

Steer and Lamb-Feeding Trials With Various Forms of Sugar-Beet Pulp¹

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California is one of the leading states in the production of sugar beets, and Yolo County has recently become the leading county in production within the State.

From the inception of the commercial production of sugar beets in the county in 1906, the acreage devoted to this crop has grown to a total of approximately 35,000 acres equal to about 10 percent of its total cropped acreage.

Prior to the erection of the American Crystal Sugar Company's factory at Clarksburg in 1935 and the Spreckels Sugar Company's factory at Woodland in 1937 all beets produced were shipped out of the county to other factories for processing. The result was that for a long period of time beet tops were the only by-product available to the livestock feeder.

However the subsequent erection of factories made large quantities of sugar-beet pulp in its various forms and molasses available for feeding. This accentuated the need for further definite information on the feeding and handling of these beet by-products under local conditions.

The Spreckels Sugar Company realized that the successful and continued operation of its factory at Woodland was dependent on a large yearly supply of sugar beets, and therefore inaugurated in 1937 a livestock-feeding program among its growers as a means to insure the maintenance of soil fertility, the establishment of a sound rotation practice, a better distribution of labor, and the development of a market through livestock feeding for home-grown feeds.

It was considered of vital importance in inaugurating a livestock-feeding program to demonstrate to our cattlemen, sheepmen and dairymen who were also beet growers, the efficiency and economy of these beet by-products in a fattening ration when compounded with the hays and feed grains so abundantly produced locally.

Therefore, a 2-year series of sugar-beet-pulp steer-feeding trials to be followed by 2 years of similar work with lambs was inaugurated at Woodland, California, in 1939, to obtain this information and to appraise the relative value in a ration for steers and lambs of the various forms of beet pulp, such as dried molasses pulp, pressed pulp, and siloed pulp.

¹Conducted at Woodland, Yolo County, California, 1939 to 1941.

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In conducting these trials the Spreekels Sugar Company received the splendid cooperation of the County and State Agricultural Extension Service, the Animal Husbandry Division of the University of California at Davis, and its farmer-cooperators, the Brownell Ranch Company, and Paul Reiff, who made possible the work done with steers and Henry Gasser who made possible the work with lambs.

Before discussing the details of these trials it is of interest to point out the use of large numbers of animals. This is perhaps the most comprehensive feature of the work carried on. Large groups of animals gave the trials a commercial background without losing sight of the scientific aspects of this type of work. They also allow for truer averages.

Highlights of the Results of Two Years' Feeding Trials with Steers

Gains.—The average daily gain for the cattle fed dried beet pulp, pressed beet pulp, and siloed beet pulp shows no significant difference for the 2 years of the trial. In lot 4 with only the 1 year's trial where no beet pulp was fed, the rate of gain was noticeably lower than in the pulp lots.

Dry Matter Required for Gains.—In both trials the cattle fed siloed beet pulp required less dry matter to produce gain than did any of the other lots (comparable with 4 years' results of Colorado Experiment Station).

Cost of Gains.—The feed cost of producing 100 pounds of gain was lower in the trial with the siloed and pressed-pulp lots than with the dried-pulp lot for the 2 years under trial. The cattle which received no pulp in the second trial had the highest feed costs per 100 pounds of gain.

Returns.—In both years larger returns above feed costs to cover labor, interest, and profit were obtained from the cattle fed wet pulp than from the cattle fed dried molasses pulp or straight hay and grain.

Replacement Value of Wet Pulp.—The value of pressed and siloed pulp from a replacement viewpoint was noticeably favorable.

The feasibility of marketing local feeds through cattle has been demonstrated.

The value of livestock feeding to the beet industry is largely in the manure produced for use on the land.

Procedure

Cattle Used.—In the first trial 45 head of short yearling Hereford steers weighing 646 pounds were placed in the feedlot for a preliminary feeding period of 7 days. They were then graded, weighed, tagged individually, and divided equally into 3 lots according to grade and weight.

Summary of Steer-Feeding Trials

Comparison of Pressed, Siloed, and Dried Molasses Pulp and Check Lot Without Pulp.
(Average of 2 years' trials.)

Brownell Ranch Woodland, California

| | Dried pulp | Pressed pulp | Siloed pulp | (1940 only) Hay & grain |
|--------------------------------|-----------------|-----------------|-----------------|----------------------------|
| Lot No. | 1 | 2 | 3 | 4 |
| Number in lot | 27.5 | 23 | 21 | 28 |
| No. of Days | 161 | 163 | 157 | 172 |
| Initial Weight | 615.2 | 569.5 | 608.7 | 591 |
| Final Weight | 926.6 | 925.4 | 930.2 | 894 |
| Total Gain | 311.6 | 355.9 | 321.5 | 303 |
| Daily Gain | 1.94 | 1.90 | 2.00 | 1.76 |
| Daily Ration | | | | |
| Alfalfa Hay | 8.71 | 7.59 | 7.43 | 15.17 |
| Roll'd Barley | 6.03 | 6.14 | 6.18 | 6.56 |
| Dried Molasses Pulp | 6.40 | ..... | ..... | ..... |
| Pressed Beet Pulp | ..... | 13.82 | ..... | ..... |
| Siloed Beet Pulp | ..... | ..... | 41.30 | ..... |
| Molasses | ..... | 1.87 | 1.87 | 1.96 |
| Dry Matter Required for | | | | |
| 100 lb. Gain | 1059 | 1082 | 939.8 | 1345 |
| Feed Cost per | | | | |
| 100 lb. Gain | \$9.65 | \$7.96 | \$7.57 | \$9.58 |
| Feed Prices Used: | | | | |
| | 1st Trial | | 2nd Trial | |
| Alfalfa Hay | \$10.00 per ton | | \$12.00 per ton | |
| Roll'd Barley | 20.00 per ton | | 20.00 per ton | |
| Dried Molasses Pulp | 25.00 per ton | | 20.00 per ton | |
| Pressed Pulp | 1.40 per ton | | 1.30 per ton | |
| Siloed Pulp | 1.75 per ton | | 1.55 per ton | |
| Molasses | 15.00 per ton | | 12.00 per ton | |

In the second trial it was decided to enlarge the scope of this work and accordingly 113 head of short yearling Hereford steers weighing 592 pounds were similarly handled and divided into 4 equal lots. The steers in both lots graded as feeders from "medium to good."

A preliminary feeding period is advisable for cattle coming off the range or pasture because it gives them a chance to get used to their surroundings, quiet down, and take on a normal fill. Both lots received alfalfa hay and a small amount of barley during this period.

Feedlots.—The feedyard used for these trials provided ample shed room and outside corral space for each lot. It provided all necessary facilities for feed storage, sorting, and weighing of the cattle.

Feeds Used.—The ration fed to each lot in trial I was as follows:
Lot I—Dried molasses pulp, alfalfa hay, and rolled barley.
Lot II—Pressed beet pulp, alfalfa hay, rolled barley, and cane molasses.

Lot 111—Siloed hoot pulp, alfalfa hay, rolled barley, and cane molasses.

All three lots received cottonseed meal the final 40 days.

Trial IT was a repetition of trial I with a fourth lot added as a cheek lot receiving alfalfa hay, rolled barley, cane molasses, but no pulp.

No cottonseed meal was used in trial IT.

Steamed bonemeal and salt were available to the steers at all times in both trials. The alfalfa hay was baled and of good quality. The barley graded as No. 1 feed barley.

The amount of cane molasses fed in both trials was equal to the amount contained in the dried molasses pulp.

Methods of Feeding.—In the first trial all foods except the hay were fed twice daily, early morning and evening. In the wet-pulp lots the grain was fed first followed by pulp and molasses. Hay was fed in small quantities three times daily between the morning and evening feedings of concentrate and pulp.

The feeding schedule of the second trial followed closely that of the 1939 trial except that the hay was fed twice daily.

Conditions During Feeding Period.—The cattle in both trials were brought on feed slowly, increases being made over short periods until full feed was reached. No serious conditions of the cattle going off feed were experienced. As pulp and grain were increased the hay was decreased. Every effort was made to keep the total dry matter and total digestible nutrients consumed on a comparable basis. Weather conditions were more favorable during the first trial. Several exceptional hot spells and a bad fly period were experienced in the third month of the second trial and were reflected in the decreased gain of this particular period.

Marketing.—The steers at the conclusion of both trials were sold without a cut at the feedlots with a 4 percent shrink to local packers, and in each year they topped the market at time of sale.

Records.—All feeds fed were weighed out and recorded at each feeding.

Representative samples of all feeds fed were taken daily and composited for their final analysis. Moisture determinations were run daily on the wet pulp fed.

At the outset of the trials individual weights of steers were taken for 3 consecutive days to account for any variation in fill. In the first trial, weights by lot were taken at the 30, 60, and 111-day periods with individual weights at the conclusion of the trial. In the second trial after the initial 3-day weighings the individual weight of each steer was taken every 30 days and at the conclusion of the trial.

Discussion of Results

Rate of Gain and Dry-Matter Basis.--- In the first trial the cattle fed dried molasses beet pulp (lot 1) made significantly less gain than those fed comparable rations containing pressed or siloed pulp. (lots II and III.) In the second trial the cattle fed dried molasses pulp made gains equal to those fed siloed pulp. This suggests that variation in the cattle or factors other than feed were responsible for the difference in results obtained. The average of the two trials indicates that there was no significant difference in the feeding value of equal amounts of dry matter in dried and in siloed pulp.

In both trials the cattle fed pressed pulp for the major part of the period made less gain than those fed siloed pulp, this difference being more apparent when comparison is made of the periods when fresh pulp was available. The agreement of both trials in this regard offers evidence that the dry matter of pressed pulp is not so efficiently utilized as that of siloed pulp.

Lot IV of trial 2 that received no beet pulp made less gain than those fed beet pulp. As barley and molasses were held constant in all lots, beet pulp was replaced in the ration of this lot by a sufficient amount of alfalfa hay to equal approximately the total digestible nutrients of the other three lots. The results confirm other digestion trials and feeding experiments in showing that the dry matter of beet pulp has the nature of a concentrate feed rather than that of a roughage, and that a pound of digestible nutrients in beet pulp has more productive value than an equal amount from alfalfa hay or other types of roughage.

Cost of Producing Gain. -Feed costs per 100 pounds of gain in the first trial based on the prices paid for feeds at the feedlot were substantially in favor of the siloed and pressed-pulp-fed cattle. The feed cost per 100 pounds of gain was \$2.26 lower for the siloed-pulp lot than for the dried-pulp lot.

In the second year's trial the costs were again lower for the siloed and pressed-pulp lots as compared with the dried-pulp lot. The feed costs of the siloed-pulp lot were \$1.38 lower than the dried-pulp lot. The cattle which received no pulp had the highest feed cost per 100 pounds of gain in this trial. The evidence in both trials definitely points to the fact that wet pulp furnished feed nutrients at lower cost than did the other feeds.

Replacement Value of Wet Beet Pulp. — Comparing lot II (pressed pulp) with lot IV (hay and grain), a ton of pressed pulp replaced 43.8 pounds of barley, 412.9 pounds of alfalfa hay, and 11.7 pounds of molasses.

Comparing lot III (siloed pulp) with lot IV (hay and grain) a ton of siloed pulp replaced 60.7 pounds of barley, 445.3 pounds of alfalfa hay, and 16.7 pounds of molasses.

Carcass Yields.—In both trials there was little difference in the carcass yields or cooler shrinkage of the various lots of cattle.

Individual Gain and Grades.—In both trials large variations in gain, grade attained from feeder classification, dressing percentage, and in cooler shrinkage were noted.

One of the interesting sidelights of the trials was this variation. It would appear that when feed and environmental conditions are so comparable, an interesting problem presents itself to the animal husbandman and the geneticist.

Returns Over Feed Costs.—In the first year's trial, the margin between purchase price and selling price was \$1.50 per hundred-weight, and in the second year's trial, \$1.15 per hundredweight.

In the first year's trial the cattle fed dried molasses pulp returned \$1.23 per head, and the cattle fed siloed pulp, \$10.00 per head over feed cost to cover labor, interest, and profit.

In the second year's trial, the following returns above feed costs to cover labor, interest, and profit were recorded:

| | |
|-----------------------------------|------------------|
| Lot I Dried beet pulp..... | \$ 6.77 per head |
| Lot II Pressed beet pulp. | .11.16 per head |
| Lot III Siloed beet pulp..... | 11.22 per head |
| Lot IV Hay and grain. | 5.17 per head |

in both years there was a larger margin of profit with the wet-pulp lots of cattle than with the dried-molasses-ptdp or hay lot.

Highlights of First Year's Lamb-Feeding Trial

One Year's Results.—It should be stated at the outset that one year's trial is not sufficient to be conclusive. This trial has, however, indicated the practicability of marketing locally produced feeds through lambs. A repetition of the test is contemplated during 1941.

Rate of Gains.— The rate of gain of the siloed-pulp lambs in this year's trial was significantly higher than the other three lots. The addition of wet pulp to a basal ration of grain and hay and molasses resulted in a definite increase in gain and a better, more-uniform finish.

Cost of Gains. - The lambs fed wet pulp made considerably cheaper gains than those fed the dried pulp or the hay and grain. The cost per 100 pounds gain for lot II (siloed pulp) was \$5.86, lot I (pressed pulp) \$6.31, lot III (dried pulp) \$7.83, and lot IV (hay and grain) \$7.95.

Replacement Value of Wet Beet Pulp. — Comparing lot I (pressed pulp) with lot IV (hay and grain), a ton of pressed pulp replaced 82.9 pounds of ground barley, 548.5 pounds of alfalfa hay, and 24.6 pounds of molasses.

Comparing lot II (siloed pulp) with lot IV (hay and grain), a ton of siloed pulp replaced 139.9 pounds of ground barley, 636 pounds of alfalfa hay, and 44.2 pounds of molasses.

Slaughter and Grade Information.—The-dressing percentages of the lambs in the dried-pulp and hay-and-grain lots were higher than the lots fed wet pulp.

In grade of carcas., which indicates finish, the siloed-pulp lot was superior as shown by the largest percentage of choice carcasses. All four lots of lambs graded out very well as the carcasses were well covered.

Operator's Financial Statement.—The financial statement shows a feed profit in each lot but particularly favorable in the wet-pulp lots. It should be remembered, however, that the prevailing feed prices were quite low, that the owner, Mr. Gasser, is an experienced lamb feeder, and the lambs were fed under ideal feed lot conditions.

Sugar Beets and Livestock.—The value of a livestock feeding program in a sugar-beet-producing area is largely in the manure produced for use on the land.

Summary of Lamb-Feeding Trials

Summary of Lamb-Feeding Trial—Fall of 1910. Comparison of Pressed Beet Pulp, Siloed Beet Pulp, Molasses Dried Beet Pulp, and Check Lot without Beet Pulp. Henry Gasser Feeding Plant Woodland, California

| (Pounds unless otherwise designated) | | | | |
|--|--------------|-------------|---------------------|---------------|
| | Pressed pulp | Siloed pulp | Molasses dried pulp | Grain and hay |
| Lot No. | 1 | 2 | 3 | 4 |
| Number of head | 142 | 142 | 146 | 141 |
| Number of days | 87 | 87 | 93 | 93 |
| Average initial wt. per lamb | 67.6 | 67.4 | 67.8 | 66.0 |
| Average final wt. per lamb | 92.3 | 96.4 | 94.9 | 89.2 |
| Average gain per lamb | 25.7 | 29.0 | 27.1 | 22.4 |
| Average daily gain per lamb | .294 | .335 | .291 | .241 |
| Average daily feed per lamb: | | | | |
| Ground barley | .94 | .94 | .94 | .96 |
| Beet pulp | 5.73 | 5.73 | .00 | ..... |
| Ground alfalfa hay | 1.20 | 1.44 | 1.24 | 2.24 |
| Molasses | .34 | .34 | ..... | .33 |
| Total dry matter per lamb per day | 2.94 | 3.04 | 2.83 | 3.16 |
| Cost per 100 lb. gain | \$6.31 | \$5.86 | \$7.83 | \$7.95 |
| Feed profit per lamb | \$1.43 | \$1.61 | \$1.05 | \$.90 |
| Feed Prices: Ground barley \$16.00, alfalfa hay \$8.00, molasses \$12.50, pressed beet pulp \$1.33, siloed pulp \$1.50, and dried molasses pulp \$21.00. | | | | |
| Average moisture content of wet pulps: Pressed 87.6 percent, siloed 88.1 percent. | | | | |

Upon the completion of the steer-feeding trials there was considerable demand that similar trials be conducted with lambs. Yolo County being one of the 10 largest sheep counties in the state with many sugar-beet growers also in the sheep business, it was felt that such trials would be of much value since fattening of lambs for market is becoming more and more of a practice in California.

The Spreckels Sugar Company with the cooperation of the same agencies and Henry Gasser, commercial lamb feeder of Woodland, outlined and got underway a lamb-feeding trial on October 1, 1940.

Procedure

Lambs Used.—From a band of 725 eastern Oregon white-faced lambs of Rambouillet-Corriedale breeding, 600 lambs weighing 61 pounds were selected for uniformity of size and weight. They were a medium type of feeder lambs of only fair quality but fairly representative of the type of lamb fed in this locality. These lambs were shorn and then divided into four lots of 150 lambs each and placed in their respective feedlots.

Feedlots.—Mr. Gasser's lamb-feeding quarters provided an ideal setup for this trial. The lots were all under roof, concrete floored (kept well bedded), with excellent facilities for feeding, weighing, etc. The lambs were confined throughout the trial to their respective lots.

Rations Fed.—The rations fed were identical to those used in the steer-feeding trials, the purpose being to evaluate these feeds for lambs as well as steers.

Lot I Pressed beet pulp, ground barley, cane molasses, and ground alfalfa hay.

Lot II Siloed beet pulp, ground barley, cane molasses, and ground alfalfa hay.

Lot III Dried molasses beet pulp, ground barley, and ground alfalfa hay.

Lot IV Ground barley, cane molasses, and ground alfalfa hay.
(Check lot).

Methods of Feeding.—The rations were so regulated that the three pulp lots received approximately the same amount of dry matter. The molasses fed to the wet-pulp-and-hay lots was comparable to that contained in the dried-molasses-pulp lot. The same amount of barley was fed to each lot. The alfalfa, hay was coarsely ground and fed in self-feeders which allowed each lot to consume hay at will. The pulp was fed twice a day, in the early morning and again in the early afternoon. The molasses was mixed with the wet pulp in lots I and II, and with the hay in lot IV. The alfalfa hay was of medium quality. The ground barley used in the first 60 days was only of fair quality but for the finishing period whole barley of excellent quality was fed. The barley was fed once a day at the start, later twice a day, and during the finishing period three times daily. This gave all lambs more of a chance to get their barley and prevented them from getting an excessive amount at any one time.

Free access to block salt and clean water was available to each lot at all times.

The pens were bedded down with rice hulls whenever necessary to insure dryness.

Weighing.—The lambs were given a 10-day preliminary feeding to get them on feed before the initial weights were taken. The lambs were weighed on October 10 following their morning feed for their initial weight, and then every 2 weeks until the final weighing on the day of shipment. The lambs in each lot were branded with their respective lot number for identification purposes in case of mix up.

Bringing the Lambs on Feed.—This is a very important step in commercial lamb feeding. Lambs are more sensitive to a change of feed and particularly to concentrates than steers, and the feeder should exercise special care in bringing lambs on feed.

From a start of 2 pounds of hay, 1.5 pounds of wet pulp, and .33 pound barley, the pulp and barley were gradually increased throughout the early feeding period until on the thirtieth day they were receiving 1.6 pounds hay, 6.0 pounds of wet pulp, .66 pound barley, and .38 pound molasses per head. As the amount of barley was increased through the finishing period, hay and pulp consumption dropped off.

It was very noticeable that the siloed-pulp lot relished their pulp more than the pressed-pulp lot, consuming more hay throughout the test.

Mortality.—The death loss in this trial was approximately 1 percent which is lower than usually experienced. The reason for this was that lambs not coming on feed within a reasonable time or otherwise out of condition were removed from the pens and put on alfalfa pasture. Practically all of these lambs survived and were later fed out. On the other hand if they had remained, many would have died and greatly increased the death loss.

Feed corrections were made for all lambs that died or were removed.

Composition and Price of Feeds Used.—Daily samples of all feeds were taken and composited for analyses. Daily moistures were run on all wet pulp feed. Prices of feeds used were charged at the current market prices prevailing at the beginning of the trial.

Discussion of Results

Rate of Gain.—The rate of gain of the siloed-pulp lambs (.335 pound daily) was significantly higher than that of the other three lots, particularly when compared to the hay-and-grain lot (.241 pound daily) which received the standard ration used by lamb feeders in the district. The siloed-pulp lot in particular showed a better and more uniform finish.

Cost of Gains.—Though the amount of *dry* matter consumed by the dry-fed and wet-pulp lots was equal, the wet-pulp lots made considerably cheaper gains than those fed the dried pulp or hay and grain.

The cost per 100 pounds gain in the lots was as follows:

| | |
|---------------------------|--------|
| Lot I Pressed pulp..... | \$6.31 |
| Lot II Siloed pulp..... | 5.86 |
| Lot III Dried pulp..... | 7.83 |
| Lot IV Hay and grain..... | 7.95 |

The difference in the cost of 100 pounds of gain between the siloed-pulp lot and the hay-grain lot of \$2.09 is of very significant importance to the commercial lamb feeder.

Replacement Value of Wet Beet Pulp. — Comparing lot I (pressed pulp) with lot IV (hay and grain), a ton of pressed pulp replaced 82.9 pounds of ground barley, 548.5 pounds of alfalfa hay, and 24.6 pounds of molasses, valued at \$3.02.

Comparing lot II (siloed pulp) with lot IV (hay and grain), a ton of siloed pulp replaced 139.9 pounds of ground barley, 636 pounds of alfalfa hay, and 44.2 pounds of molasses, valued at \$3.94.

Slaughter and Grade Information.—The slaughter data showed that the dressing percentages of the lambs in the dried-pulp and hay-and-grain lots were higher than the lots fed wet pulp. In grade of carcass, which indicates finish, the siloed-pulp lot was superior as shown by the largest percentage of carcasses grading choice. All four lots of lambs graded out very well. 89 percent of the carcasses grading good and choice.

Operator's Financial Statement.—The financial statement is the chief interest of the commercial feeder showing whether the operations have been profitable. The financial statement of this trial shows a feed profit in each lot but was particularly outstanding in the wet-pulp lots. Operating on a narrow margin or spread of 1 cent per pound, the feed cost profit varied from 96 cents in lot IV (hay and grain) to \$1.61 per lamb in lot II (siloed pulp). This profit does not include labor, interest, taxes, or overhead, nor was any credit allowed for the manure produced.

Second Year's Trial.—To evaluate the findings of this trial, a second trial is at this date nearing completion. As soon as possible a summation of the data and their relation to this trial will be available.

Conclusions

It is the earnest belief of all parties working on these trials that a great deal of valuable information was obtained.

Upon the completion of each trial a field day and barbecue were held at which time the sheepmen and cattlemen of the community and other interested parties had an opportunity to inspect the steers and lambs and obtain the results of the experiments.

These meetings were especially well attended which was most gratifying because the main object of these trials was to interest and instruct the producers in livestock feeding.

The place, economy, and efficiency in a ration for fattening steers and lambs on the various forms of sugar-beet pulp when compounded with locally produced alfalfa hay and barley were definitely shown.

Valuable information was developed which demonstrated that it is possible and feasible to market home-grown feeds through livestock and by so doing to produce large quantities of manure so vital to the maintenance of soil fertility.

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Beet-Sugar Production as Influenced By Climate¹

Albert Ulrich et al

The cultivation of sugar beets in the United States and Europe has been limited by trial and error to definite areas. These areas, as shown by the annual production records, may vary considerably in productivity not only from district to district but from year to year within a district. The cause for these variations is not entirely clear. Some of the differences in yields may be attributed to diseases or to differences in rainfall or cultivation practices and undoubtedly to soil fertility. Superimposed upon these variables is the effect of climate, which in itself varies from year to year.

That climate is an important factor in sugar production was shown for sugarcane by Borden (1986) when two soils taken from high and low-production areas with similar temperatures gave yields which were related primarily to the sunlight of the localities rather than to soil differences. Clements (1940) in comparable field experiments at two locations correlated the lower yield of cane sugar with a lower light intensity. Kruger and Wimmer (1936), with sugar beets grown in pots receiving direct and diffused sunlight,

³ conducted by the Division of Plant Nutrition, University of California, in cooperation with the Spreckels Sugar Company.

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Assistance in the preparation and maintenance of the light cells was received from Dr. P. K. Stout and Leo Kline. The temperature data were tabulated by James B. Carleton.

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