy Ind. Control Board, Windhoeck, South Africa. Milchwissenschaft, **9**: 115. 1954.

At temperatures of 104-113° F. and higher the bacterial count decreases in milk under a pressure of 8 atm. of O_2. This is attributed to the bactericidal effect of O_2. The destruction under compressed O_2 and CO_2 follows a first order reaction. The antropy of activation for the bacterial reduction may be computed and the resulting values suggest that the destruction of cells is caused by break-up (reaction of stronger linkages than hydrogen bridge linkage).

Combined application of heat and O_2 pressure can extend the storage life of bottled milk to 2 mo. or more at 53.6° F. J. Tobias

777. Treating milk with oxygen. II. Bacteria increase under oxygen pressure. H. LÜCK, Dairy Ind. Control Board, Windhoek, S. W. Africa. Milchwissenschaft, **9**: 5. 1954. (English Summary).

The increase of bacteria under compressed O_2 is being examined at different temperatures and O_2 pressures and the average generation time is being determined. The theoretical conditions for the keeping quality of milk under O_2 pressure are discussed. Of the microorganisms, *S. lactis* in liquid medium is especially resistant to O_2. Its reaction is partly responsible for the relatively poor keeping quality of milk under compressed O_2. While growth of most bacteria is completely stopped by 8 atm. O_2 that of *S. lactis* is only retarded. The bacterial content has a direct influence on the bacteriostatic effect of O_2. The latter decreases with increasing bacterial count. J. Tobias

778. Studies of the biological determination of antibiotics in non-sterile substances, particularly in raw milk. K. H. MEEWES and SL. MILOSEVIC, Bacteriologisches Inst. der Bundes-Versuchs-und-Forschungsanstalt fur Milchwirtschaft, Kiel, Germany. Kieler Milchwirtschaftliche Forschungsberichte, **6**: 59. 1954. (English Summary).

Among the auxanographic methods employed to determine the penicillin content of raw milk, the cup-plate test was found to be the most adequate. Milk containing penicillin yields narrower inhibitory zones when heated to 65° C. for 30 min. than when heated to 74° C. for 3 min. Penicillin is destroyed more rapidly in heated water than in heated milk. To disseminate the test organisms it has been found more effective to distribute them over the surface with a spatula than by mixing them in. Inhibitory zones may be produced by raw milk containing no penicillin. In sterile whole milk the effect is indistinct.

Among organisms giving rise to inhibitory zones are *B. pyocyaneum*, *B. fluorescens*, *B. subtilis* in sterile milk and *B. pyocyaneum*, *B. linens*, *B. fluorescens*, *B. syncyaneum*, and *B. subtilis* in sterile whole milk. J. Tobias

NUTRITIVE VALUE OF DAIRY PRODUCTS

779. Significance of the vitamins in human nutrition. L. D. WRIGHT, Sharp & Dohme Div. of Merck & Co., Inc., West Point, Pa. J. Agr. Food Chem., **2**: 672. 1954.

A discussion and summary of the present knowledge on vitamins in human nutrition is given without bibliography. S. Patton

PHYSIOLOGY AND ENDOCRINOLOGY

780. Biosynthesis of milk-fat in the rabbit from acetate and glucose. The mode of conversion of carbohydrate into fat. G. POPJAK, G. D. HUNTER, and the late T. H. FRENCH, Natl. Inst. for Med. Research, London. Biochem. J., **54**, 2: 238. 1953.

Solutions of radioactive acetate, starch, glucose and pyruvate were given to lactating rabbits either by vein or by stomach tube. Milk samples taken at various intervals were fractionated and checked for radioactivity. A milking apparatus for rabbits is illustrated. It was concluded that the synthesis proceeds from glucose to pyruvate to acetate to fatty acids. "It was estimated that in 6 hr. at least 30-70% of the short-chain acids originate from acetate, or about 25% from carbohydrate; only one-fifth to one-tenth of these amounts of the long-chain acids were, however, synthesized in the mammary gland from either of these sources." There are 30 references. A. O. Call

781. Incorporation of (carboxy-^{14}C) acetate into lactose and glycerol by the lactating goat udder. G. POPJAK, Natl. Inst. for Med. Research, London; R. F. GLASCOCK and S. J. FOLLEY, Univ. of Reading. Biochem. J., **52**, 3: 472. 1952.

Lactose and glycerol were isolated from milk samples following intravenous injection of C^{14} acetate and the radioactivity of each measured. It is thought that the synthesis follows a path of acetate to lactose to glycerol and that this takes place in the udder. A. O. Call

782. Studies on the synthesis of lactose by the mammary gland. 2. The sugar-phosphate esters of milk. M. G. MCGEOWN and F. H. MALPRESS, Queen's Univ., Belfast. Biochem. J., **52**, 4: 606. 1952.

Using barium fractionation and chromatographic methods, it was shown there are 4 sugar-phosphate esters and also a carbohydrate breakdown product in normal milk. Concentrations vary from about 1 mg. to less than 0.1 mg. per liter. There is a discussion on the possible significance of these findings to lactose synthesis. A. O. Call

783. The effect of repeated glucose injections upon milk and milk fat production. J. C. SHAW, A. C. CHUNG, and J. W. POU, Md. Agr. Expt. Sta., College Park. Guernsey Breeders' J., **91**, 4: 566. 1954.

Four cows were each injected with 250 ml. of 50% glucose daily for 6 d. A similar group had injections of 250 ml. of 50% glucose for 2 d., followed by 500 ml. for each of the next 4 d. A control group of 6 cows was not injected. Milk and fat production for each cow was recorded during a 6-d. preliminary period, during the injection period, and for 6 d. thereafter.

The results indicated that repeated intravenous injections of glucose do not increase or decrease milk or fat production of normal cows with an adequate food intake. A. R. Porter

784. The effect of incipient vitamin A deficiency on reproduction in the rabbit. I. Decidua, ova, and fertilization. G. W. SALISBURY, R. L. HAYS, and K. A. KENDALL, Dept. of Dairy Sci., Univ. of Ill., Urbana. J. Nutrition, **52**, 2: 217. 1954.

Incipient vitamin A deficiency in the mated female rabbit did not reduce decidua formation after the insertion of a thread into the uteri. The deficiency did produce premature degeneration of ova and reduced the number of fertilized ova at 40 hr. and 4 d. post coitum. Plate 1 with 6 figures illustrates normal and degenerate ova and blastocepts.

O. T. Stallcup

785. The effect of incipient vitamin A deficiency on reproduction in the rabbit. II. Embryonic and fetal development. G. E. LAMMING, G. W. SALISBURY, R. L. HAYS, and K. A. KENDALL, Dept. of Dairy Sci., Univ. of Ill., Urbana. J. Nutrition, **52**, 2: 227. 1954.

Incipient vitamin A deficiency reduced by 14% the number of rabbits which mated normally. The total number of deficient animals which conceived was 18% less than the conception rate in similar groups which received adequate vitamin A. The deficiency did not reduce the average number of corpora lutea in pregnant animals at autopsy. The litter size was significantly reduced as was indicated when deficient animals were autopsied at 16 d. past coitum. This was caused by ovum infertility and degeneration.

Resorption and abortion of fetuses occurring during late gestation reduced the normal fetuses present per rabbit at 28 d. past coitum. It was estimated that only 26.4% of the original ovulations resulted in normal fetuses in deficient rabbits as compared to 74.6% in controls. Ocular abnormalities were observed in fetuses from deficient rabbits as well as changes in the fetal placenta. The fetus size was reduced in deficient rabbits at 16 and 28 d. past coitum even though the dams appeared to be in good health. The abnormalities observed are illustrated.

O. T. Stallcup

786. The measurement of water evaporation from limited areas of a normal body surface. R. E. MCDOWELL, D. H. K. LEE, and M. H. FOHRMAN, U. S. D. A. J. Animal Sci., **13**, 2: 405. 1954.

A method is described and illustrated for measuring the rate of water evaporation from selected areas of the skin. Air is circulated alternately through a capsule attached to the skin and an absorber containing a saturated solution of a salt giving the desired vapor pressure. The gain in weight of the absorber indicated the evaporation from the skin.

Data obtained by the use of this apparatus on cows under hot conditions are given. The rate of evaporation from the skin increased with hotter conditions. No significant differences were found between Jersey and Jersey-Sindhi crossbred cows for areas on the forechest and paunch. At 105° F., and 34 mm. Hg. vapor pressure the evaporation rates for these selected areas reach 660 gm/sq.m/hr. Rabbits under the same conditions showed virtually no evaporation. O. T. Stallcup

787. The determination of metabolic fecal nitrogen. H. H. MITCHELL and M. H. BERT, Div. of Animal Nutrition, Univ. of Ill., Urbana. J. Nutrition, **52**, 3: 483. 1954.

The authors report that the ratio of fecal nitrogen to air-dried food consumed is linearly related to the protein content of the diet within a range of 0.26 to 20%. They conclude that direct determination of the metabolic fecal nitrogen per unit of dry food consumed is a valid method for the growing rat.

The direct measurement of metabolic fecal nitrogen in the determination of the biological value of a protein was more economical of time and animals than the method involving the establishment of a regression equation between fecal nitrogen and nitrogen intake. It may also be subject to less random error at high levels of nitrogen intake. Confirmation of the validity of the measurement of metabolic fecal nitrogen directly by the feeding of a protein-free diet is cited from published experiments on pigs, dogs, and sheep.
O. T. Stallcup

788. The influence of the ash content of the rumen ingesta on the hydrogen ion concentration in the bovine rumen. J. L. CASON, E. S. RUBY, and O. T. STALLCUP, Dept. of Animal Ind., Univ. of Ark., Fayetteville. J. Nutrition, **52**, 3: 457. 1954.

A study is reported in which a positive correlation was found to exist between the ash content of the rumen ingesta and the pH of the rumen. This relationship appears to be due to the buffering capacity of the ash which, together with the buffering action of the saliva, tends to keep the pH of the rumen contents within rather narrow limits. O. T. Stallcup

789. A survey of the effect of phenothiazine on uptake of radioiodine by the thyroids of farm animals. R. V. TALMAGE, R. A. MONROE, and C. L. COMAR, Univ. of Tenn. — AEC, Oak Ridge, Tenn. J. Animal Sci., **13**, 2: 480. 1954.

Data are presented to indicate that the feeding of some commercial phenothiazine preparations results in a reduced thyroid uptake of injected radioiodine in poultry, sheep, swine, cattle, and burros. This effect may be indicative of an induced hypothyroidism.
O. T. Stallcup

790. Thyroprotein for lactating ewes and its effect on lamb weights. R. M. JORDAN, S. D. Agr. Expt. Sta., Brookings. J. Animal Sci., **13**, 2: 438. 1954.

In three separate trials the feeding of thyroprotein to lactating ewes failed to increase the growth rate of the nursing lambs by a significant amount. Loss of body weight occurred among the ewes receiving thyroprotein.
O. T. Stallcup

791. A modified metabolism stall for steers. A. B. NELSON, A. D. TILLMAN, W. D. GALLUP, and R. MACVICAR, Okla. Agr. Expt. Sta., Stillwater. J. Animal Sci., **13**, 2: 504. 1954.

A modified metabolism stall for use in digestibility and nutrient balance trials with steers is described and illustrated by a photograph and drawings which give dimensions and details of construction. The stall is built largely of metal and has replaceable parts. It features a rounded metal feed box, a sliding dairy type stanchion which governs the length of the stall, an automatic watering device, and interchangeable floor pieces which permit collection of urine by means of a metal grid and funnel, or a rubber funnel and hose. O. T. Stallcup

792. A comparison of the effects of starvation and thermal stress on the acid-base balance of dairy cattle. H. E. DALE, C. K. GOBERDHAN, and S. BRODY, Mo. Agr. Expt. Sta., Columbia. Am. J. Vet. Research, **15**, 55: 197. 1954.

Urine and blood composition were studied from four cows kept at uniform temperature and humidity through 6 control days followed by 5 days of fast. The major blood changes were a drop from 7.5 to 4.8 m Eq/l of Ca, a drop from 3.2 to 2.0 m Eq/l of Mg and a 10-fold increase in ketone bodies. Slight decreases also occurred in Na, K, So_4, CO_3, and Cl; but PO_4 did not change. Urine content of these same ions did not follow the blood levels closely. In general, starvation resulted in reduced urinary excretion of Ca, K, Na, Mg, CO_3, Cl, SO_4, and organic acids other than ketone bodies. A large increase in urine excretion of ketone bodies and PO_4 occurred. Blood pH values were not changed significantly by starvation. The major differences were due to metabolism of body tissue during starvation. These effects were not comparable to those observed in cows under thermal stress. E. W. Swanson

793. Secretions of androgens and estrogens in milk. U. MÜNCH, Inst. für Tierzucht der Universität München, München, Germany. Milchwissenschaft, **9**: 150. 1954.

Only estrogens and no androgens have been detected in milk. The secretion of estrogens varies according to the cycle. The percentage of estrogen in milk increases with progressing gestation. J. Tobias

SANITATION AND CLEANSING

794. Problems of insecticides in foods. C. C. COMPTON, Julius Hyman & Co., Div. of Shell Chem. Corp., Denver, Colo. J. Milk and Food Technol., **17**, 6: 173. 1954.

The ever-increasing use of insecticides for the protection of food crops has been well established. However, the development of biological resistance to many insecticides along with spray residues on plants constitutes a problem in controlling insects and other pests. Emphasis should be placed upon the education of the farmer and food processor in the proper use of insecticidal chemicals. H. H. Weiser

795. Causes and control of corrosion of stainless steel in ice cream plants. G. M. RIEGEL, Republic Steel Corp., Massillon, Ohio. Ice Cream Trade J., **50**, 6: 22. 1954.

The various forms of corrosion which occur in stainless steel are described, and methods are

given for controlling or preventing corrosion. The importance of cleanliness and proper use of sanitizing agents are stressed.

W. H. Martin

796. Effect of added hypochlorite on detergent activity of alkaline solutions in recirculation cleaning. D. R. MacGregor, P. R. Elliker, and G. A. Richardson, Ore. Agr. Expt. Sta., Corvallis. J. Milk and Food Technol., **17**, 5: 136. 1954.

Concentrations of sodium hypochlorite varying from 25 to 100 ppm were added to three standard cleaners, and they markedly increased their cleaning efficiency.

It is possible that the chlorine reacts with the detergent by creating a solubilizing action of the hypochlorite on the protein portion of the soil.

H. H. Weiser

797. Iodine bactericides in the dairy industry. N. E. Lazarus, Lazarus Laboratories, Inc., Buffalo, N. Y. J. Milk and Food Technol., **17**, 5: 144. 1954.

Two iodine bactericides have been studied under laboratory and field conditions. These sanitizers apparently meet Federal, State, and Municipal health department requirements. The products are IOSAN for dairy sanitation and IOBAC for plant use. The germicidal efficiency of iodine is maintained by combining the elemental iodine with nonionic surfactants, causing the latter to provide a solubilizing medium of the iodine and thus retain the germicidal efficiency of iodine.

H. H. Weiser

798. Spray cleaning of evaporators and vacuum pans. E. L. Bonewitz, Bonewitz Chemicals, Inc., Burlington, Iowa. Milk Prod. J., **45**, 7: 26. 1954.

The spray cleaning system described has the following advantages: (1) positive cleaning of the evaporative equipment on a day-to-day basis removing all soil without any gradual build-up, (2) enabling the plant to include the pan in an in-place cleaning system which will include lines to and from the pan, hot-wells, tubular heaters and any other equipment that falls into circuit, (3) reducing cost of clean-up including steam, water, detergent, and labor. Savings of $30 per day have been noted in some plants. (4) Permitting selective temperatures which enable plant to employ use of compounds that will be non-corrosive to equipment at operating temperatures.

J. J. Janzen

799. Adhesion (wettings) of detergent solutions to different materials. (Preliminary report) W. Mohr and E. Mohr, Physikalisches Inst. der Bundes — Versuchs — und Forschungsanstalt für Milchwirtschaft in Kiel. Kieler Milchwirtschaftliche Forschungsberichte, **6**: 29. 1954. (In German, English summary).

Differences in the wetting power of various detergent solutions may be very large. The adhesion of the same solution to the surfaces of different kinds of material (glass, tinned iron, copper, aluminum, electrically oxidized and lacquered aluminum, V2A steel) may vary widely. Adhesion is stronger at 40° than at 20° C. Butterfat has a comparatively strong adhesion to the materials used for dairy equipment and should therefore be brought into a stable emulsified form. Surface tension is no yardstick with which to measure adhesion, or wetting. After being wetted with a detergent solution containing silicate, the adhesion, also of water, was found to be better, whereas it is not markedly affected during the process of cleaning.

J. Tobias