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THE AGRICULTURAL EXPERIMENT STATION SERVES THE FARMER

Work of Two Years Ending June 30, 1943

UNIVERSITY OF MISSOURI
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

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M. F. MILLER, *Director*

The Agricultural Experiment Station Serves the Farmer

Work of the Agricultural Experiment Station During the Two Years Ending June 30, 1943

M. F. MILLER, S. B. SHIRKY,
H. J. L'HOTE

COLUMBIA, MISSOURI

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PRESIDENT F. A. MIDDLEBUSH,
UNIVERSITY OF MISSOURI,
COLUMBIA, MISSOURI

SIR:

I am submitting herewith the report of the Agricultural Experiment Station for the two years ending June 30, 1943. This report is submitted in accordance with the Federal law requiring such report, a copy of which is to be submitted to the Governor of the State and to the Secretary of the Treasury of the United States.

Respectfully submitted,

M. F. MILLER, *Director*

Missouri Agricultural Experiment Station.

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FOREWORD

Agriculture is a very complex enterprise. Success is dependent upon many factors. Unfortunately some of these, such as those associated with the vagaries of the weather and to a large extent, those determined by the over-all economic situation from year to year, are largely beyond the farmers' control. The factors associated with the soil and its management, with the selection and production of crops and animals, with plant and animal diseases and with insect ravages include most of those in which knowledge and skill may be used in control measures. It is the function of the agricultural experiment station to study the problems in these various fields and in so far as possible, to provide answers to them.

The accompanying report covers two years of work on the many projects on which the staff of the experiment station has been engaged. The majority of the projects carried forward during this time have been pointed toward the solution of those immediate problems confronting the farmers in the war emergency. In doing this it has been necessary to intensify the work on those projects offering most immediate results and to minimize the activities on those of lesser importance to the war effort. This work has been carried on in spite of the loss of practically all of the younger staff members to the armed forces. However, the experimental findings brought to the farmers, largely through the activities of the Agricultural Extension Service, have been widely used in the food and fiber production and marketing programs of the war. They have been of great value to the farmers of the State.

M. F. MILLER,

Director

Work of the Agricultural Experiment Station During the Two Years Ending June 30, 1943

AGRICULTURAL CHEMISTRY

A. G. HOGAN, *Chairman*

Abnormal Bleeding of Swine. During the past two years the efforts of the investigators on this project, M. E. Muhrer, A. G. Hogan, E. T. Mertz, and Ralph Bogart have been directed toward developing a mating system that would provide sufficient bleeder animals; a treatment of hemorrhage in affected animals; determining the mode of inheritance of the abnormality; the effect of hemolysis on the coagulation time of the blood; and the role of nutrition with respect to the abnormality. Careful study has indicated that the bleeding defect was not sex-linked. It is a simple recessive with variations in severity due to modifying genes. Within a certain range, hemolysis decreased the coagulation time of the blood. Acetyl phenylhydrazine was quite effective, while Congo red and saponin were only fairly satisfactory. Extensive hemolysis increased the coagulation time of the blood. The feeding of onions decreased the coagulation time. The capillary resistance increased rather sharply after food was consumed. The bleeding time and the coagulation time were not affected by the consumption of food. Heparinized normal animals had a prolonged clotting time but a normal bleeding time. This may indicate that the fundamental defect in the bleeder animals lies in the walls of the capillaries.

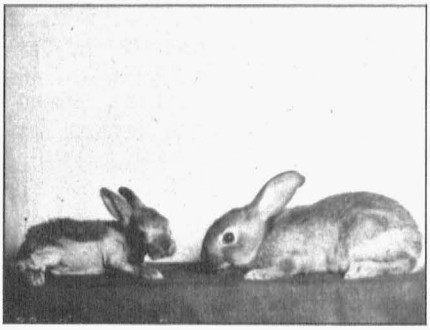
The Nutritive Value of Foods. In 1942 work was started on a project having as its general objective the construction of the nutritive value of food. This work has been undertaken because most nutritionists agree that while the nutritive value of food may be high when harvested it may be reduced seriously before the food is consumed. The specific objective are to determine: (1) the amount of certain nutrients in the food when it is harvested or when these nutrients are at the maximum level; (2) what factors contribute to the reduction of the nutritive value; (3) the degree of reduction of nutritive value that occurs in practice; and (4) the method of reducing the losses to a minimum.

During the year vitamin assays by chemical methods have been made on tomatoes, peaches, apples, cabbage, potatoes, carrots, and turnips. In addition the effects of various methods of cooking and handling have been studied. Major emphasis, however, has been placed on developing methods and acquiring the skill necessary for making reliable assays. This work is under the direction of A. G. Hogan and Laura M. Flynn.

Vitamins Required by Small Experimental Animals. Of the many problems in animal nutrition one that is of special importance is the determination of the various nutritional factors that are required by

the various species of animals. Small animals such as rabbits and guinea pigs have been used in the experimental work because some of the deficiency diseases to which they are susceptible resemble those that have been observed in some of our farm animals. Also it is much cheaper to use the small animal and work can progress faster because they reproduce at a more rapid rate than farm animals. Many of the things that are learned with these small animals may be directly applicable to the larger species.

Previous work had shown that rabbits and guinea pigs were readily reared on simplified diets in which yeast supplied the water soluble vitamins. Females on these diets failed to rear their young, however, and further work was undertaken to discover the nature of the deficiency. A. G. Hogan, L. R. Richardson, and J. W. Hamilton found that these animals required vitamin K during the reproductive period. When vitamin K was included in the diet the number of young weaned was fairly satisfactory. It was found that rabbits could be depleted of vitamin K in about 75 days and guinea pigs in 45 days. Guinea pigs required about 10 mg. daily of ascorbic acid for optimum performance. Vitamin K may be replaced by 5 mg. of phytol daily although it may be that this is a result of contamination with vitamin K.



Young rabbit on left denuded as a result of poor nutrition. Nutrient responsible not known. Rabbit on right is normal.



Rats fed a high level vitamin mixture became denuded when riboflavin was omitted.

Weanling hamsters required six vitamins for normal growth, E, K, thiamine, riboflavin, pyridoxine, and pantothenic acid, and it is assumed that two more, A and D, were required. This makes eight in all. When vitamin K was omitted from the diet the rate of growth was retarded for a time due to hemorrhages. When inositol was omitted from the diet no living young were born. If either nicotinic acid or choline were omitted the weaning percentage was reduced. This makes eleven vitamins necessary for the complete life cycle of the hamsters. It is not certain that a diet containing all eleven is optimum during reproduction, and it is entirely possible that the diet for this stage is improved by the inclusion of some unrecognized vitamin.

Up to the present no other animal had been found suitable for the assay of vitamin E. The hamster is suitable for that purpose.

In studying the vitamins required for the complete life cycle of rats, a basal ration of the simplified type which was supplemented by all the recognized vitamins except ascorbic acid was fed. Various crude vitamin carriers were tested as possible sources of unrecognized vitamins required for normal lactation. Practically every female rat on the basal ration bore young but only 34 per cent of the young were weaned. When 4 per cent of the ration was composed of a water extract of beef liver, 75 per cent of the young were weaned. When the ration was made of one per cent of an eluate of a fuller's earth adsorbate which was prepared from the liver extract the females weaned 85 per cent of their young. Rations without nicotinic acid, inositol, and p-aminobenzoic acid were just as satisfactory as those which contained these vitamins. They may be required, but the first limiting factor for lactation was at least one unrecognized vitamin which was present in liver extract. So far as present information goes this active agent may be vitamin B_c.

With respect to the vitamins required by pigeons, efforts were directed toward the determination of which water-soluble vitamins were required. The major criteria were: (1) a normal red cell count; (2) normal weight; and (3) normal plumage. Approximately 200 mature pigeons receiving synthetic diets were observed. They received no water-soluble vitamins except those supplied in pure crystalline form. A deficiency of any one of the following in time produced a severe anemia: pyridoxine, pantothenic acid, biotin. Also when any one of these was deficient the feathers were affected adversely. A deficiency of any of the following in time produced severe losses in weight: thiamin, riboflavin, pyridoxine, and pantothenic acid. In addition to the recognized vitamins mentioned at least one more unrecognized vitamin is required both to prevent anemia, and to prevent losses in weight. There was some



(Left) Turkey poults suffering from malnutrition. (Right) The same poults after 3-days' feeding of a milk and yeast mixture.

evidence that nicotinic acid and choline improved the nutritional state.

Chick Nutrition Problems. Earlier work at this station showed that two fractions of dried beef liver were indispensable for a rapid rate of growth of chicks on simplified diets. One was a water extract which followed alcohol extraction. The other was the residue, or the residue after acid hydrolysis, following alcohol and water extractions. The most active fraction obtained from the water extract was an eluate of a fuller's earth adsorbate of the liver extract. When this preparation was included the total amount of crude vitamins carried in the diet could be reduced to one per cent or less.

A. G. Hogan, L. R. Richardson, and Boyd O'Dell fed chicks a simplified ration. The chicks developed a type of perosis due to a deficiency of an unidentified organic substance. The chicks received all the vitamins now recognized with the exception of ascorbic acid. The perosis was prevented by the addition to the diet of 1.0 per cent of an ammonia eluate which was prepared by adsorbing a water extract of beef liver with fuller's earth at a pH of 1.0. The filtrate after adsorption was inactive. The chicks grew faster and developed more severe perosis when the ration contained 6 per cent of this filtrate and 3.0 per cent of a fuller's earth adsorbate which was prepared from a 95 per cent alcohol extract of dried beef liver. Choline, methionine, molasses, ash from beef liver, and a fuller's earth adsorbate of rice polishing extract were found by experiment to be inactive.

Chicks also developed perosis as a result of a deficiency of biotin. One gamma of biotin per chick per day administered orally was sufficient to prevent perosis when no other source of biotin was available, but 2 gamma per day were required for a normal rate of growth. When 30 per cent of raw egg white was substituted for the casein in the diet of the chick, every chick developed perosis in 14 to 21 days, but the chicks grew very slowly and the mortality rate was high. Ten per cent of raw egg white was sufficient to bind all the biotin that was carried as an impurity by the constituents of the diet. Three hours moist heat at 90 degrees did not destroy the biotin binding power of the egg white. Intramuscular or intreperitoneal injection of 3 gamma of biotin per chick daily did not prevent perosis completely when the ration contained 30 per cent of raw egg white.

Baby chicks on a synthetic diet became anemic, and the anemia was due to a deficiency of an unrecognized vitamin. Approximately 2000 chicks were observed, and about 40 per cent became anemic. Some of the chicks failed to become anemic because the hens had been on a good diet and transferred to the egg a store of the antianemic vitamin. The addition of 1 per cent sulfaguanidine to the ration increased markedly the incidence of anemia. Xanthopterin had no antianemic activity. Vitamin B_c greatly improved the simplified diet, but it has not been proved that it makes the simplified diet complete.

AGRICULTURAL ECONOMICS

O. R. JOHNSON, *Chairman*

Land Use Investigations. Final report on this investigation has been prepared for publication and is entitled, "The Economics of Recreational Land Use in the Lake of the Ozark Area." This study which was made by Conrad H. Hammar and J. Roger Snipe showed the extent to which recreational development has occurred in the Lake of the Ozarks area. It also showed the trends of recreational land use near the lake. After an early period of high prosperity when most of the properties near the lake were developed for recreation, a later period of declining property values ensued. Many platted lots and acreages were unsold and there was some disappointment over the prospects for future business in the area. The study showed the causes of the decline and the nature of outlook for land use. One factor which has caused some disappointment was that the water level in the lake fluctuated widely, reducing the use and appearance of the shore line.

This study has removed some of the emotion from the controversies over the development of the Lake of the Ozarks and has shown rather clearly the causes for the slowing of the development of the area. A careful investigation should be made for restoring fishing in this great body of water. Also, there should be a more thoughtful and orderly development if the delightful rustic aspects of the lake are to be maintained. A need for zoning is apparent. The recreational improvements of the area will be at their best only if the entire lake shore and hinterland areas are developed under a unified plan for recreation fishing, forestry, hunting, grazing, and farming.

Productive Value of Pastures in Missouri. So much land in Missouri is utilized for pasture that it is important to determine the production from this acreage. Therefore, O. R. Johnson, Homer J. L'Hote, and Aaron Schmidt have developed a method of measuring the yields of various kinds of pastures. This method embodies the determination of the feed requirements necessary to maintain the livestock and to produce gains and products

Yields of Permanent Pastures by Soil Types

Major Soil Types in Area Surveyed	Yield per Acre in Bushels of Corn Equivalent
Marshall, Wabash	18.1
Baxter, Avilla	13.6
Summit	13.4
Putnam, Lindley, Memphis	11.7
Putnam, Lindley	10.2
Shelby, Lindley	9.8
Clarksville	8.8
Cherokee, Bates	8.0

from pasture. The feed fed other than pasture is deducted and the residual amount credited to pasture production. Pasture animal unit values for the various classes of livestock have been determined on the basis of value of pasture per head per day and per head for the pasture season. Yields of various kinds of pastures have been determined. The average production from permanent pastures was equivalent to a yield of 11.2 bushels of corn per acre. The yields of permanent pastures on the various soil types are shown in the following table in terms of equivalents of bushels of corn per acre.

Frequently, rotation pastures gave a larger return for the same land than permanent pastures. The most productive rotations were Sudan, sweet clover—second year, and barley pastured. These crops may be expected to yield the equivalent of 20 bushels of corn or more per acre. A second group of medium productivity included timothy, oats and Korean, timothy and Korean, rye, wheat, first year sweet clover following small grain, and Korean following small grain. These crops yielded from ten to twenty bushels of corn equivalent. Crops yielding under ten bushels of corn equivalent were mostly supplemental pastures.

Livestock Marketing. In 1942 records of livestock marketing practices were obtained by mail from 3,684 farmers; by personal interview from 600 farmers, 199 livestock dealers, 24 cooperative livestock shipping associations, 4 concentration yards, 59 community livestock auctions, 19 packing plants, and retail meat dealers who slaughter livestock. Herman M. Haag, George A. Carlson, Milton Borcherding, and Claud Scroggs were responsible for this work. Preliminary tabulations have been completed.

The Feed Import Situation On Missouri Farms In 1943. Early in 1943, it was realized that the large increase in livestock production would require more feed than was available on Missouri farms. O. R. Johnson, J. E. Crosby, and H. M. Haag obtained information on feed needs and supplies from 30 representative farmers in each Missouri county. Using this information as a basis, estimates of feed supplies and needs were prepared for each cooperating county.

Early in 1943, it was determined that Missouri farmers would have to buy about 40 per cent of their feed requirements if yields were normal and heavy feeding was continued. This meant about 100 million bushels of corn and 50 million bushels of oats would need to be purchased. The data also indicated that a hay shortage was probable because roughage-consuming animals were increased while hay acreages were apparently to be decreased. It also was apparent that Missouri farmers needed and intended to buy much more protein than would be available.

Having this information available early in 1943, the Agricultural Extension Service stressed this feed situation. It emphasized the use of lespedeza in small grains to increase pasture and hay, and to reduce need for protein supplements. It encouraged farmers to use pastures as much as possible to reduce other feed requirements.

Turkey Production and Marketing in Missouri. A survey of turkey producers in Missouri was made by H. M. Haag and E. N. Funk. They found that more than one-half of the producers included in the survey hatched the poults they raised with hens. However, this number of poults totaled less than one-sixth of all poults raised. More than 80 per cent of the turkeys raised were Bronze. From 80 to 90 per cent were hatched in May and June. Producers generally sold their turkeys when 24 to 28 weeks of age. Commercial turkey starting mashes were used by 84 per cent of the growers.

Mortality in turkeys raised with chickens was 36.0 per cent while where turkeys were raised alone the rate was 24.9 per cent. About 80 per cent of Missouri turkeys were sold at the farm.

Very few turkeys produced in Missouri were ready for the Thanksgiving market. In order for producers to secure the best price, the turkey should be well finished before marketing. Using the practices now followed in Missouri, most turkeys would have to be held for the Christmas market.

Conservation of Transportation Facilities for Farm Products. Under the direction of H. M. Haag, data were obtained on movement of products into and out of 9 Missouri counties. Included was information on farm-to-market milk transportation for the entire Missouri portion of the St. Louis milkshed and for the south central area of Missouri involving milk plants in the towns of Cabool, West Plains, and Ava. Information on livestock shipments in Boone county also was obtained.

Analyses of the information revealed that more tonnage was being hauled into most Missouri counties than was being hauled out and that possibilities of transportation savings by coordinating in-and-out movements were great. These studies supported O.D.T.'s contention that return freight was available for trucks going to market if truck movements were properly coordinated.

Farm-to-market transportation in the St. Louis milkshed revealed possible savings of 16 per cent in mileage over that actually used in August, 1942. The routing developed in this study was used as the basis for the mileage conservation plan proposed by the St. Louis Milk Industry Transportation Committee and approved by the Office of Defense Transportation.

The study of livestock shipments in the Boone county area indicated that a more efficient routing and loading of trucks could result in a saving of approximately 15 per cent. Results of this study were used as a basis for livestock industry transportation plans in Missouri.

Land Tenure in Missouri. A summary of the data on types of tenancy areas in Missouri collected two years ago has been completed and a report written. The original work was conducted by Wade Jones and the report was written by O. R. Johnson and Howard Fugate in consultation with John Timmons of the Bureau of Agricultural Economics at Washington and James Marshall of the Milwaukee office of the Bureau of Agricultural Economics. A grant from the Research Council of the University of Missouri has been

made to study a phase of land tenure in Knox and adjoining counties. This work has been designed to determine the adequacy of farm units for tenure operations. Data have been collected on 100 farms.

In addition, the Corn Belt Land Tenure Committee of the Farm Foundation is cooperating in this work. A plan of field study which avoids duplication of effort and at the same time covers all major phases of land tenure studies has been developed. In 1942 emphasis was shifted to special wartime problems of land tenure, including the shifting surplus and inefficient farm labor from land of low productivity to more productive agricultural areas or to non-agricultural occupations. Special studies of difference in production conditions on tenant farms, as compared to owner-operated farms, have been made. Some of the items which result in ineffective production were found to be: insecurity of occupancy of the land; lack of soil and soil building resources; inadequate improvements for effective production, particularly of livestock; and methods of renting which were uninspiring to tenants. Results have indicated that now is a good time for landlords, under improved income conditions, to establish conditions on their farms that will enable tenants to increase production.

When incomes are ample also is a good time to improve farms for long time production. This, in a very real sense, is the creation of reserves which may be drawn upon in postwar years.

In 1943, special attention was given to the development of a policy whereby farm operators would share the income with their workers as a means of inducing workers to remain on the farm.

It is proposed that a preliminary agreement be made at the beginning of the year and that this agreement be modified at the close of the year, when an actual accounting of the results of the year's work can be definitely determined. A record system that will enable the operator and the worker to make a fair determination of each one's contribution during the year is necessary for this plan to function.

Experience has shown that sharing the administrative responsibility of the farm with the son, or a hired worker, is a highly useful method of giving a young person experience in making decisions; of keeping a worker interested in doing a careful and conscientious job; of giving a worker an interest in unusual returns due either to a better job of management or increase in prices; of avoiding the obligations of paying wages above what the farm can afford, should prices fall; and of giving the young farmer a chance to accumulate some livestock for the day when he can start for himself. It is easier for a young man to save when that saving is in livestock rather than in the form of a weekly or monthly pay check. By using these and similar methods farm proprietors can be more successful in competing for the services of efficient workers.

Missouri Farm Land as an Investment. A study has been made of Missouri farm land as an investment during the early or pioneering period and during the later 1920 to

1940 period. Operating farmers in 1910 had a 58 per cent equity in the real estate which they were farming. By 1940 this equity had shrunk to 41 per cent. Conrad H. Hammar, who has made this investigation, found two major causes for this decline in equity: (1) Farmers of Missouri, and indeed of the United States, have received lower incomes on the average than other classes of the country, particularly people dwelling in large cities. Since large income receivers save more easily than low income receivers, ownership has migrated into their hands. (2) Operating farmers in Missouri also have lost their equities because the title to much farm property has moved into urban localities along with children who have migrated from Missouri farms to cities.

The Farm Real Estate Situation in Missouri. Data relating to the period 1917 to 1935 inclusive have been made available by a WPA statistical project. The records included every mortgage upon every tract of land within eight townships. Equally comprehensive data have been obtained upon farm mortgage foreclosures in these townships and the report on these results is practically completed. Contrary to the findings of other investigators in other states, mortgage foreclosures in these eight townships were not the greatest where the land was the poorest and the real estate value the lowest. The failure of mortgage credit as indicated by the foreclosure data was caused by a complex set of circumstances involving the terms and types of mortgages; the period in which the mortgage credit was contracted; and particularly the lavishness with which credit was granted.

During the period 1917 to 1935 long term, low rate, installment mortgage credit was available, but farmers persisted in obtaining short term, high rates, non-installment credit. Apparently, farmers have not made a sufficient use of the credit facilities of the Federal Land Bank, despite the fact that it provides a more suitable type of credit. Much of the failure of farm mortgage credit has been due to faulty lending policies. These policies can be corrected easily. In some areas lenders have provided lavish amounts of credit upon an apparently shallow appraisal of the productive capacity of the land. Foreclosures tended to concentrate, not where lands were poor, but where credit was too large.

In 1942-43, quarterly surveys of land values and land market developments in Audrain, Harrison, Lawrence, Nodaway, and Pemiscot counties were made. Surveys indicated that land values were moving upward in all five counties. The volume of transfers in these counties was the largest since 1920. However, the amount of new mortgage debt contracted was not at all excessive. Non-farmer buyers were a considerable factor in all five counties though most purchasers were farmers.

Trends of Land Values and Rents in Atchison County. An analysis of trends of land value and rents in Atchison county for the period 1900 to 1940 has been made by C. H. Hammar in cooperation with George Walter, M. M. Regan, and J. H.

Marshall of the Bureau of Agricultural Economics of the United States Department of Agriculture. A series of interest rates that were relevant to the relationship of land income to land value in this area has been secured. For example, rates on local bonds floated in the area during the same period were obtained and data on the average mortgage rate of interest also were obtained.

Preliminary results showed that the average mortgage rate of interest was not the capitalization rate that was employed customarily in relating land income to land value. The average mortgage rate of interest was one of the higher interest rate series for the county, while the relation of net cash rates to value, as far as they represented the capitalization rate, consistently was one of the lowest. Changes in net cash rents did not correlate as closely with changes in land values as did changes in net share rents. These results are opposed to those reported by previous investigators. The early data on this project showed that the rate of capitalization as it related to farm land values was an individual phenomena; varying as the experiences with, and outlook for, land investment changes. It was not related in a material way to the average mortgage rate of interest upon which so much dependence has been placed. A questionnaire designed to obtain capitalization rate data has been prepared and mailed to land owners in the county and a number of them have been returned but have not been tabulated.

Cycles and Seasonal Variation in Prices of Missouri Farm Products. Information on prices of about forty different grades and classes of ten different farm products and feedstuffs, for which such information usually has not been available, has been assembled by Herman M. Haag and Elmer Kiehl. Indexes of seasonal variation have been constructed and the assembling of data on factors affecting prices started. The items covered were various classes of slaughter steers, slaughter heifers, calves, cows, feeder steers, feeder heifers, veal calves, sheep, feeder lambs, slaughter hogs, slaughter sows, poultry, eggs, milk, butterfat, barley, kafir, and wool.

Farming Systems for Small Farms. On the advice of a general supervisory committee, O. R. Johnson and Loryn McQuerter selected an area for study, prepared forms, and completed the required amount of field work to determine the better farming systems for small farms. A total of 100 individual farm records was secured covering: labor income; special notations on the contribution of the farm toward family living; the farm management practices in use; and a considerable amount of personal history of the operators. About 35 of the farms were in a strawberry section and wherever such special enterprises were included additional information was secured on these enterprises. The farms studied were under 125 acres in size and the object of the investigation was to determine to what extent it is feasible for a farmer on a small farm to make an adequate living for him-

self and family, with some promise of security in old age.

The 100 farm records were grouped into three groups: the top one-third, the middle one-third, and the low one-third. The labor earnings, including labor income from farm, farm contributions to living, and labor earnings off the farm were for the upper one-third $1,249, for the middle one-third $588, and for the low one-third $170. The average labor earnings for the area for the year 1941 was $668.

On the 100 farms, 12 per cent of the total acres were in intertilled crops. The average size of the farm was 72.7 acres. Three per cent of the intertilled crops were intensive crops, mostly strawberries and tomatoes. Seventeen per cent of the land was in small grain, 6 per cent in legumes, 11 per cent in rotation pasture, and 35 per cent in permanent pasture. Nearly 12 per cent of the land was double cropped. The high income group had a crop index of 153, the middle group 97, and the low group 61.

The Influence of Declining Land Productivity on Land Values. The field work on this project was practically completed in July, 1941, and covered approximately 150 records. From these records O. R. Johnson and Howard Fugate have determined that there has been a deterioration in the effective size of a farm unit of approximately 40 per cent since the land was first settled. There was considerable variation with individual farms. Some farms have been maintained fairly well and others now are worth only a minor fraction of their original productive value. Where the better production has been maintained the more erosive land was kept in sod crops; ownership and operatorship were co-existent; and heavy mortgage indebtedness at inopportune times was avoided.

An improvement program based on year to year maintenance was more effective than neglect for many years and consequent complete restoration at a later date.

On many farms the investment value has practically disappeared. This has occurred much more rapidly than would be evident to the casual observer by comparing the farm's present production with that of thirty years ago. For example, if the original production of the farm was 5,000 units and its present production 3,000 units, a loss of 40 per cent, it is entirely possible that the cost of production in the original situation may have been 1500 units and at present it may be 2500 units. Thus, the net investment value actually would be only one-seventh of its original value.

The farms which had deteriorated most showed an average corn equivalent production of crops and pasture land of 9.5 bushels of corn equivalent per acre, the middle third showed 12.2 bushels per acre and the group including those which had deteriorated least but not including those which did not deteriorate gave a production of 15.3 bushels corn equivalent per acre. The percentage decrease in productivity was least on Wabash soils (.29 per cent per year) and heaviest on the Putnam-Edina series (2.23 per cent per year). The average rate of decline was 1.64 per cent per year.

While the rate of deterioration by

type of farming was not greatly different, the farms where hogs were a major enterprise deteriorated least rapidly and general farms deteriorated most.

From the standpoint of type of tenure, the tenants were located on the least productive farm units. Tenant farms had a productivity of 15 per cent below the average for the area. Owner-operators had farm units of just about average productivity. Part-owner operated units had a productivity of more than 20 per cent above the average. Tenant operated farms produced an average of 11.5 bushels corn equivalents per acre, the owner operated farms 13 and the part-owner operated farms 13.8.

The Cooperative Organizations of Missouri. The financial records of about 180 local cooperative exchanges and elevators have been summarized by H. M. Haag and classified according to size of business, geographical location, and other factors in 1940 as they are related to income, margins, and returns. In 1941 the record of 144 local associations and 21 large scale associations were analyzed.

Sales of all cooperatives totaled 76 million dollars in 1941. This was 38 per cent greater than in 1940. Sales of central agencies were up 42 per cent and of local associations, 30 per cent.

Margins per dollar of sales taken by all associations in 1941 averaged 10 per cent less than in 1940 and expenses relative to sales were 17 per cent less. As a result, net savings were 9 per cent more. The net savings of all cooperatives studied amounted to $1,600,000 in 1941 which was 50 per cent more than in 1940.

The estimated net worth of all associations studied was nearly 6½ million dollars at the end of 1941. Total assets amounted to 9½ million dollars.

The results of these studies keep cooperative leaders informed of changes occurring in the margins, expenses and conditions of cooperative associations in the State, and make it possible for them to take steps to correct specific weaknesses revealed. The studies have also been used to establish standards of performance which associations might use as goals in their business operations.

Labor Requirements for Crop and Livestock in Missouri. Data collected in past years have been used by Ben H. Frame to compute the seasonal distribution and the average labor requirements of all the principal crops and livestock produced in Missouri. Seasonal distribution and total labor requirements of the less common crops have been estimated from data published by nearby states. The total 1942 production labor requirements of all crops and livestock for each county in Missouri have been estimated by months. The 114 Missouri counties then were grouped into ten regions and the productive man-labor requirements for these regions computed by months. These results have been used by the State Employment Office as a guide in supplying farm labor demands for peak seasons in various counties and regions.

Farm Construction and Investment Cycle. Data from nine areas

representing widely different situations of soils and types of farming have been collected by Conrad H. Hammar. Tables have been constructed showing: the average number of buildings per farm by types, including dwellings, tenant houses, barns, storage buildings, and animal shelters; the volume of buildings per farm for the same building classes; the condition of buildings by classes; the age of buildings by classes; the years of service remaining by classes; the paint condition by classes; and the percentages of buildings of various types of construction by classes. For four of these areas the volume of buildings by classes per acre of land in farms has been computed. Apparently, many of the farm buildings in Missouri are in poor condition. The oldest and poorest buildings were found upon the poorest farms and these were, in turn, upon the poorest land. A great farm building program is needed if Missouri farm buildings are to be placed in an efficient condition. However, the buildings in many areas and upon many farms are in too poor a condition to be rehabilitated and perhaps the land too poor to justify reconstruction.

Cost of Family Living on a Farm. Farm diary accounts and simple farm accounts have been summarized by Ben H. Frame, but many of the records were slow this year because the farmers found it convenient to retain the farm account books until March 15, because of income tax returns. A farm and home record book has been revised and on account of the large demand it has been necessary to reprint this book. Approximately 100 cost-of-production records have been secured in Southeast Missouri and now are being tabulated. Present prices and scarcity of certain supplies have increased greatly the demand for cost-of-production studies.

Cost of Producing Cotton in Southeast Missouri in 1941. A survey was made of 88 farms producing cotton in Southeast Missouri in 1941. B. H. Frame directed the survey and analyzed the data. The gross cost per acre for producing cotton was lowest for the owner-operator and highest for the sharecropper with the tenant operators falling in between but the gross cost per pound for lint was highest for the owner-operator and lowest for the sharecropper. Man labor constituted more than half of the total cost of the production of cotton. The net cost for producing a pound of lint cotton was 6.28 cents for the owner-operator, 5.43 cents for the tenant and 4.79 cents for the sharecropper.

In 1941 the owner-operators surveyed had a net income per acre of $52.95, tenant operators $35.45, and sharecroppers $27.58.

A complete report giving the details of this study has been published as Missouri Agricultural Experiment Station Bulletin 467.

Wartime Utilization of Farm Labor and Equipment. Under the direction of O. R. Johnson a survey was made of the farm labor and equipment situation on 8,906 Missouri farms. These farms reported that they had lost laborers to the army or war industries in 1942 on

an average of .4 worker per farm. These farmers paid 30 per cent more for year-around help in 1942 than in 1941 and 40 per cent more for seasonal help. The value of the living accommodations furnished the laborers was increased 20 per cent over 1941.

Of the farms studied, 14 per cent of the farm operators left for war or war industries and 30 per cent of the farms that were operated in 1941 were idle in 1942.

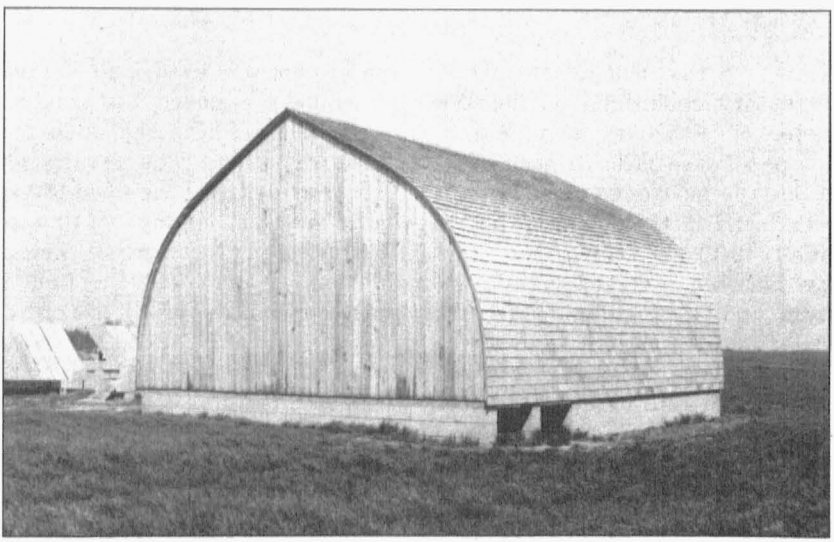
To partially offset the decreased farm labor available, farmers increased the use of labor-saving tools by 42 per cent.

The results of this survey were released to public officials as aids in formulating public policy to help in expanding agricultural production.

AGRICULTURAL ENGINEERING

J. C. WOOLEY, *Chairman*

Economically Constructed Farm Buildings. Farm buildings with a curved rafter type of construction have been designed by J. C. Wooley and Ralph Ricketts. This type of construction reduced the cost of buildings since it used native lumber and was economical of labor. A laminated rafter and frame machine shed, size 30′ x 40′, has been constructed. Rough oak lumber was used in the frame and sheathing, yellow pine car siding for the ends and doors, and wood shingles for the roof. There are a number of advantages in using this type of construction. This 30′ x 40′ machine shed required 4,220 bd. ft. as compared to 5,648 bd. ft. for the conventional design of the same size. Small sizes and random lengths were used resulting in a



Special type barn built of laminated native 1″x4″ oak framing.

marked saving of lumber. Rough oak lumber, 1″ x 3″ and 1″ x 4″, was used throughout for the framing except for the end construction. Much of the work was standardized resulting in efficient use of labor. Forms were made and all rafters and frame trusses were made alike. This type of construction lends itself to partial fabrication and should interest lumber dealers because slack time in lumber yards or shops could be used to advantage as the complete frame could be fabricated in the yard and later hauled to the farm for erection.

Plans have been made for a dwelling 26′ x 40′, a garage, and a poultry house using the same design.

Effect of Environment on Laying Hens. For a number of years J. C. Wooley has been studying three types of poultry houses (with variations) embodying different ventilating systems in order to determine a satisfactory environment for laying hens. House No. 1 is a regular 20′ x 20′ Missouri type straw loft house. House No. 2 is a 20′ x 20′ double deck house with combined flue and open front ventilation. In 1941-42 this house was modified. The upper and lower decks on each side of the central alley were connected by a ramp. The roosts and nests were placed up stairs, feed, water, and scratching pen down stairs. House No. 3 is 12′ x 12′, open on four sides and has the roosting space in the attic. The following represents a six-year average for the factors indicated:

	House No. 1	House No. 2	House No. 3
Number of days during year that production exceeded 50 per cent	120	87	136
Percentage mortality	4.5	3.0	1.7
Average number of eggs per hen per year	145	130	151
Percentage production	43.3	39.3	45.0

None of the houses furnished satisfactory conditions during the months of February and March. The open house (No. 3) seemed to furnish the environment needed in the fall and in the summer.

In 1942-43 a comparison was made between a forced ventilation system and the regular open front ventilation. An electric fan was installed to force fresh air into the house at the rate of 30 cubic feet per hen. Air was allowed to escape from the house through the straw loft over the roosting section. The number of eggs produced per hen was less where the forced ventilation system was used, and the number of hens removed for treatment greater than where the open front house was used. The results gave further evidence of the need to avoid drafts at least in the rooting section of the poultry house. The circulation of cold air through the house produced very little if any drying effect and caused too great a loss. The open front ventilation was satisfactory except in cold windy weather.

Tillage Methods in Growing Corn. Any saving of labor or machinery costs without decreasing yields means more profit to the grower.

M. M. Jones, L. E. Hightower, and R. P. Beasley have been investigating the effect of different methods of seed bed preparation and of different methods of cultivation upon the yield of corn and the cost of production. The plots for this work has been located on Putnam silt loam near Columbia, Missouri. Seven different methods of seed bed preparation for corn following oats with lespedeza and four different methods of cultivation were studied.

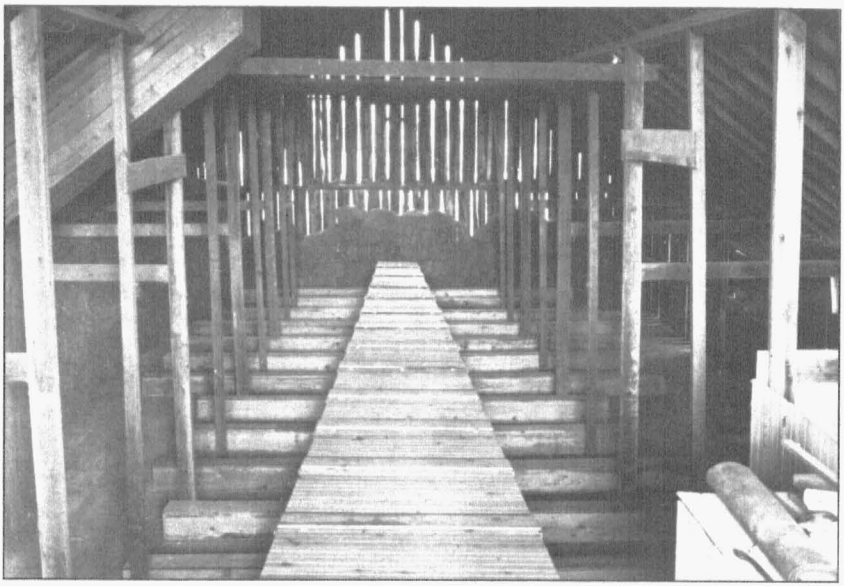
Plowing as early in the spring as possible, and then discing and harrowing just before planting gave the highest yields and the lowest cost of production. The use of the field cultivator instead of the plow was tried in preparing the seed bed. Although less work and power were required per acre, yields were consistently lowered with the field cultivator.

There was no significant difference in results obtained with three different methods of early cultivation—using the rotary hoe, using the spiketooth harrow, or using the ordinary cultivator equipped with sweeps and rotary hoe fenders next to the row. The results of cultivation with sweeps and with surface blades were quite satisfactory and about equal.

Results indicated that certain tillage operations may be omitted or less costly operations substituted, thus enabling more economical production and effecting savings in power, labor, and machinery. For example, discing ahead of early plowing has been found to be of little or no benefit in general; and faster, cheaper early cultivations with a spiketooth harrow or rotary hoe are generally just as good as the more costly, tedious, and supposedly more thorough cultivation with the regular cultivator.

Cost of Service from Small Tractors. A number of problems must be solved in selecting power for a farm. Is it better to own a tractor, is it better to own additional horses, or would it be more economical to hire work done by custom operators? Small farm tractors are being used more and more each year. In order to help farmers solve their power problems more satisfactorily, M. M. Jones, L. E. Hightower, and R. P. Beasley surveyed thirty-five owners of small tractors and 15 dealers to obtain information on various items of cost of owning and operating tractors, as well as information on the amount of work done and the factors causing variations in cost. They found that the costs of service from small tractors rated to pull one 16-inch or two 12-inch plows varied from $4.05 per 10-hour day for tractors used 20 days per year, to $2.28 for tractors used 150 days per year.

Hay Harvesting Costs. In selecting haying machinery and equipment, better selections can be made if the labor requirements and costs of operation of the different machines are known. With labor shortages imminent, information on labor-saving equipment is particularly valuable. Field observations and surveys of haying practices were made on 93 Missouri farms in the summer of 1941. Data were obtained on man labor, power, and machinery required for various hay-



Barn for hay curing. Air ducts on barn floor.

ing operations, as well as the advantages and disadvantages of different methods used for harvesting. M. M. Jones, L. E. Hightower, and R. P. Beasley have partially analyzed the data obtained. Labor was computed at local rates while horse labor was charged at 10 cents per horse-hour. Mowing costs averaged 72.4 cents per acre for those using horse drawn mowers and 37.7 cents per acre for tractor mowers.

Homemade Electrical Equipment for Poultry and Livestock. With scarcity of materials and manufactured farm equipment and with the demand for increased pork and poultry production, satisfactory homemade appliances are particularly valuable at this time.

	Cost per Ton Except Mowing	Man-hours per T. Except Mowing
Baled with pick-up baler	$1.44	1.60
Baled with stationary baler	2.54	4.52
Field stacked; tractor combination sweep rake and stacker	1.49	2.45
Field stacked; horse sweep rake and overshot stacker	1.55	4.53
Field stacked; horse sweep rake; pitched by hand	1.67	5.02
Field stacked; hauled on wagon; loaded and pitched by hand	1.73	5.37

M. M. Jones and J. C. Wooley constructed several different types of homemade chick brooders and several units of one type of homemade pig brooder and put them into service for observation and experimentation. They also constructed and tested a stock water tank heater.

The homemade chick brooders proved quite satisfactory and eco-

nomical. The pig brooder consisted essentially of an electric lamp with a cheap reflector, built into the corner of the farrowing pen. Energy consumption for the period February 19 to March 25, 1943, averaged 195 Kwh (kilowatt hour), or about 5½ Kwh per day. This type of brooder was practical and satisfactory. The electric heater for livestock watering tanks was practical and satisfactory when the water tank was insulated with straw and manure held against the outside of the tank by a wooden frame. From November 15, 1941, to February 20, 1942, such a heater used 86 Kwh of electrical energy. It kept ice from forming on the water in temperatures as low as zero.

Irrigation of Corn in River Bottoms. J. C. Wooley and R. P. Beasley have made studies on the costs and practicability of irrigating corn on river bottom land. As a result of their studies they believe that much of the Missouri and Mississippi river bottoms could be irrigated. A 4-inch sand point was driven to a depth of 52 feet on the J. S. Williamson farm in the Missouri river bottom. This furnished water at the rate of 170 gallons per minute. Two inches of water was applied to the corn. A head ditch was constructed with a plow and water ran from this down the corn rows. The irrigated plots produced 120.3 bushels of corn per acre as compared to 106.9 bushels on the unirrigated check plots. Irrigation costs including depreciation on equipment, fuel, oil and labor was $4.75 per acre or 35 cents per bushel for the increase in yield. The year 1942 was a reasonably favorable year for corn and the 13 bushel increase in yield could be increased proportionately in an unfavorable year.

Use of Straw in Soil Building. At the present time it is common practice for Missouri farmers to burn straw and cornstalks prior to plowing. Missouri soils are in need of this organic matter which is destroyed but a way must be found to utilize these materials without having a deleterious effect on the crop following the incorporation of these materials in the soil.

J. C. Wooley has used three different treatments on straw. On Plot I, Korean lespedeza furnished the nitrogenous material to aid in hastening the decay of the straw when it was plowed under. On Plot II, commercial nitrogen was added as the straw was plowed under. On Plot III, the straw was removed from the plot, piled and the decayed straw returned to the plot the following year. Plot IV was used as a check. In the spring of 1941 the plots were seeded to oats. Using the check as 100 per cent, yields in per cent of check were as follows: Plot I, 113.8; Plot II, 114.7; Plot III, 120.7. This does not represent a true comparison as Plot III had no compost returned to it as there was none available since this was the first year of the test. The following year, 1942, the yield of oats was as follows: Plot I, 40.5 bu. per acre; Plot II, 40.9 bu.; Plot III, 29.7 bu.; Plot IV, 28.0 bu. Expressed as per cent of the check, the yield of Plot I was 150.6 per cent; Plot II, 121.2 per cent; and Plot III, 135.2 per cent.

In both years all plots receiving

treatment gave yields in excess of the plot with no treatment which indicated that some sort of treatment of the straw was definitely desirable.

New Farm Buildings and Equipment Designs. A new combination milk house and milking parlor has been designed. The plan embodies two arrangements, one having regular milking stalls and the other having a walk through the stalls so that the cows pass through the barn and leave at a different door and enter a different yard from the one provided for the cows before milking. The ventilation, arrangement of doors, and space allowances meet the requirements of the milk ordinance.

A barn has been designed which may be used as a loafing barn for dairy cows, a barn for beef cows and calves, or a barn for feeder cattle by changing the floor plan arrangement. This barn provides for some control of drafts by use of a straw loft for ventilation.

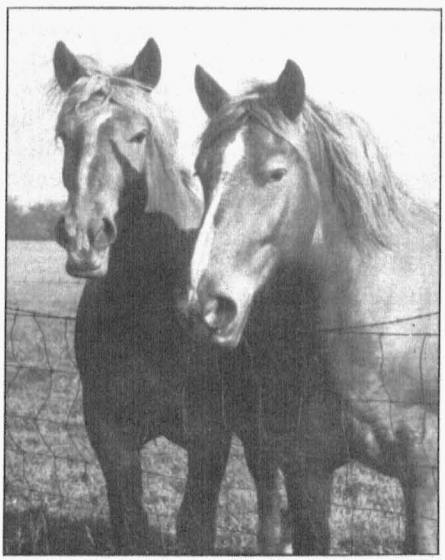
Other buildings which have been designed are: a barn for beef cows and calves, a barn for feeder cattle, a central farrowing house for hogs, a loafing barn for dairy cows, and an individual farrowing house for sows.

New equipment designed includes a tractor hitch for horse-drawn mowers, a slip scraper converted into a tractor scraper, a tractor bulldozer, and a self feeder for hogs. (J. C. Wooley, M. M. Jones, L. E. Hightower, R. P. Beasley)

ANIMAL HUSBANDRY

E. A. TROWBRIDGE, *Chairman*

The Managed Grazing of Bluegrass. Three systems of grazing have been under comparison for 12 years in order to determine the best method of handling bluegrass pastures. Using System I, a 25-acre field of bluegrass was grazed continuously throughout the season. With System II, a 25-acre field of bluegrass was divided into three divisions, the steers grazed one division for two weeks and then rotated to another division for another two weeks. With System III, a 25-acre field of bluegrass was divided into three divisions and each division grazed for two weeks before the steers were rotated to another. About the middle of July the steers under this system were



Belgian mares on University farm.



Use of pasture and roughage in producing beef. Two-year old steers on lespedeza pasture.

moved to 23 acres of Korean lespedeza where they grazed until the latter part of September. The bluegrass under this system was not grazed again until in the winter after growth had ceased.

In 1941 seventy range-bred Shorthorn yearling steers averaging 525 pounds were used. The steers were placed on pasture April 15. The 20 steers under System I gained 180.8 pounds per steer or 144.6 pounds per acre. The 20 steers under System II gained 178.2 pounds per steer or 142.6 pounds per acre. The 30 steers under System III grazed the bluegrass until July 8 and gained 134.7 pounds per head or 161.6 pounds per acre on bluegrass. From July 8 to September 30 they gained 139.9 pounds per head or 182.5 pounds per acre on Korean lespedeza.

The greater seasonal gain per steer on System III shows the advantage of grazing Korean lespedeza during the mid-summer period as these steers continued making good gains while cattle on bluegrass made smaller gains during this period because the bluegrass was dormant, dry, and less palatable.

In 1942 there was considerable white clover on the pastures and some Korean lespedeza. The lespedeza had been seeded in the spring of 1941. The 70 steers used in 1942 were range-bred Shorthorns averaging 775 pounds in weight. They were turned on pasture April 21.

The 20 steers under System I made an average gain of 291.6 pounds each or 233 pounds per acre. The steers under System II made an average gain of 287.4 pounds each or 230 pounds per acre. The 25 steers under System III grazed the bluegrass until July 15 and made an average gain of 160.5 pounds each on the bluegrass or 193 pounds per acre, and 105.7 pounds each on the lespedeza or 138 pounds per acre. The steers under this system made an average gain of 266.2 pounds each with 45 days less grazing than the steers under the other two systems.

J. E. Comfort and E. M. Brown have pointed out that the greater beef production in 1942 was due largely to more abundant and better distributed rainfall, particularly during the summer, and the presence of considerable white clover and lespedeza in the pastures. Larger gains per animal were made by two-year-old steers than younger animals provided they were thin when the grazing was started. This project has been in cooperation with Sni-A-Bar Farms and the United States Department of Agriculture.

Vitamins Required by Swine. Approximately 40 per cent of the pigs farrowed under farm conditions die before they are marketed and many survivors are subnormal in weight and condition. Most of the deaths occur during the first week after birth. Earlier work at this Station by A. G. Hogan and V. F. McRoberts has shown that a large part of these losses were due to vitamin deficiency and that the rations commonly supplied to brood sows were deficient in vitamins. Efforts are now being concentrated on discovering which are the deficient vitamins. Three groups of four sows each were used. Group I received the basal ration. Group II received the basal ration supplemented with all the known vitamins. Group III received supplements rich in vitamins such as yeast and liver. Also the problem was approached differently by rearing new-born pigs on a synthetic diet in which no vitamins were supplied except in crystalline form.

The ration of the sows in Group II was not improved by the inclusion of pure vitamins. Apparently the ration was deficient in an unrecognized vitamin. The performance of the pigs that were reared on synthetic diets was further evidence that this was the case. Their growth rate was inferior. However, they grew normally when the diet was further supplemented with a water extract of liver. It was therefore concluded that swine require an unrecognized vitamin that is frequently deficient in the usual rations and that this vitamin is of considerable importance.

Since it was too expensive to use swine entirely for these studies, rats have been used because they have been found to be suitable substitutes. In the work with rats the objectives have been to determine which vitamins limit growth of the suckling rats, which vitamins limit reproductive efficiency, and what are the characteristics of the unrecognized vitamins.

The results have indicated that the factor that limits growth is one or more of the following: thiamine, pyridoxine, riboflavin, or panto-

thenic acid; that the addition of choline increases the percentage of young weaned and increases somewhat the rate of growth; that some unrecognized factor is more potent than choline, and that this factor is soluble in boiling water, insoluble in hot 95 per cent alcohol, and is adsorbed on fuller's earth at a pH of 1.

In an attempt to rear pigs on a synthetic milk diet it was found that pigs between the ages of 2 and 56 days cannot be raised on diets that contain no vitamins except those now recognized.

Brood sows have been supplied with rations that contained dried yeast. This was a fairly good source of the unrecognized vitamin and could replace alfalfa meal, but when combined with alfalfa meal did not improve markedly the ration.

Systems of Breeding for the Improvement of Swine. The work at the Missouri Station on swine improvement consists of establishing four distinct lines (3 Poland China and one Hampshire) of swine. This has been done by moderate inbreeding and rigid selection, the object being to develop superior producing strains which may be used to improve the productivity of animals within the breed by outcrossing or for use in cross breeding with methods similar to those demonstrated to have merit by corn breeders.

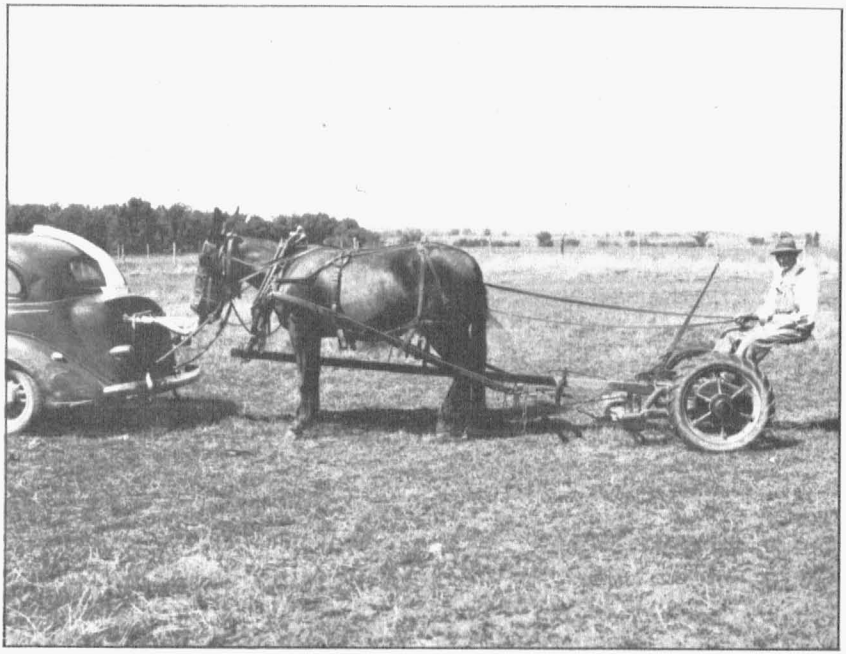
In the year ending June 30, 1942, 42 spring and 36 fall litters were produced. The work thus far has shown that inbreeding has not resulted in loss of vigor in lines which were superior prior to inbreeding but has reduced it in those less vigorous at the beginning. Not all sows giving positive tests for pregnancy farrowed litters. Foetal resorption or abortion were the causes of the sows not farrowing. Gilts selected from productive dams as measured by prolificacy, birth weight of pigs, mammary development of sows, weaning weight of litter, etc., were more productive as sows than gilts selected from less productive sows.

Feeding trials showed that with increasing age the gain per day per head increased but the gain per day for each one hundred pounds live weight decreased. The feed per one hundred pounds gain increased with increasing age. As the body weight increased the gain per day per head increased but the gain per day for each one hundred pounds live weight decreased. With increased food consumption there was a greater gain per head per day and an increased economy of gain. Younger pigs consumed more feed per one hundred pounds live weight than older ones and consequently had a greater percentage increase in weight per unit of food consumed. Hot weather prevented a large daily food intake. This decreased the rate and economy of gain. Healthy, vigorous pigs gained more rapidly and economically throughout the growing period than pigs lacking in vigor.

Barrows made slightly more rapid and economical gains than gilts from the same litters. Crossbred pigs made faster gains than either the inbred or out-cross groups. Outcross pigs made faster gains than inbreds. There was little difference in amount of feed consumed per

hundred pounds gain due to type of mating. Individual inbred boars tested varied considerably in their value for bringing about improvement when used for out-cross and cross breeding.

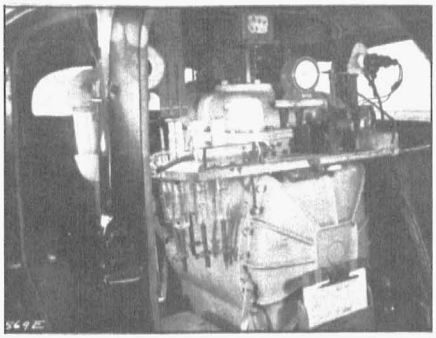
In 1943 the development of the 4 inbred lines was continued and one additional line started. The results have demonstrated further that through inbreeding (and selection) uniformity of type and other desirable characteristics may be increased resulting in production of more efficient animals; that boars from such inbred lines have superior value for out crossing and cross breeding; that there was a direct relationship between the weight of a pig at weaning and later feed-lot performance as measured by rate and economy of gains; that heavy weaning weights were influenced by prolificacy and suckling ability of sows and that these measures of efficiency in brood sows were inherited since gilts from high producing dams made better sows than did gilts from poorer producers. (E. A. Trowbridge, L. A. Weaver, J. E. Comfort, Ralph Bogart.)



Measuring energy metabolism of mules pulling a mower.

Energy Metabolism, Work Capacities, and Related Factors Involved in Muscular Work in Horses and Mules. Before this project could be started actively, considerable amounts of preliminary work were necessary. Special apparatus had to be built and tested. This consisted of an open-circuit metabolism apparatus embodying a mask

connected through a valve to a constant-pressure expansion chamber and through a motor-blower to a gas meter. An aliquoting apparatus furnished representative



Inside view of experimental car showing open circuit apparatus for measuring metabolism of working horses and mules.

sample of the exhaled air for analysis. A car has been modified so that speeds of one to three miles per hour can be maintained during trials. The metabolism apparatus occupies most of the space back of the driver's seat. A specially designed tractive pull regulating apparatus has been mounted on a trailer. The metabolism can be measured while the animal is pulling a farm implement in the field. A dynamometer measures the tractive force exerted by the animal.

The usual test (Schneider test) for work capacity (or really for cardio-respiratory capacity) for man cannot be used for other species. Under this project a new test for cardio-respiratory capacity (called muscular-work capacity) has been developed. It is applicable to all species of animals, especially for horses and mules, and may be used as a yardstick for selecting animals in breeding operations. The versatility of this index is indicated by the fact that an aviation physiology laboratory is investigating it as a test for aviators. This project is in cooperation with the Bureau of Animal Industry, U. S. D. A. (E. A. Trowbridge, S. Brody, H. H. Kibler, J. B. Sappington, H. Alderson, T. Freeman, B. E. Rice.)

Forage Crops for Swine. L. A. Weaver and Ralph Bogart have compared the amount of feed and time required to fatten hogs on pasture and dry lot. In 1942 pigs self fed on pasture weighed 205 pounds when 180 days of age as compared with 195 pounds for those fed in dry lot. A total of 377 pounds of feed was consumed for each 100 pounds of gain by the pigs in dry lot as compared to 353 pounds for the pigs on pasture. With feed at 1½ cents per pound the saving in grain due to pasture would amount to more than $50 per car load of hogs marketed.

In 1943, 50 pigs were full fed a ration of 20 parts ground wheat supplemented with a mixture of equal parts of tankage and soybean oil meal. A similar number were fed one-half as much of the same ration as the full fed pigs until near the close of the feeding period when they too were put on a full feed. All lots were on pasture and were self-fed a mineral mixture of equal parts ground limestone, bone meal, and salt.

The full fed pigs made an average daily gain of 1.39 pounds as compared with 1.18 pounds for those fed the limited grain ration. When the amount of concentrate was limited, 330 pounds of feed were re-

quired to produce 100 pounds gain as compared with 361 pounds for the full fed lot. The full fed pigs reached a marketable weight (225 pounds) in 130 days while those fed the limited ration required 150 days to reach the same weight. Even though the two lots had the same final weight, some of the limited fed pigs lacked market finish at the end of the feeding period.

The amount of grain required to make a hog marketable can be reduced by limiting the amount fed on pasture during the first part of the grazing season provided full feeding is started in time to get the pig marketed before the end of the grazing period thus avoiding winter feeding in dry lot. Since more time (and more pasture) is required when limited feeding is practiced, the price at time of marketing may be influenced by the manner of feeding unless adjustment is made in farrowing dates to take care of the longer period required for fattening.

Supplements to Corn for Fattening Hogs. In Missouri corn usually furnishes the energy producing nutrients required for pork production. Pastures or green leafy legume hay supply the necessary vitamins and a simple mineral mixture self-fed adequately and economically furnishes minerals which may otherwise be lacking. The primary hog feeding problem in this State is therefore one of providing efficient and economical protein supplements.

L. A. Weaver has worked on two phases of this problem, namely, the kind of supplement to use and the method of feeding. Ten lots of ten pigs each farrowed in September 1941, were placed on a 94-day feeding trial at an average weight of 58 pounds. All lots were fed on concrete floors. In addition to corn, each lot received a protein supplement or mixture as shown in the following list.

Lots	Supplement	
I & VI		
Shorts	500	lbs.
Hominy feed	300	"
Blackstrap molasses	260	"
Tankage	250	"
Cottonseed meal	50	"
Linseed meal	50	"
Dried buttermilk	50	"
Gluten meal	50	"
Alfalfa meal	50	"
Approximate Protein Content of Supplement	23.0%	
II & VII		
Shorts	500	lbs.
Tankage	250	"
Linseed oil meal	125	"
Cottonseed meal	125	"
	33.5%	
III & VIII		
Shorts	125	lbs.
Tankage	250	"
Linseed oil meal	100	"
Cottonseed meal	125	"
	43.2%	
IV & IX		
Tankage	400	lbs.
Linseed oil meal	100	"
Cottonseed meal	100	"
	53.1%	
V & X		
Tankage	xxx	lbs.
	60.0%	

For lots I, II, III, IV, and V the various protein supplements were mixed with ground corn (No. 2 yellow) in definite proportions before being placed in self feeders so that the ration fed each lot would contain approximately 14 per cent protein.

Lots VI, VII, VIII, IX, and X received the same rations as Lots I,

II, III, IV, and V respectively but the ground corn and supplement were self-fed each lot free choice. That is, the pigs were allowed to choose between corn and supplement, and thus balance their ration with respect to proportion of corn and supplement consumed. All hogs on trial had access to a mineral mixture of equal parts finely ground limestone, bone meal, and salt.

The results showed that in this test there was little difference in either rate of gain or amounts of feed required to produce 100 pounds gain due to difference in protein supplement.

In general, the cost per pound of protein was less in the simple than in the complex mixtures, so that even with the same amount of feed consumed for each 100 pounds gain, production costs were lower when the more simple mixtures were used. This would be especially true when corn is cheaper than protein feeds since the more complicated the protein mixture the smaller the percentage of protein contained therein and hence the larger the amount of supplement needed to balance a given amount of corn. For example, when the 23 per cent protein supplement was used only about 2 pounds of corn were fed with each pound of supplement while with the 60 per cent supplement almost 10 pounds of corn were fed per pound of supplement.

While there was little difference in amount of feed consumed resulting from kind of supplement there was a significant difference due to manner of feeding it.

Without exception the lots of hogs which were allowed to choose between corn and supplement ate more total feed and gained more rapidly than the comparable lot which had the corn and supplement mixed so that the ration contained approximately 14 per cent protein. In every case also the proportion of supplement consumed to corn was greater when the hogs were self-fed free choice. There was little difference, however, in amount of feed consumed per 100 pounds gain, due to manner of feeding.

Vegetable Proteins as Supplements to Corn for Fattening Hogs. Because of the marked shortage of animal protein, L. A. Weaver has used various combinations of vegetable proteins to determine their adaptability as supplements to corn for fattening hogs. Six lots of pigs averaging about 50 pounds in weight were fed for a period of 112 days in dry lot. Shelled corn and supplement were self fed, free choice, to all lots. When more than one feed was used in a particular supplement, the protein feeds were mixed in definite proportions before being put in a feeder. A mineral mixture of equal parts finely ground limestone, bone meal, and salt was self fed all lots except Lot IV.

There was no significant difference in either rate of gain or total feed required per 100 pounds gain for Lots I and VI. These two lots gave the best results of all the tests. Lot VI, consumed slightly less corn but 40 per cent more supplement than Lot I. There was practically no difference in the performance of Lots II, III, and V. Results here did not agree too closely with previous trials, where under similar conditions a small amount

of tankage has usually resulted in more rapid gains and a decrease in amount of supplement required per unit gain.

When no mineral and no animal protein were fed as with Lot IV gains were less rapid and slightly more total feed and significantly more protein supplement were consumed which emphasized the necessity of supplying additional mineral when soybean oil meal was the primary source of protein.

In general, the higher the percentage of protein in the supplement the smaller the amount of supplement consumed with a given amount of corn. When self-fed free choice, all lots consumed more supplement than should have been required according to Morrison's feeding standard.

The results in these trials indicated that maximum returns from limited supplies of proteins of animal origin may be secured by limiting the amount used to 25 per cent of the total protein furnished by the supplement using vegetable proteins for the balance. For example, a ration of 3 parts soybean oil meal with 1 part tankage and a simple mineral mixture self fed should give satisfactory results.

Protein supplement may be saved by hand feeding or by mixing it with the entire ration before feeding rather than self feeding free choice.

When purchasing protein supplements select those containing relatively high percentages of protein such as oil meals, tankage, etc., since usually the higher the percentage of protein the lower the cost of protein per pound and the smaller the amount needed to balance home grown grains.

Until the pigs reached a weight of 125 pounds the supplements fed were as follows:

Lot I	
Tankage	50%
Soybean oil meal	25%
Alfalfa meal	25%
Approximate Percentage of Protein in Supplement	45%
Lot II	
Tankage	25%
Soybean oil meal	50%
Alfalfa meal	25%
	40%
Lot III	
Soybean oil meal	75%
Alfalfa meal	25%
	35%
Lot IV	
Soybean oil meal	75%
Alfalfa meal	25%
	35%
Lot V	
Soybean oil meal	25%
Linseed oil meal	25%
Cottonseed meal	25%
Alfalfa meal	25%
	35%
Lot VI	
Shorts	25%
Tankage	12½%
Soybean oil meal	12½%
Linseed oil meal	12½%
Cottonseed meal	12½%
Alfalfa meal	25%
	30%

After the hogs reached a weight of 125 pounds the alfalfa meal was discontinued in all rations.

Lespedeza Seed as a Protein Supplement for Lambs. In the winters of 1941 and 1942 ground lespedeza seed was compared with cottonseed cake as a protein supplement for fattening lambs. Two lots of 10 each were fed each winter. The ration consisted of shelled corn 10 parts, protein supplement 1 part, and alfalfa hay.

In the first season the lambs getting the lespedeza seed made a slightly better gain while the opposite was true in the second season. When the two seasons' work were averaged the daily gain on the lambs getting lespedeza seed was .43 pounds and the lambs getting the cottonseed cake .41 pounds. The total feed consumed, the average daily ration, and the feed required per 100 pounds gain were practically the same for each protein supplement.

E. A. Trowbridge and A. J. Dyer believe that the ground lespedeza seed may be used satisfactorily as a protein supplement for fattening lambs but present high price of the seed prohibits its use.

The Maximum Use of Roughage for the Production of Beef. For a number of years this Station has been conducting trials on producing beef with a maximum use of roughage and a minimum use of grain. In the present emergency with maximum production the goal and grain limited in quantity, the extensive use of pasture and roughage tends to make fullest use of our resources, uses some land not otherwise useful in the production effort, and lessens the grain requirements in beef production.

A herd of 96 yearling steers was grazed through the summer of 1941 on wheat, lespedeza, and bluegrass pastures. The wheat had been seeded in the fall on lespedeza stubble. As the wheat was grazed in the spring volunteer lespedeza followed and was pastured until October 15. These steers had been wintered on good roughage, including legume hay and good silage and gained 225 to 286 pounds per head during the following grazing season on the wheat-lespedeza pasture. Slightly more than one acre of this pasture per steer was required. These same cattle were put on a pasture of bluegrass and other grasses on October 15 and showed some loss in weight for the remainder of the season.

Cattle which had one pound of cottonseed meal daily in addition to the roughage ration during the previous winter gained less rapidly on pasture than the steers which had no cottonseed meal.

In the winter of 1941-42, the steers were again wintered on legume hay and silage. In the spring of 1942, 16 of the steers were grazed on small grain-lespedeza pasture from May 11 to July 7 and gained an average of 60 pounds per head. They were then put on full feed, one-half of them in dry lot and one-half on pasture, and full fed 56 days. During the full feeding period they consumed slightly less than 15 bushels of corn and less than 100 pounds of soybean oil cake. The steers on pasture each consumed 2 bushels less of corn than the cattle in dry lot and both lots graded "Middle Good" in the carcass.

Another 16 head of the steers were grazed until September 1 and then were full fed for 35 days, one-half in dry lot and one-half on pasture. They consumed somewhat less than 10 bushels of corn and less than 50 pounds of supplement each and graded "Middle Good" in the carcass.

The remaining cattle were grazed through the summer, fed for a short

period until they graded "Good," and marketed. Each steer weighed more than 1,100 pounds when marketed. (E. A. Trowbridge, A. J. Dyer, J. E. Comfort.)

Ground Lespedeza Seed as a Protein Supplement for Fattening Cattle. Two lots of cattle which had been wintered on corn silage and alfalfa hay and pastured on good pasture through the following summer were put on full feed in dry lot on December 29, 1941. The ration for one lot consisted of shelled corn 10 parts, soybean pellets 1 part, and alfalfa hay and corn silage. In the other lot, ground lespedeza seed was substituted for the soybean pellets.

During the 105-day feeding period the steers receiving lespedeza seed gained .43 pounds less daily than those getting the soybean oil meal but they did make a very creditable gain, namely, 2.34 pounds daily. They ate somewhat less corn and were not quite as fat when marketed as the cattle that received the soybean oil meal. Difficulty was experienced grinding the lespedeza seed and some of it was not ground. Indications were that more complete crushing of the seeds would apparently increase its efficiency. (E. A. Trowbridge, J. E. Comfort, A. J. Dyer.)

Wintering Yearling Steers on Various Kinds of Silage. In the winter of 1941 corn silage, atlas sorgo, green barley, and a mixture of legume crops were compared as silages when fed with alfalfa hay to 72 head of yearling steers. The corn silage was made from Missouri No. 8 hybrid corn. The estimated yield of corn was 45 bushels per acre and it produced 8½ to 9 tons of silage per acre. The corn plant was fairly dry when ensiled and water was added. The atlas sorgo was cut when the grain was nearly ripe. The first was ensiled October 20. Then fall rains interrupted silo filling and the last sorgo was put in the silo on November 13 after a part of it had been frozen in the field. It yielded 15 tons per acre. Legume silage was made from a mixture of alfalfa, sweet clover, and red clover which had been grazed by sows and their spring litters. It was put into the silo during the last week of May. The sweet clover was in full bloom, one-half of the red clover blossoms were brown, and the alfalfa was in bloom. Seventy-eight pounds of blackstrap molasses were added to each ton of cut silage as it was blown into the silo. Fresh field samples of the legumes contained 79 per cent moisture. It remained in the swath for 4 hours before ensiling and then contained between 55 and 65 per cent moisture. Small grain was ensiled May 22 and 23. The silo was filled 75 per cent with barley and 25 per cent with a mixture of oats and rape. The barley was fairly mature and the oats were in the dough stage. All small grain was cut with a binder. About 45 pounds of blackstrap molasses were added to each ton of silage. The legume, sorgo, and small grain silages were about average in composition and the corn silage better than average. A mineral mixture of equal parts of ground limestone, bonemeal, and salt was fed.

Four uniform lots of Good to Choice yearlings were used. They were purchased when calves, win-

tered on silage and hay, and grazed one summer before this feeding test began. A 126-day feeding period was used.

Corn silage produced not only the most rapid but also the most economical gain. The cattle receiving it were much fleshier at the end of the winter period than those fed other silages. Had dry lot fattening been practised these cattle would have had quite an advantage over the others for their gains had been made more cheaply through the winter and in addition a much shorter grain feeding period would have been required.

Legume silage and sorgo silage gave similar results. However, legume silage had a slight advantage in rate of gain and economy of gain.

Barley silage produced the lowest rate of gain and the least economical gains even though daily consumption of this silage was greater than for any of the others tested. (E. A. Trowbridge, A. J. Dyer.)

The Physiology of Reproduction in Farm Animals. Data have been accumulated on semen of various farm animals under diverse environmental conditions which included a study of such physical characteristics as pH; osmotic pressure and buffer capacity; the morphology of the sperm cell; and studies of variations in motility, concentration, and survival time. In the study of boar semen it was found that estrogens were present but androgens were absent. Starch increased the survival time of boar spermatozoa under storage conditions more than any other substance tried.

In an effort to develop a pregnancy test for cattle it was found that none of the estrogens were excreted in the urine of cattle early enough in pregnancy to base a test either upon total estrogens or any of them individually.

Undiluted bull semen was found to be sensitive to the rate of cooling. Yolk-phosphate diluter protected sperm from the detrimental effects of rapid cooling and of storage temperatures other than the 5° C. at which maximum sperm survival occurred.

Six 3-year old Rambouillet rams were divided into two lots of 3 each. One lot was fed lespedeza hay grown on untreated soil low in calcium and phosphorus while the other lot was fed lespedeza hay grown on similar soil which had been treated with lime and phosphate. Under the conditions of this experiment no significant difference in the characteristics of the semen of the two lots of rams was observed which would be attributed solely to the differences in the hays fed.

Twenty-one boars were used in studying epididymal sperm. The sperm were secured by castrating the animal and forcing the sperm from the epididymis by injecting a suitable diluter into the tubule. These sperm were much more resistant to a cold temperature shock and survived for longer periods during storage than sperm in the ejaculated semen of the same male. Dilution of the epididymal sperm with accessory secretions gave no decrease in resistance or survival during storage. Neither did dilution with a phosphate buffer to as much as 32:1 have any effect on the

resistance of the sperm. The addition of epididymal secretions to normally ejaculated sperm did not have any significant effect on the resistance of the sperm. The most important factor in lowering resistance and storage time of the sperm in the normal ejaculate seemed to be an aging effect.

A staining method for the differentiation of dead and live spermatozoa was applied to the study of bull semen storage. It was found that the addition of egg-yolk buffer to the semen increased the resistance of the sperm to a cold shock by 400 per cent and their survival time during storage by 600 per cent or more. Spermatozoa with greater resistance also survived for greater periods of time during storage. The resistance of the spermatozoa in egg-yolk buffer possibly may be used as a criterion for predicting the storing ability of a semen before it is stored for future use in artificial insemination. The possibility also exists that the more highly resistant sperm are more capable of fertilizing the egg so that the resistance of the sperm may be a measure of fertilizing capacity.

A chemical test for pregnancy has been developed for the sow based upon the increased urinary excretion of estrogens during pregnancy. Pregnancy can be accurately diagnosed from the 21st to 32nd day of gestation and from the 72nd day of pregnancy until farrowing.

It has been found that sperm concentration definitely affects the respiration rate of mammalian sperm. It was also found that an optimum concentration exists above and below which changes in the hydrogen-ion concentration affect respiration rate. (F. F. McKenzie, C. F. Winchester, D. T. Mayer, Ralph Bogart, B. H. Moore, J. F. Lasley, S. Y. Roth, G. T. Easley.)

Black Fibers, Dwarfism, and Turned-in Eyelids in Sheep. Black tipped fibers may appear in black faced breeds of sheep following illness or any physiological disturbance which causes a "break" in the fleece but the number of true black fibers in the fleece is not altered by changing the environment or physiological condition of the sheep.

Dwarfism, a simple recessive lethal in sheep, apparently is due to an abnormal thyroid which in turn may be the result of an abnormal pituitary. Feeding and injecting thyroxin to dwarf lambs has prolonged their lives but none has reached breeding age. Selective breeding may be used to eliminate this abnormality from the sheep flock.

Lambs with turned-in eyelids make less than half the growth of normal lambs and the time required for sewing the eyelids open and treating the eyes is considerable. The incidence is much greater in some flocks than in others. Records have demonstrated that the abnormality is conditioned by inheritance but the exact mode of inheritance has not been determined. (Ralph Bogart, Albert Dyer.)

Abnormalities in Swine. The bleeder abnormality though not common in swine herds is economically important causing losses during parturition and castration. Tests for distinguishing the bleeder hogs from normal have been de-

veloped and the age when such tests are accurate has been established at 3 months. Genetic studies have demonstrated that a selection program to eliminate the gene causing the bleeder condition would be the same as that used in eliminating any other simple recessive.

More than one pair of genes are involved in the age of first expression and severity of the bleeder condition. Although the most severe bleeders usually show bleeding tendencies at an early age, two pigs showing the tendency at the same age may later differ greatly in the severity of the affliction. The environment has little influence on the first expression and severity of the bleeder condition except that both depend on the development as well as on the age of the animal.

Inverted nipples and mastitis in sows cause great losses of suckling pigs. Since studies indicated that these abnormalities have a genetic basis, it is important that the condition of the udder be considered in brood sow selection. (Ralph Bogart.)

BOTANY

C. M. TUCKER, *Chairman*

Development of a Variety of Tomato Resistant to Fusarium Wilt. For a number of years hybrids involving *Lycopersicon pimpinellifolium*, a wild tomato which is highly resistant to Fusarium Wilt, have been produced and improved by C. M. Tucker. More recently, James M. Crall and R. A. Schroeder have helped in this work. Definite progress has been made and in the near future new tomato varieties highly resistant to wilt should be available for description and distribution.

In 1941 nine acres of tomato hybrids containing a factor or factors from *Lycopersicon pimpinellifolium* were grown. Most of the hybrids were third to sixth backcrosses, followed by one to five self-pollinated generations. Numerous lines have been again backcrossed with desirable commercial varieties, particularly Early Stone, Indiana Baltimore, Rutgers, and Landreth. Approximately 300 individual plants have been selected for desirability of fruit and plant characters. Yield records have been obtained and cuttings made from selected plants for growth in the greenhouse for selfing and crossing. All tests for resistance to wilt have been made by planting seeds in steamed soil infested with virulent isolates of *Fusarium lycopersici*, the tomato wilt disease. At transplanting a suspension of spores and hyphae was poured around the roots of each plant. The commercial varieties used as controls were completely susceptible. The study has indicated that resistance is dependent upon a single, dominant genetic factor.

The segregation in selfed progenies of heteroxygous plants consistently has shown an excess of resistant plants above the number expected on the basis of the monogenic inheritance. For two years there was an identical percentage, 7.7 per cent, of wilting plants. Individual progenies varied considerably in percentage of susceptible plants. This suggested that en-

vironmental conditions during pollination may have affected fertilization by microgametes carrying specific factors. A study of 1,177 plants from field open pollinated seeds from thirty-five heterozygous plants showed 10.5 per cent were susceptible. Self-pollination of the same thirty-five parent plants in the greenhouse yielded 875 plants of which 11.7 per cent were susceptible. Apparently, therefore, the environmental conditions prevailing during pollination caused no significant differences.

Occasionally wilting has been observed in August in heterozygous progenies. Since homozygous susceptible plants usually wilted in June, the behavior of progenies from late wilting plants was studied. There were indications that the dominance of the resistance factor was not complete and that there may be a decrease in the potency of the resistance mechanism in mature plants.

Additional studies showed that crossed varieties used as the pollen parent in backcrosses exerted no significant effect on the segregation of resistant and susceptible plants in the backcross generations.

A highly virulent strain of tomato wilt from an Ohio greenhouse has caused some wilting of *Lycopersicon pimpinellifolium* and of hybrids which had been considered homozygous for resistance to strains of the fungus commonly encountered.

In 1942, 40 hybrid lines were grown in a yield test and compared with 2 commercial varieties, Rutgers and Pan America. A total of 50 plants in each line in 5 replications of 10 plants each were grown in a field where wilt was not a major problem. Five hybrid lines exceeded the variety Rutgers in total yield of marketable fruit, and 33 of the 40 lines tested yielded more than Pan America. Twenty-two lines equalled or surpassed Rutgers in average fruit size and 14 equalled or excelled this variety in ratio of weight of marketable fruit to culls. The season was very favorable to the development of diseases, and the hybrid lines varied widely in resistance.

In 6 acres of breeding plots 300 individual plant selections were made and records were kept on the yield and quality of fruit on each plant.

The Mechanism Producing Resistance to Tomato Wilt and Its Inheritance in Tomato Hybrids. In an effort to determine the causes of immunity to tomato wilt and how they may be inherited in tomato hybrids, C. M. Tucker and J. M. Crall have been studying the fungus *Fusarium lycopersici* which causes the tomato wilt disease. A quantitative determination of the virulence of isolates of *Fusarium lycopersici* to Bonny Best tomatoes has been made to select those which have high virulence so that they may be used for experimental work.

Tests have been made on the hydrogen-ion concentration and osmotic concentration of the sap of resistant and susceptible varieties. Also, studies have been made on the toxicity of extracts of the mycelium of *F. lycopersici* to cuttings. These tests were made on cuttings of Bonny Best and Marglobe varieties of *Lycopersicon esculentum* and compared with similar tests made on a

strain of *L. pimpinellifolium* which has been very resistant to this wilt. No significant differences were observed in the hydrogen-ion concentration. The osmotic concentration of the sap of *L. pimpinellifolium* was significantly greater than that of Bonny Best and Indiana Baltimore. Tests of toxicity of fungus extracts to cuttings made at room temperature gave less consistent results than tests at 0° C. Probably this was due to the effect of bacterial action at the higher temperatures.

Mycelial extracts heated at 50 and 55° C. for one hour caused wilting of cuttings of Bonny Best and Marglobe, but not of *L. pimpinellifolium*. Other tests showed similar differential toxicity and the behavior of the toxic substances indicated that they were colloidal in character. They were removed by filtration through a Berkefeld V filter and by precipitation with acid. Dialysis of the extract also resulted in loss of toxicity. Autoclaving increased the toxicity.

In 1942 comparative tests of the pathogenicity of the tomato wilt fungus isolated in Ohio with that of other highly virulent strains were made. The Ohio strain differed qualitatively in pathogenicity from strains previously studied. It proved highly virulent to some tomato lines which were entirely resistant to the usual forms. *Lycopersicon pimpinellifolium*, highly resistant to the common strains, proved somewhat susceptible to the Ohio strain. The tests of parental and hybrid material indicated that the factor governing resistance to the usual strains was not sufficiently potent to confer resistance to the Ohio strains, but that the presence of this primary resistance factor, together with an undetermined number of accessory or complementary factors results in a satisfactory type of resistance.

Investigations on the Genus Phytophthora. This project has been in cooperation with the California Agricultural Experiment Station and the Oregon Agricultural Experiment Station. At the Missouri Station in 1941, C. M. Tucker obtained new isolates from calla, snapdragon, *Aucuba japonica*, salvia, *Erica melanthera*, Transvaal daisy, squash, bean, and Feijoa from California; from *Cucurcita maxima*, potato, and tomato from Argentina; from Contoneaster, Aucuba, and maple from Oregon; and from tomato from New Zealand.

A root rot of pepper and pumpkin was found to be caused by *Phytophthora capsici*. All varieties of pepper and pumpkin tested were susceptible.

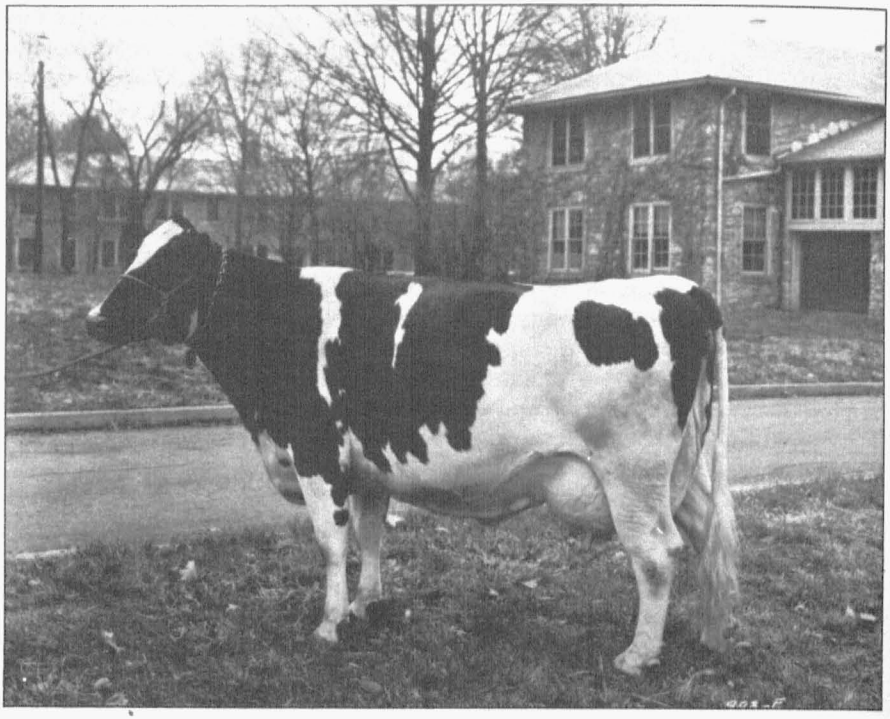
A root rot of Chamaecyparis was caused by *Phytophthora lateralis*, which was described as a new species. There was considerable variation in resistance to infection among the species and varieties of Chamaecyparis.

The identification of these parasites permitted recommendation of control measures based on the knowledge of the environmental requirements of the fungi and varietal resistance.

In 1942 twenty-two cultures of the genera Phytophthora and Pythium were received for identification. The cultures identified included *Phytophthorn cactorum* for apple (Canada); from loquat (New

York); and from *Fragaria Vesca* (California); *P. Capsici* from pepper (Texas); *P. palmivora* from Citrus (Argentina); *P. megasperma* from almond, apricot, peach and raspberry (Calif.) and holly (Oregon).

In cooperation with the California Station a study was made of a disease of Gloxinia caused by *Phytophthora cryptogea.*



U-Mo-Vesper M-O-W Zierc Ella 2064973 classified "Excellent." Produced 15,185 lbs. milk and 556.5 lbs. fat in 325 days. Age 2 yrs. Probably the best individual cow ever owned by the University. and 3 mo.

DAIRY HUSBANDRY

A. C. RAGSDALE, *Chairman*

Thyroprotein. In 1941 a method of producing artificial thyroprotein possessing all the properties of thyroid substance was developed. It was produced by chemically combining the protein of milk with iodine. In further work it was found that critical factors in the formation of thyroprotein were the degree of iodination of the casein, the pH of the reaction medium, and the temperature at which the iodination and incubation processes were carried out.

Thyroprotein contains at least four times the thyroidal activity of dessicated thyroid. Crystalline thyroxine has been recovered by hydro-

lysis of thyroprotein. When hydrolyzed with sulfuric acid, l-thyroxine, which is twice as active metabolically as the racemic form, was isolated.

A number of methods for measuring the thyroidal activity of iodinated proteins have been developed. Thyroidal activity may be determined quantitatively by administering the test substance to guinea pigs and noting the percentage increase in oxygen consumption.

Another simple, rapid, and inexpensive method based on the effect such substances produce in stimulating the metamorphosis of tadpoles has been developed. A microinjection apparatus with which volumes of liquid ranging in amounts from 0.005 to 0.2 ml. can be injected. The percentage decrease in body length of tadpoles due to stimulation with thyroidal substances increases as the logarithm of the dose. Apparently the tadpole assay technique is highly specific for thyroidal materials.

Thyroprotein fed to cows in declining lactation at the rate of 50 to 100 grams daily increased both milk yield and fat percentage. In order to determine whether or not these favorable effects could be extended throughout the lactation period, four cows in the Experiment Station herd were placed on continuous thyroprotein feeding at the rate of 60 to 100 grams per cow daily. Four cows at a similar stage of lactation were selected as controls. During the first month, the milk yield of all the tested cows remained at their initial level or above and there was an increase in fat test in 3 of the 4 cows, ranging from 25 to 46 per cent. After 12 weeks on experiment, 2 of the cows were still 9 per cent and 23 per cent above their initial level in butterfat yield, and the other 2 had declined to somewhat below their original production. The 4 control cows had declined to 75 to 90 per cent of their initial production at the end of the first 12 weeks.

Virgin female mice weighing 13-16 grams were given thyroxin injections subcutaneously in doses ranging from 0.015 to 0.04 mg. daily. These mice consistently grew at a more rapid rate than controls for a period of 4 to 6 weeks. An average difference of 1.5 gm. between body weights of control and treated mice was reached in 5 weeks, after which time the difference gradually became less. The daily feed intake on one series of thyroxin injected mice was increased about 25 per cent above that of controls.

Thyroxin treated mice stored more nitrogen and gained more in body weight per unit of feed intake than did controls for the first few weeks of treatment. After the rapid gains of the treated animals had subsided, the controls were more efficient in this respect than treated animals. Non-treated animals stored more fat and more energy per unit of feed intake than did the thyroxin injected animals. Feeding synthetic thyroprotein in the proper amounts increased growth in a manner similar to the injected thyroxin.

Thyroprotein is very effective in hypothyroidism. At proper feeding levels, the stimulation of egg production in older hens has been

noted. When fed to chicks, feathering has been hastened and a slight improvement in rate of growth made. (C. W. Turner, E. P. Reineke, Victor Hurst, Marvin Koger, M. B. Williamson.)

Some Factors Which Influence the Texture and Structure of Ice Cream. In studying the influence of drawing temperature, variable increments of sucrose and dextrose, mix compositions, and different types of freezers on the texture and structure of ice cream, W. H. E. Reid and C. W. Decker found that as the drawing temperature was decreased from 24 degrees Fahrenheit to 22 degrees the size of the ice crystals decreased markedly. This resulted in an ice cream with a smoother and finer texture and structure.

A 33⅓ per cent replacement of sucrose (the standard mix contained 15 per cent sucrose) with dextrose gave a smaller ice crystal and a better structure than a 25 per cent replacement. An increase in the serum solids content from 11 per cent to 13 per cent did not have as important an effect on the ice crystal size as did an increase of butterfat from 12 per cent to 14 per cent. The increase in butterfat resulted in a finer ice crystal and a smoother texture in the ice cream.

The influence of variations in composition upon the meltdown properties of the ice cream was quite apparent. An increase in the increments of butterfat, serum solids, and gelatin seemed to cause the ice creams to become more stable and retarded melting. Increased homogenizing pressures caused the ice creams to be more stable. High butterfat and serum solids ice creams gave some evidence of being somewhat spongy and flaky with slight whey expulsion. The variations in drawing temperatures did not have any visible influence upon the meltdown appearance of the ice creams.

Sources of Oospora Lactis on Dairy Farms. Sources of oospora lactis and other molds on 60 dairy farms in the vicinity of Columbia producing sour cream was studied by E. R. Garrison. It was found that the percentages of different dairy utensils that contained detectable numbers of oospora lactis were as follows: milk and cream pails 77 per cent, strainers 64 per cent, and separator parts 67 per cent. Molds other than oospora lactis were found on all pieces of dairy utensils examined and usually exceeded oospora lactis in numbers. Pieces of milk equipment that had not been well cleaned usually contained larger numbers of oospora lactis than equipment that was well washed and dried.

Oospora lactis was found in 48 per cent of the cistern water samples examined while other molds were found in 97 per cent of the samples. The above organism was not detected in the samples of grain, hay, and manure examined but occasionally it was found in samples of barnyard soil. Agar plates exposed in the milking barns and cream storage basements contained oospora lactis in only one instance while other molds were always quite numerous on the plates.

In studies of acidity and temperature on the growth of oospora lactis cultures it was found that none

of the oospora lactis cultures grew at the usual dairy refrigeration temperature of 40° F, but as the temperature was raised from 40° to 90° F. growth increased and then decreased at 100° F. showing that the optimum temperature for these cultures is at or near 90° F.

Growth of oospora lactis was scanty at pH 9.0 and somewhat retarded at pH 8.0, while it was essentially the same at pH 7.0, 6.0 and 5.0; growth was considerably reduced at pH 4.0, scanty at pH 3.0 and negative at pH 2.5.

Mold Mycelia in Cream and Butter. An extensive study has been made of the factors conducive to the development of mold mycelia in cream and the resultant butter by W. H. E. Reid and J. E. Edmondson. They found that storage temperature exerted a great influence on the amount of mold mycelia present since the mold multiplied rapidly at higher temperatures due to its ability to tolerate acid. This factor may be overcome by delivering the cream to a processing plant within 4 days after it is produced. A definite correlation was found between the rate of mold growth and the percentage of butterfat, the mold growth diminishing as the butterfat content of the cream increased.

In cream samples from containers in which the cream was stirred upon the addition of fresh cream it was found that mold growth was more apparent than in samples that had not been stirred but the finished butter from the nonstirred samples had the highest mold count. Cream that had been kept covered had a lower mold count but when the containers were sealed stale, musty, and absorbed flavors developed and were transmitted to the resultant butter. Layered samples of cream gave a much lower mold count in the cream and resultant butter. This may be due to the control of the air supply which is required by the mold.

Cream samples delivered to four cream buying stations in Columbia showed a seasonal range in the amount of mold mycelia in cream since 9.6 per cent of all cream samples delivered in February contained a doubtful or excessive amount of mold mycelia as compared to 43.7 per cent during July. The percentage of samples containing a doubtful or excessive amount of mold mycelia varied with the age of the cream as follows: 1-4 days, 14.7 per cent; 5-7 days, 26.6 per cent; and over 7 days, 44.0 per cent.

Many samples of producers cream delivered at cream stations contained few or no mold by the plate method but gave a doubtful or excessive methylene blue borax test for mold mycelia. This indicated that factors other than the mold content of cream influenced the MBB test for mold mycelia. Udder infection and late lactation were factors that cause a false-positive test for mold mycelia in gravity cream. The MBB tests on the gravity cream obtained from the milk of 123 cows were distributed as follows: good, 44.7 per cent; fair, 26.8 per cent; doubtful, 16.8 per cent; and excessive, 12.2 per cent. Cream obtained by centrifugal separation of the milk from these cows always gave a negative MBB test. Producers who deliver cream obtained

by the gravity skimming of milk may be penalized if the cream is graded by the mold mycelia test because of a false positive MBB test caused by udder infection or late lactation of the cows concerned while producers that use a centrifugal milk separator escape this penalty.

This false-positive test for mold mycelia on gravity cream can be largely eliminated if the test is conducted at a temperature of 195-200° F. instead of at the specified temperature of 180° F. Since this higher temperature does not affect the amount of sediment obtained by the MBB test on centrifugal separated cream samples due to the actual presence of molds, it is recommended that a minimum temperature of 195° F. be adopted for conducting the MBB test at cream stations.

Dairy farmers are benefited economically by controlling mold mycelia in cream since cream free of mold mycelia will grade higher and will consequently bring a higher price. Cream should not be held longer than four days.

Artificial Insemination of Dairy Cows. The efficiency of artificial breeding of dairy cows using fresh to 24 hour old semen stored at 40° F. continues to compare favorably with natural breeding, averaging 1.7 to 1.8 services per calf.

A detailed examination has been made of the variations in properties of 256 samples of semen, representing consecutive collections over a period of several months from ten bulls in the Experiment Station herd.

The fertility of dairy bull semen was found to be correlated with initial motility and ability of the sperm to survive under storage conditions. Abnormal spermatozoa (to levels of 28 per cent abnormal) and concentrations between 200,000 and 2,000,000 per cubic millimeter were indices of settling ability. Season was found to exert only a slight effect on physical and chemical characters of the semen.

The single property of the semen which was most nearly correlated with fertility was the time of survival with vigorous motility in semen stored at 40° F. Among separate samples from the same bull, initial motility was roughly correlated with viability in storage.

If the fertility of a bull is to be rated from the semen picture, it should be based on at least five consecutive samples collected over a period of two weeks. If a single criterion must be used and based on a single sample, the motility of the fresh semen provided a rough index as to fitness for use or storage. Semen samples of good motility average about 75-80 per cent living sperm.

The egg-yolk-buffer dilutor was found superior to glucose, Milovanov's SGC, and saline solutions. Good quality semen has been found to survive longer when stored undiluted than when diluted with any of the diluents tried.

The respiration rate of spermatozoa has been found to be correlated with the quality of bull semen. Preliminary observations on the effect of centrifuging indicated that a considerable number of spermatozoa was killed, while the respiration rate of those remaining alive

was unaffected. The respiration rate of spermatozoa suspended in a phosphate buffer medium was stimulated appreciably by addition of seminal fluid. (A. C. Ragsdale, H. A. Herman, E. R. Berousek, E. W. Swanson, Ray Ely, C. F. Winchester.)

The Mechanism of Milk Secretion. It is an established fact that the lactogenic hormone of the anterior pituitary stimulates the lactation process in the mammary gland. A further study of the mechanism of milk secretion has involved the tracing of the level of lactogen in the pituitary in the absence and presence of lactation and during postpartum in the presence and absence of the nursing stimuli. Tests were made on the influence of stilbestrol on the lactogen content of the pituitary. It was found that the secretion of lactogen by the pituitary was increased by the estrogens and stilbestrol.

During pregnancy in the absence of lactation the lactogen content of the pituitary was low and when animals were lactating and pregnant the content was high. During pregnancy in the absence of lactation the progesterone secreted overrode the effect of estrogen while at parturition estrogen overrode the progesterone, stimulated an increased secretion of lactogen, and initiated lactation. The stimulus of nursing or milking maintained the secretion of lactogen since the absence of this stimulus caused the lactogen secretion to decline rapidly and soon stopped milk secretion.

As an aid in this work, a rather simple method of extracting the lactogenic hormone from the pituitary in a high state of purity was developed. (C. W. Turner, A. J. Bergman, Victor Hurst, Joseph Meites.)

The Parathyroid Gland and Calcium Metabolism. Parathyroid glands from a large number of rabbits, rats, and goats, have been weighed and a study made to show the influence of certain factors upon parathyroid size. In rabbits fed a grain mixture containing bonemeal and good quality alfalfa hay neither ovariectomy, pseudopregnancy, nor pregnancy increased parathyroid weights, but the glands of animals killed during normal lactation were markedly heavier than those of control animals. When the number of young suckling was limited to two, the parathyroids of the lactating animals were of normal size. A comparison of parathyroid weight per kilogram body weight in mature animals showed that values for the goat were somewhat higher, and for the rabbit very much higher than those for the rat.

The parathyroid glands of rats fed for several months on a deficient basal diet low in calcium and vitamin D have been found consistently to be much enlarged. When an adequate quantity of calcium was added to this diet the glands were of normal size. The addition of vitamin D only to the basal diet resulted in glands of a weight about midway between normal and that of the enlarged glands of rats on the diet deficient in both calcium and vitamin D. The animals receiving vitamin D were able to utilize more efficiently the small amount of calcium in the diet and thus less compensatory activity was required from their parathyroid glands.

The commercial preparation used in the treatment of humans suffering from hypoparathyroidism was tested for its effects upon lactating goats. Two hundred and 400 milligrams of this material fed over a period of four days gave small but significant rises in serum calcium and inorganic phosphorus. Milk calcium values showed transitory increases. Milk and fat production were not affected.

Sufficient amounts of estrogen have been found to increase the deposition of calcium in the bones. Short term injections of estrogens and androgens into chicks and rats have failed to stimulate any increase in the mitotic activity of the parathyroid glands, and injections of estrogens over periods up to 200 days have not increased significantly the size of these glands in normal female rats and ovariectomized rabbits. In parathyroidectomized young female rats, long serum injections of stilbestrol resulted in a slight increase in bone calcification similar to that of injected normal animals. From these results it would appear that estrogens and androgens in the species studied are not acting indirectly by stimulating the parathyroid glands.

Intraperitoneal injection of sufficient sodium citrate solution caused mice to have violent convulsions. Pretreatment of the mice with parathyroid hormone was found to reduce the incidence of convulsions in these animals. Perhaps this procedure may be adapted to the assay of parathyroid extracts.

The Mechanism of Mammary Gland Growth. The value of stilbestrol for stimulating udder development was compared with the type of lobule-alveolar growth stimulated by the hormone of the corpus lutem-progesterone. The synergistic action of estrogen and pituitary preparations in stimulating growth of the lobule-alveolar system was discovered. This suggested that the value of estrogen was due to its action on the stromal tissue surrounding the mammary gland which produced an increased hyperemia and vascularity associated with increased permeability of the vascular system. It was observed that virgin female goats injected daily for 60 days with 20 or 30 mg. of progesterone plus 100 or 150 micrograms of stilbestrol, were stimulated to develop mammary glands similar to mid-pregnancy. Additional treatment daily for twelve days with 0.25 mg. of stilbestrol caused an initiation of secretion in these mammary glands similar to that occurring at the time of parturition.

While stilbestrol stimulated the growth of the mammary gland and the secretion of milk, the extent of gland development was quite variable and consequently the yield of milk at times was not large. If a cheap substitute for progesterone could be found, the complete growth of the udder and the initiation of lactation could be secured in nonfertile cows. (C. W. Turner, J. P. Mixner, A. J. Bergman, I. L Campbell, J J. Trentin, A. A. Lewis.)

The Production of Veal Calves. In view of present milk prices and the corresponding decrease in number and quality of veals on the principal markets, dairymen and packers have raised numerous questions

as to the practicability of producing veal by using whole milk substitutes.

Five calves have been reared by the nurse-cow method. They have averaged one pound gain for each 9.4 pounds whole milk consumed. In addition each calf has eaten from 0.1 to 0.4 pounds of grain per day and a similar amount of alfalfa or clover hay. Practically all veals finished out by this method have gained approximately 2 pounds per day.

Another group of five calves was fed whole milk for six weeks but limited to 1 pound of milk for each 10 pounds of body weight. These calves averaged gains of 1.6 pounds per day and have required from two to three weeks longer to finish, and only one of the four sold was rated "Choice." A third group of five calves was fed whole milk up to 21 days of age, and then changed to skim milk and gained at the rate of 1.3 to 1.4 pounds per day. It is obvious that they will be markedly inferior to the calves permitted plenty of whole milk.

The production of choice veal depends upon the liberal feeding of whole milk and whether or not this is economical will depend entirely upon market prices of veal and whole milk. (A. C. Ragsdale, H. A. Herman.)

Effects of Rations and Management Practices on the Rate of Growth of Dairy Heifers. The length of time and amount of nutrients required to grow dairy heifers to productive age are of economic importance and the feeding and management of the calf effects its performance at lactating age.

In order to determine the relation between the feed intake, quality of ration, and the rapidity and economy of growth of dairy heifers fed on simple and complex rations; and the effect of the growth rate on lactation, breeding efficiency, and longevity 25 heifers have been fed on special rations and compared to 10 heifers grown in accordance with normal practices in the Station herd.

After the whole milk and skim milk feeding period 5 Holstein heifers were grown to freshening age on a ration of chopped alfalfa hay, supplemented with salt and steamed bone meal. At freshening age these heifers were 13 per cent below normal in weight and 5 per cent below normal in wither height. They were fed roughage the first lactation, but in subsequent lactations were fed 1 pound of grain to each 6 pounds of milk produced daily. During the fourth lactation normal grain feeding was practiced. At five and one-half years of age the average weight of the heifers was approximately normal. While the growth rate was retarded on the heavy roughage feeding program, approximately normal size was attained eventually.

Six heifers fed the usual herd rations plus thyroprotein failed to grow faster than those not receiving thyroprotein.

Twenty heifers are being reared on a complex ration containing 26 per cent crude protein and 71 per cent total digestible nutrients, fed *ad libitum*, and 10 to 20 pounds of whole milk. Fifteen of the heifers

at 12 months of age averaged approximately 30 per cent above normal in body weight and 4.7 per cent above average in height. At two years of age the heifers ranged from 8 to 20 per cent above normal in weight and 4 per cent above normal in height. Such heifers were of normal breeding size some 4 to 6 months early. Ten heifers reared in a similar manner to those above have freshened. The lactations are incomplete, but the heifers freshening at 19 months of age, and approximately normal to above normal in body size, have averaged 7,498 pounds of milk and 284 pounds butterfat in 332 days. Whereas, those freshening at 27 months of age and approximately 10 per cent above normal size have averaged 7,943 pounds of milk and 299.4 pounds of butterfat in 323 days. There was little difference in the two groups for the second lactation averaging 7,773 pounds of milk and 303 pounds of fat in 301 days. The animals were fed grain and roughage at the usual rates. In general, their production has been disappointing and they have consistently failed to produce as well as the controls, or as well as the average heifer of similar breeding in the Station herd. This may be due to the lack of maturity from an age standpoint at freshening time for some of the heifers. (A. C. Ragsdale, H. A. Herman.)

Ground Lespedeza Seed as a High Protein Concentrate for Milk Production. Chemical analyses of Korean lespedeza show a striking similarity in protein content to that of the high protein feeds such as cottonseed meal, soybean oil meal, and linseed oil meal commonly used in balancing dairy rations. About 7,000,000 acres of Korean lespedeza are grown annually in Missouri and only about 200,000 acres are harvested for seed with an approximate yield of 400 lb. of seed per acre. There is a possibility of harvesting a larger acreage of the lespedeza for seed and thus securing a large supply of a relatively cheap protein.

Two groups of 10 dairy cows each were used to determine the value of the ground seed as a substitute for cottonseed and soybean oil meal. The cows in each group were comparable as to body weight, stage of lactation, and daily milk yield. The lespedeza seed used was finely ground and mixed into a ration so as to give the same protein content as a ration containing cottonseed meal and soybean oil meal as the main source of protein.

The lespedeza seed used analyzed 92.48 per cent total dry matter, 34.5 per cent crude protein, 9.5 per cent crude fiber, 7.93 per cent ether extract, 34.1 per cent nitrogen-free extract, and 6.4 per cent ash. The grain mixture fed to each group averaged 13.8 per cent crude protein and was fed in accordance with daily milk production. The cows were fed alfalfa hay and sorgo silage as a source of roughage. Each feeding trial consisted of a 40-day period with a 10-day preliminary period.

During the first feeding period, the cows receiving the ground lespedeza seed averaged 31.5 pounds of milk daily while the cows receiving the ration containing cotton-

seed oil meal and soybean oil meal averaged 30.8 pounds of milk daily. The slight difference in milk yield was not significant and observations seem to justify the statement that the proteins of ground Korean lespedeza seed were equal pound for pound to the proteins of cottonseed oil meal and soybean oil meal fed together as a source of protein in the ration of lactating cows.

The cows have eaten the lespedeza seed-grain mix readily and no adverse physiological effects have been noted. The body weight of the cows remained approximately constant for both groups. (A. C. Ragsdale, H. A. Herman.)

The Nutritive Value of the Proteins of Lespedeza Hay. Lespedeza has become an important hay crop in this State and it would seem advisable to determine the feeding value of lespedeza hay as compared to other legumes and also its value when fed with other feeds in common rations.

The biological value of protein was determined by using purebred Holstein heifers 15 to 18 months of age. Korean lespedeza hay gave biological values averaging 86 as compared to 75 for alfalfa hay. The results suggested that the proteins of lespedeza hay were superior to those of alfalfa, corn, and milk because a larger percentage of the absorbed lespedeza protein was utilized by the animal. A larger proportion of the proteins of alfalfa, corn, and milk was digestible than of the proteins of lespedeza. Apparent digestibility of the lespedeza protein was of the order of 40 to 45 per cent, while the alfalfa, corn, and milk proteins had apparent digestibilities of around 50 to 55 per cent. Early cut Korean lespedeza hay contained 52 per cent total digestible nutrients as compared to 37.9 per cent for late cut highly lignified hay. The actual amount of nitrogen retained by the animals did not vary significantly with any of the rations which indicated that the heifers were able to utilize all of the digested proteins equally well but that they simply digested more than they needed in the cases of the more digestible feeds. Apparently the cow does not depend so much upon the quality of the digested protein as upon the amount of ingested protein which can be absorbed. In this respect lespedeza hay protein was distinctly inferior to alfalfa hay protein and all the other proteins used in this experiment. (A. C. Ragsdale, H. A. Herman, E. W. Swanson.)

Lactose Determination in Milk. Inadequate allowance for the volume of precipitate in the dilution of the milk is an important source of error in the polarimetric determination of lactose in milk by the A. O. A. C. method. This has been shown by a study of milk samples by E. R. Garrison. The results have been used as a basis for recommending a change in the official A. O. A. C. method of diluting milk for the optical determination of lactose.

Samples of milk from 25 individual Holstein, Jersey, and Guernsey cows were analyzed for fat and total protein by the usual procedures. The volume of precipitate from these substances in 65.8 grams of milk was computed assuming a specific gravity of 0.92 for the fat and 1.35 for the proteins. The per-

centage of lactose in the samples was determined by means of the polariscope using the official A. O. A. C. dilution method and the double dilution method.

The total volume of precipitate in 65.8 grams of milk samples ranged from 3.03 to 7.39 ml. and averaged 5.14 ml. The volume of precipitate in all samples was thus considerably more than the 2.6 ml. allowed for dilution by the A. O. A. C. method. The lactose values by the A. O. A. C method ranged from a minimum of 0.1 to a maximum of 0.35 per cent and averaged 0.25 per cent higher than the results secured by the double dilution method. The A. O. A. C. method thus gives erroneously high lactose values due to inadequate allowance for the volume of precipitate and should be changed to eliminate this source of error.

Heat Resistant Bacteria in Milk and Lactose-Fermenting Yeasts in Cream. E. R. Garrison has concluded that the udder of the cow is a negligible source of heat resistant bacteria and that the outside of the body of the cow and the barn air were more important sources of contamination. A sanitary program in all matters relating to production—care and sterilization of equipment with particular attention to the exterior of the cow's body and the barn air will reduce the number of heat resistant bacteria in milk.

A reliable procedure for determining the number of lactose fermenting yeast in sour cream was found to be the dilution method using lactose whey at a pH of 4.0 and incubating for 6 days one set of the inoculated tubes at 25° C. and the other set at 37° C. and then examining for gas production. The number of lactose fermenting yeasts in 50 samples of sour cream delivered by producers was found to be highest in June, July, August, and September and lowest in December, January, and February.

The Energetic Efficiency of Growth and Related Transformations. A standard for the minimum maintenance cost of rapidly growing Jersey heifers from birth to 25 months of age has been constructed. Prior to "natural weaning", 5 to 6 months of age, the metabolism varies directly with simple body weight and following this age varies with the .6 power of body weight meaning that increasing body weight 1 per cent increases maintenance cost only 0.6 per cent. This same condition holds true for human metabolism. From the surface-area viewpoint, the metabolism per square meter rises from birth until the age of "natural weaning" and remains approximately constant thereafter.

Beginning with age about 10 days, the relation of metabolism to weight in rats is similar to that in cattle; that is, the metabolism is directly proportional to body weight preceding weaning and varies with the .6 power of body weight following weaning. There is a peculiar break in the rat curve at about age 10 days and preceding this break, the metabolism varies with the .7 power rather than with the .6 power of body weight.

Data on growing rats indicate that the faster the growth rate,

whether due to age, sex, or smallness of litter, the greater the heat production.

An elaborate investigation was made on the relation of the weights of the pituitary, brain, thyroid, adrenal, kidney, heart, lung, liver, blood, stomach, and intestines to



Apparatus for measuring metabolism.

total body weight in mature animals of different species and in growing animals of the same species. It was found that the differential percentage increase in organ weight is 0.7 as rapid as the corresponding percentage increase in body weight; that is, increasing total body weight 1 per cent increases organ weight about 0.7 per cent. This observa-

tion is significant because the minimum maintenance cost, circulation and ventilation rates, external and internal nutritive and excretory surfaces, and milk-energy production vary in a similar manner thus bringing out a fundamental unity apparently of diverse structures and functions.

A study has been made of the relation of milk-energy production to body weight in mature animals of different species: dairy cattle, dairy goats, and white rats. It was found that the differential percentage increase in milk-energy production is 0.7 as rapid as the percentage increase in body weight. Thus increasing body weight 1 per cent increases milk-energy yield 0.7 per cent. (S. Brody, A. C. Ragsdale, H. H. Kibler.)

A Straw Loft Calf Barn. From March 1931 to November 1939 pneumonia caused a loss of 9.2 per cent of all calves dropped at the Hatch Dairy Experiment Station. Most of the losses from pneumonia occurred between November 1 and April 1. Moisture condensed on the wall and ceiling of the barn and occasionally collected on the floors, walls, and ceiling. Such conditions usually preceded the development of one or more cases of pneumonia.

A new calf barn was constructed in 1939 which provided for a layer of 12 to 18 inches of loose straw on a slatted floor over the calf and cow pens the entire length of each side of the barn with a solid floor over the feed alley. Open cupolas were constructed on the peak of the building to provide an outlet for foul air. Intake was through the doors and windows.

Individual pens were provided for calves under two months of age. The floors for the baby calf pens were made of 2 inches of cement plaster on 5-inch unglazed hollow tile placed over a layer of 18 inches of cinders. Each pen was provided with a floor drain. The walls of the pens were built of matched lumber. Removable, slat wood floors were used during the winter months for calves under one month of age.

The new calf barn was put in use November 24, 1939. Since that time 88 calves have been dropped in the herd and kept in the new barn. No calf has had any symptoms of pneumonia during this time. (A. C. Ragsdale, C. W. McIntyre.)

Preservation of Sweet Clover Silage. Attempts have been made to find new methods of preserving legume silage. Sweet clover was ensiled in 50-gallon steel oil barrels. The sweet clover was cut with an ensilage cutter to ⅜-inch lengths, treated, and trampled as the barrels were filled. The lids were placed on the top and sand bags placed on them to make a weight equivalent to approximately 15 feet of silage.

Four different treatments were tried: (1) 200 pounds of salt per ton of silage; (2) 100 pounds of salt per ton; (3) 200 pounds of whey per ton; and (4) 400 pounds of whey per ton.

The barrels were opened seven months later. The silage treated with 200 pounds of salt per ton had a good acid odor, was slightly brown, and 15 inches of the top silage had spoiled. The silage treated with 100 pounds of salt per ton had a good acid odor, similar to mo-



Sorgo on University of Missouri South Dairy Farm.

lasses-alfalfa silage, and 3 to 4 inches of the top was spoiled. The silage treated with 200 pounds of whey per ton had a good color and acid odor, and had 10 inches of spoilage. The silage that had been treated with 400 pounds of whey per ton had good color and acid odor, nearly the same as molasses-alfalfa and had six inches of spoilage.

The silages were removed and fed to heifers and dry cows so that they could select the silage they preferred. The silage treated with the salt was preferred and eaten first although there was no apparent difference in appearance or odor.

The results indicate that either whey or salt solution might be useful as a preservative in sweet clover silage. (A. C. Ragsdale, C. W. McIntyre.)

Pasture Studies at the Hatch Dairy Farm. For the past 7 years various fertilizer applications have been made to bluegrass pasture plots at the Hatch Farm located on Memphis silt loam. Forty plots of 0.01 acre each were used. One-half of the plots were fenced so that they could be clipped to determine yields and one-half were left unfenced to permit grazing. Duplicate plots for each treatment were used both in the fenced and pastured plots.

The fertilization of bluegrass with nitrogen fertilizers produced a heavy increase in green hay during the early season with no change or a decrease in yield during late summer and fall. The yield of dry hay was increased to a smaller extent. The stand of grass was more affected by dry weather and extreme heat. The grass was more palatable to dairy cattle and the protein was increased with little or no effect on other constituents. The effectiveness of nitrogen fertilizers varied with, and was dependent on an ample supply of soil moisture.

The yield of dry grass on the plots treated with superphosphate and nitrogen fertilizer was slightly lower than the plots with nitrogen only. However, the difference was not significant. The stand of grass was maintained better during adverse seasons. The phosphorus, protein, and ether extract were increased and the ash content lowered.

Potash fertilizer used with phosphate and nitrogen fertilizer increased the yield of pasture grass, both green and dry. The increase was well distributed during the season. There was no significant change in percentage of dry matter. The ash content was increased with no other significant change in composition of the dry hay. The stand was not affected.

The yield of green and dry grass was less on the plots where limestone was used with a complete fertilizer as compared to the plots treated with a complete fertilizer only. The percentage of dry matter was lowered during the early season and increased in the fall months The calcium and ash contents were increased. Under this treatment the stand of grass was maintained better than with any other fertilizer treatment.

A second application of nitrogen fertilizer on bluegrass, treated with a complete fertilizer and limestone, produced a very large increase in the yield of green and dry grass. The yield was more affected by rainfall than with other treatments except nitrogen alone. The additional nitrogen increased the percentage of dry matter early and late in the season but lowered it in mid-season. The stand of grass was not maintained as well as when one application of nitrogen was used. There was no significant change in the composition of the dry hay.

Manure on bluegrass increased the yield of dry grass more than any other treatment. The increase was well distributed throughout the pasture season. The percentage increase of dry hay on manured grass was higher in dry years and near that for other treatments in seasons of heavy rainfall. There was no significant change in the composition of the grass. The stand of grass was maintained nearly 100 per cent during dry years and improved during normal seasons. Cattle did not graze manured pastures until from 6 to 8 weeks after the application.

If only the yield of grass is considered it is doubtful whether the increase in yield for any of the treatments, except manure, would pay for the fertilizer on soil such as was used in these tests. There is the possibility, however, that the biological value of the herbage re-

sulting from some of the treatments would be sufficiently better to warrant the cost of the treatment.

Rotation grazing of three bluegrass pastures where heavy applications of manure were used, and clipping twice each year, markedly increased productivity. Seeding of sweet clover, crimson clover, alfalfa, lespedeza and orchard grass in limited areas of these pastures further increased yields. (A. C. Ragsdale, C. W. McIntyre.)

Miscellaneous Investigations at the Hatch Dairy Experimental Farm. During the past two years a number of dairy management problems have been under investigation at the Hatch Dairy Experimental Farm. This work has been under the supervision of A. C. Ragsdale and C. W. McIntyre and in cooperation with the Bureau of Dairy Industry of the United States Department of Agriculture.

One group of cows fed grain at the rate of 1 lb. for each 6 lbs. of milk for the first two months of lactation, 1 lb. to 8 for the third and fourth months, 1 lb. to 10 for the fifth and sixth months, 1 lb. to 12 for the seventh and eighth months, and no grain for the ninth to twelfth months produced 90 per cent as much milk and 83 per cent as much fat as cows fed a full grain ration.

Cows fed ground yellow corn, alfalfa hay, and alfalfa-molasses silage supplemented with steamed bonemeal and salt produced about the same amount of milk and fat as cows fed the usual more complex grain mixes.

Alfalfa yields for the eight years, 1935 to 1942, at the Hatch Dairy Farm averaged 4.88 tons per acre per year and cost $4.89 per ton of hay harvested. The cost included $1.51 per ton for seeding, $2.06 for harvesting, and $1.32 for land rent.

During the past four years shortwave diathermy, used on 69 cows including 28 showing clinical symptoms of mastitis, has been effective in 91 per cent of the cases of recent infection and in 44 per cent of the cases of old infection.

Ten cows fed condensed whey solids at the rate of ¼ lb. per day produced 69.8 per cent as much butterfat in the eighth month as in the first month; and seven cows fed ½ lb. per day produced 72.9 per cent as much as in the first month. Seven check cows averaged 54.1 per cent as much in the eighth month as in the first month's production.

Fifty bulls bred in the herd and leased to cooperating farmers in three states and in two additional states to federal and state experiment stations have sired 1,131 heifer calves in 43 herds. Lactation records have been completed on 340 daughters. A total of 201 daughters sired by 17 of these bulls out of 186 dams have shown an increase of 125 lbs. of milk and 26 lbs. of butterfat over that of the dams.

ENTOMOLOGY

L. HASEMAN, *Chairman*

Missouri Ticks and Their Control. —The presence and economic control of ticks in Missouri have been investigated by R. W. Portman, L. Haseman, and E. E. Roselle. The results during the past two years have indicated that the lone star tick and the American dog tick or wood tick were the two most troublesome species in Missouri. The lone star tick was found to be more abundant in the Ozarks and it seemed to winter generally as the nymph and adult while the dog tick or wood tick usually wintered as the adult. Both these species attack most all kinds of livestock and wild animals. The wood tick, seed tick or larval stage, attacks only small rodents. The black-legged tick was also a problem of some importance on horses and cattle in some parts of South Missouri.

Preliminary results showed that derris and other rotenone-bearing products used as sprays, or dusts applied by hand, killed ticks on cattle quite satisfactorily, but treatment had be repeated often to keep livestock free of ticks.

During the year there were several cases of Rocky Mountain spotted fever and tularemia in the State and a number of deaths, all of which followed tick bites. It is, therefore, of utmost importance that satisfactory means of controlling ticks in Missouri be developed.

The Control of the Chinch Bug in Missouri. In the 1942 chinch bug infestation was at its low ebb and of little economic importance in Missouri. There were very few heavily infested fields for studies on insecticides and controls. New dinitro-ortho-cyclohexyl phenol and dinitro-ortho-cresol dust barriers were tried experimentally at Columbia and Paris for the first time and proved to be impractical because they were easily washed away and required constant renewal.

Results of seasonal surveys of five chinch bug problem areas in the State made it possible to keep farmers fully advised in relation to the overwintering abundance of the chinch bugs and indicated the areas in which it might be necessary to fight the insect.

Chinch bugs were reared in the laboratory under controlled conditions of temperature and humidity by P. C. Stone and H. E. Brown. Marked differences in the number of offspring and length of life of the individual bugs were revealed. Other studies showed rather conclusively that when the offspring of one pair of chinch bugs were reared for generation after generation under the same conditions and on the same food, certain individual bugs always had vigorous offspring while others produced weak offspring. Chinch bugs reared out-of-doors by the same technique as in the laboratory, except that temperature and humidity were not controlled, showed that the late maturing final offspring of overwintering adult chinch bugs went into hibernation in the late summer or early fall without mating or producing a second generation. The early ma-

turing first offspring of overwintering adult bugs mated and produced a second generation. There was no partial third generation in 1942.

The Control of Codling Moth. In 1942, codling moth control was aided by frequent rains during the period of the first brood, thus reducing the early worm population considerably below that of the preceding year. Where sprays were timed properly the codling moth infestation remained lower at the end of the season than last year. Observations over a period of years indicated that in orchards that either missed a crop or had a bloom removal spray, a marked reduction in codling moth carryover for the following year was experienced. It was found, however, that when only two rows in a heavily infested orchard had the bloom removed, the infestation of worms the following year was practically as great as in the surrounding orchard. Late fall varieties were found to carry a much heavier overwintering codling moth population than those ripening in early fall.

The results of three seasons testing indicated that, while it may increase worm control, severe damage to foliage may result from the use of brown sugar with lead arsenate for controlling moth. The addition of oil of sassafras to brown sugar, lead arsenate, and oil did not increase the control of codling moth above the results when the oil of sassafras was omitted. The addition of saccharin to the lead arsenate, lime, and summer oil spray did not increase the percentage of clean fruit. Inverted lead arsenate and oil alternated with flocculated bentonite gave decidedly poorer codling moth control than the regular lead arsenate sprays. Best results were secured with 3 pounds of lead arsenate to 100 gallons in all cover sprays, plus ½ per cent summer oil added in the peak sprays, or with fixed nicotine plus summer oil used as substitute for lead arsenate in the second and third brood cover sprays.

As a service to the fruit growers of the State, weekly reports were furnished codling moth activity giving recommendations as to spray materials and the dates of application.

Insecticide Investigation. One of the chief objections to the use of lead arsenate for spraying apples has been the residue remaining on the fruit. In many instances, fruit growers incurred additional expense in removing this residue before the fruit could be marketed. Therefore, a satisfactory substitute for lead arsenate would greatly benefit fruit growers.

Bentonite-fixed nicotine, either as a home mix or as commercial 14 per cent nicotine-bentonite, has proved as effective as lead arsenate for controlling second and third brood apple worms, where it was used with summer oil following lead arsenate sprays for first brood worms. It has helped to solve the spray residue problem, but it added materially to the cost of spraying. The addition of a ½ per cent summer oil to the lead arsenate sprays, applied ahead of peak hatches of first and second brood apple worms, also materially aided worm control but complicated the residue problem. None of the other substitutes

for lead arsenate or other chemicals added to the lead arsenate sprays were satisfactory.

For a number of years various insecticides have been tested for their use in controlling corn ear worms. Of the insecticides tested, white mineral oil, with or without the addition of pyrethrum extract, and hexachlorethane tablets applied in the tips of sweet corn ears, gave from 45 to 85 per cent worm-free roasting ears as compared to the untreated plats that had less than 2 per cent of the ears free of worms. Neither of these two compounds caused injury to the ears and left no harmful odor or deposit when used properly. The best time to use the compounds was after the silk began to wilt, as this indicated that pollination had been completed. This work has been under the direction of L. Haseman, assisted by the other members of the staff of the Entomology department.

Controlling the Strawberry Leaf Roller. Generally speaking, strawberry growers hope to control insect pests largely by planting new beds every second year and by destroying the old beds as soon as insect pests start to cause trouble. However, the leaf roller often suddenly appears in a berry-growing community, necessitating prompt use of insecticides to save the year's crop. The results of the spraying and dusting experiments carried on in the last few years in Southwest Missouri have enabled growers to know the most effective insecticides and the best time for application.

Dust applications, in every case, proved more effective than did the spray application, using the same insecticide. The order of effectiveness of the five best insecticide dusts was found to be as follows: (1) Cryolite-talc, (2) Lead arsenate-lime, (3) Pyrethrum dust (.2 per cent pyrethrin), (4) Derris-Pyrax dust, (5) Derris-flour. W. W. Smith has been in charge of the work on this project.

Other Work Conducted by the Department of Entomology. An attempt to control the spotted and striped cucumber beetles has been made. Best results were obtained by timely applications of dust either of lead arsenate or cryolite. Pyrethrum dusts with high pyrethrin content killed squash bug nymphs and some adults where they were well-coated with the dust, but this treatment was too expensive for effective work on large acreages.

Work of special interest to the Army Sanitary Corps and the Public Health Service was the gathering of data for determining the range of the malarial carrying mosquito. Anopheles punctipennis, and to a less extent Anopheles burberi, were found prevalent in the Waynesville and Fort Leonard Wood areas. However, Anopheles quadrimaculatus was more numerous in the St. Louis area where it endangered health of the men at Jefferson Barracks and in the various defense plants. During the year, reports indicated no increase in cases of malaria in the central part of the State. (L. Haseman.)

FIELD CROPS

W. C. ETHERIDGE, *Chairman*

Breeding Early Wheat for Missouri. Early maturing varieties of wheat have practical advantages in present Missouri cropping systems. Their chief value lies in the increased growth of a legume following an early wheat crop since this makes possible the successful production of a "second crop" for hay or pasture from the same area. In Missouri early wheat also escapes much weather, insect, and disease injury. Also, an early wheat crop usually commands a better price. Advanced earliness is found in Missouri Early Premium, a variety developed at this Station.

Early Premium wheat now is grown widely in Missouri and the grain has excellent milling and baking qualities. Higher yields and better resistance to common wheat diseases would be desirable improvements. In an effort to acquire these improvements this variety has been crossed with Michigan Wonder, Fulcaster, Harvest Queen, Poole, Kawvale, Thorne, Clarkan, Wabash, and other varieties.

In 1942 approximately 1200 F_5 lines from Kawvale X Early Premium were vernalized and spring planted. Over 95 per cent of these headed and gave enough viable seed to plant the next generation.

The 1942 yields and test weights of the four leading Missouri wheat varieties were as follows:

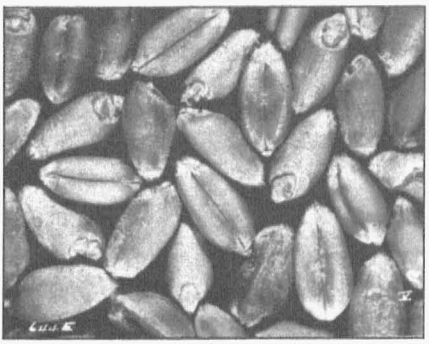
	Clarkan	Early Premium	Michigan Wonder	Fulcaster
Yield (bu. per A.) ..... (Avg. of 27 tests)	29.0	24.6	24.8	25.0
Test Weight (lbs. per bu.) (Avg. of 11 tests)	60.5	58.2	57.7	58.2

Extensive use of Clarkan by farmers growing wheat as a cash crop, and of Early Premium by livestock farmers who are especially interested in the establishment of a legume in wheat seedings, is having a far-reaching effect in establishing wheat production in Missouri on a sound profitable basis. (J. M. Poehlman.)

Breeding Barley in Missouri for Feed. Winter barley has become an important feed crop in Missouri. It produces high yields of grain on soil of medium fertility supplementing, or often replacing, corn on rolling land. By early, rapid growth in fall and spring barley produces excellent pasture and is quick to recover from grazing. Winter barley may be used efficiently in rotation with lespedeza or soybeans as an excellent nurse crops and aid in controlling erosion.

Missouri Early Beardless is the variety most widely grown. It is hooded, high yielding, relatively winter hardy, excellent for grazing, and early in maturity. Yield tests have confirmed again the superiority of Reno and Michigan Winter in yield and winter hardiness. Both

are bearded varieties. They have a stiffer straw but are susceptible to loose smut and are less efficient than Missouri Early Beardless as



Missouri No. W5226 (Sel. Fulcaster x Early Premium) wheat kernels. Grown at Columbia.

nurse and pasture crops since they are later in maturity. Bushel yields per acre of these three varieties in 1941-42 were Reno 40.3, Michigan Winter 39.1, Missouri Early Beardless 24.5. Relative winter survival was Reno, 98 per cent; Michigan Winter, 95 per cent; and Missouri Early Beardless, 90 per cent.

Efforts have been made to increase the uniformity, yield, and winter resistance of Missouri Early Beardless by pure line selection and by crossing with high-yield and winter-resistant varieties. A large number of varieties and multiplied selections of winter barley were grown at Columbia, Sikeston, Lathrop, and Bethany during the season 1941-42, and compared in winter hardiness and general agronomic characters. In addition 700 head selections were grown from Early Beardless and 1500 head selections from bulk hybrids of Early Beardless crossed with each of the following: Kentucky 5, Poland, Michigan Winter, Ward, Alaska, Welchers Winter, B 289, Wisconsin Winter, and Trebi. (J. M. Poehlman.)

Breeding Fulghum and Columbia Oats for Resistance to Loose and to Covered Smut. Fulghum and Columbia oats are two early maturing varieties of red oats that invariably produce the highest yields in Missouri. The importance of the Columbia variety, a product of the Missouri Agricultural Experiment Station, was recognized recently by the federal establishment of a special market subclass for grain of this variety. Both Fulghum and



Method of inoculating barley with loose smut.

Columbia, however, are susceptible to loose and covered smuts and to stem and crown rusts. More resistance to these diseases would in-

crease production in years when smut and rust are factors. J. M. Poehlman has attempted to develop a new variety with resistance to smut and rust and with the earliness and productivity of Columbia or Fulghum. Definite progress has been made toward this goal as a number of selections from crosses seem to possess the desired characteristics and the problem remaining is to find strains that are the highest in yield.

A large number of crosses have been made. These have involved Columbia with each of the following: Navarro, Markton, Bond, Bond x Iogold selections, and Victoria x Richland selections. These varieties and selections are resistant to loose and covered smuts, and Bond is essentially immune to crown rust. The Bond x Iogold and Victoria x Richland selections are resistant to both crown and stem rusts.

In the year 1942-43 approximately 5,000 resistant plants were selected from advanced generations of bulk hybrids. Eleven hundred of these, from Columbia x Victoria-Richland were advanced one generation (F_4) in the greenhouse during the winter. New crosses made were: Columbia (Victoria-Richland) x Columbia-Bond; Columbia (Victoria-Richland) x Columbia (Bond-Iogold); and Columbia (Victoria-Richland) x Columbia (Columbia-Navarro).

Uniform winter hardiness tests were conducted on a number of winter oat varieties at Sikeston and Columbia. The two highest yielding varieties at Sikeston in 1942 were Stanton and Victorgrain with respective yields of 51.6 and 50.7 bushels. Other high yielding varieties C. I. 3398, C. I. 2498 (Winter Fulghum) and Tennex.

Improvement of Permanent Pastures. Permanent bluegrass pastures usually produce less grazing and less livestock gains per acre than rotation or supplemental pastures. E. M. Brown has attempted to develop methods, tillage practices, clipping treatments, and grazing management for the establishment and maintenance of Korean lespedeza and sweet clover in Kentucky bluegrass and orchard grass with the hope that the production from permanent pastures may be increased.

Preliminary results indicated that orchard grass offered less competition than bluegrass to the legume seedlings. Either lespedeza or sweet clover can be established in grass sods but sweet clover requires more tillage of the sod, more careful management of grazing during the first year after seeding, and more favorable weather for its successful establishment.

When grown together in thermoregulated growth chambers Kentucky bluegrass retarded the growth of Korean lespedeza at 80° F. and almost completely suppressed its growth at 60° F. Lespedeza somewhat retarded the growth of grass at 80° F. but had no appreciable effect on grass growth at 60° F. At 80° F., a mid-summer temperature, the combined growth of bluegrass and lespedeza in mixed cultures exceeded that of either growing alone.

The growth made by lespedeza and bluegrass both in pure and mixed cultures from August 13 to November 2 (an average day length

of 12.1 hours) was much less than that made by comparable cultures from May 19 to August 3 (an average day length of 14.5 hours).

The influence of the legumes on the productivity of grass and liveweight gains made by beef cattle was measured in 1942. From April 21 to July 31 at Lathrop beef cattle gains on bluegrass pastures were as follows:

Bluegrass with no legume or soil treatment
105 lbs. per acre

Bluegrass plus lespedeza
175 lbs. per acre

Bluegrass plus lespedeza plus phosphate and lime
198 lbs. per acre

Bluegrass plus sweet clover plus phosphate and lime
222 lbs. per acre

Heavy shading by cheesecloth, tall grass, or a residue of vegetation left from the preceding year as the result of undergrazing had a destructive effect on lespedeza seedlings during their early growth. Good stands of sweet clover were established in bluegrass where the grass was thin and unproductive or where it was grazed short during April, provided the soil was adequately limed and rainfall was abundant during spring and early summer. Dense stands of second-year sweet clover or intensive grazing during May and June prevented the establishment of sweet clover seedlings in grass sod.



Winter barley fall pasture.

Bluegrass produces about twice as much herbage in the spring as it does in the summer and fall combined. Therefore, the grazing of bluegrass should be concentrated in the spring months, or even restricted exclusively to this period. This is further emphasized by the fact that the combined production of roots and rhizomes is essentially the same in the fall as in the spring and thus, the fall period is the more logical time for "resting" the pasture. There was a large gain in roots and rhizomes at the end of a four-year period resulting from semi-annual mowing as compared to semi-monthly mowing. This demonstrated the deleterious effects of "overgrazing" without "resting".

Efficiency of Grain-Legume Short Rotations. Korean lespedeza has been found to be the most widely adaptable legume in Missouri. In 1941 Korean lespedeza was grown on 92 per cent of all Missouri farms. More than 40 per cent of them used it in an annual rotation with small grain. The fact that Korean lespedeza may be utilized in all small grain rotations partially accounts for its wide use.

At Columbia on Putnam silt loam a rye-lespedeza pasture produced 214 pounds liveweight gain in cattle per acre from April 15 to October 11, 1941. At Paris, on the same soil type, 168-pound gains in cattle were obtained. The wheat-lespedeza rotation was not as successful as usual on account of heavy winter damage to the wheat in the winter of 1940-41. In some places there was considerable damage to lespedeza from the summer drought of 1941. At Columbia on Putnam loam soil, the acre production from this rotation was 7.2 bushels of wheat and 184 pounds liveweight gain in the cattle for the grazing period. At Bolivar on Cherokee silt loam, the yield was 15.3 bushels of wheat and 21 pounds gain per acre. At Cabool there was a yield of 15.6 bushels of wheat and 56 cattle-days of grazing. This was on Clarksville gravelly loam. At Tarkio and Lathrop on Marshall silt loam winter killing destroyed the wheat below a harvestable residue, and the whole rotation was grazed out producing 356 pounds liveweight gain per acre at Tarkio and 206 pounds at Lathrop. At other places where the wheat-lespedeza rotation was completely grazed out over the period April 15 to October 10, the liveweight gains per acre ranged from 135 pounds at Paris to 140 pounds at Unionville, 175 pounds at Bolivar, and 281 pounds at Columbia.

A winter barley-lespedeza rotation at Columbia, after heavy winter damage to the barley, produced 12.6 bushels of barley grain and 2,764 pounds of lespedeza hay per acre. Corn nearby yielded 36 bushels per acre which was the best yield obtained for many years. At Lathrop, the barley was completely destroyed by winter killing and the lespedeza yielded 4,944 pounds of hay per acre, followed by a valuable second growth for pasture. This rotation at Bolivar produced 20.8 bushels of barley and 2,100 pounds of hay, while corn was a complete failure from drought. At Cabool, 36.3 bushels of barley per acre and 76 cattle-days of grazing on the lespedeza were produced

which was a high return when compared to 44 cattle-days of grazing per acre on local native pasture.

In the barley-soybean rotation pasturing out the barley produced 104 pounds of cattle gain and 2,689 pounds of soybean hay at Columbia; 18 cattle pasture days and 1,757 pounds of hay at Cabool on one field and 19.6 bushels of barley grain and 1,052 pounds of soybean hay on another. These yields were in situations entirely unfavorable for the profitable production of corn.

In a dry summer at Paris, Missouri, the oats-lespedeza rotation produced 17.5 bushels of oats per acre and 55 pounds of cattle gain on the lespedeza pasture; at Unionville 36 bushels of grain and 175 pounds of cattle gain; at Tarkio 3,200 pounds of oats hay and 144 pounds of cattle gain; and at Cabool 2,184 pounds of oats hay and 43 days grazing of lespedeza pasture.

On a field of worn crop land at Columbia a mixed pasture of orchard grass and lespedeza produced 331 pounds of cattle gain per acre from April 18 to August 22, while Kentucky bluegrass, much above average and on virgin land, produced only 273 pounds. At Unionville a timothy-lespedeza mixture on worn crop land produced 150 pounds of cattle gain per acre, while Kentucky bluegrass during an equal period on virgin land produced 197 pounds. Orchard grass-lespedeza on worn crop land at Bolivar yielded 176 pounds of cattle gain for the season. A redtop-lespedeza pasture on poor land at Paris gave 93 pounds of cattle gain per acre while a native pasture of redtop without any legume gave 43 pounds of gain per acre.

In 1942 the barley-lespedeza rotation at Lathrop produced 20 bushels of grain and 2 tons of hay per acre; at Bolivar 11 bushels of grain and 177 pounds of liveweight cattle gain from pasture; at Cabool 12 bushels of grain and 88 cattle-days of pasture. The wheat-lespedeza (both grazed) at Unionville gave 296 pounds of liveweight gain in cattle per acre; at Bolivar 334 pounds; and at Lathrop 345 pounds. Wheat-harvested for grain the lespedeza pasture produced 17 bushels of grain and 92 pounds of cattle gain per acre; at Bolivar 24 bushels and 227 pounds of cattle gain. Oats-lespedeza at Paris returned 36 bushels of grain and 145 pounds of cattle gain; at Unionville 41 bushels of grain and 230 pounds of cattle gain.

The joint total returns in feed from these short rotations were much larger than could have been gained from corn on similar land. Their cost was low and their effect upon the soil was beneficial, whereas the cost of corn is always high and the crop's degenerative effect on soil is a major worry of Missouri farmers. These yields have shown that farm production can be increased considerably through the use of these rotations and through the proper management of livestock. (C. A. Helm.)

The Efficiency of Cotton Production. Cotton is the major crop grown in the southeast lowlands of Missouri. In 1941, 409,000 acres

were grown. Continuous ginning soon deteriorates the seed stocks of the better varieties by mixing with gin-run seed and through natural crossing with inferior varieties. It is therefore a continuous task to maintain adaptable and productive strains and varieties of cotton and to discover new varieties to take the place of those which have degenerated. B. M. King grew four hundred individual plant selections from the third generation of eight crosses for observation. Thirty of these strains showed promise and have been saved for further testing.

In 1941 eight varieties were grown in yield tests on Lintonia loam at Sikeston and on Sarpy silt loam near Steele.

D. & P. L. 12 led in lint yield both at Sikeston and at Steele and was especially outstanding at Steele where it withstood the wilt and black rust much better than other varieties. Coker 100 and Washington appeared to be highly susceptible to injury by these diseases. Stoneville 2B was outstanding from the standpoint of quality of fiber.

The yields of lint cotton obtained were as follows:

Variety	Pounds of Lint Cotton per Acre	
	Sikeston	Steele
Stoneville 2B ..	480	553
Ambassador ...	349	540
Stoneville 5A .	524	615
Washington ...	558	478
Coker 100	587	413
D. & P. L. 11A .	519	514
D. & P. L. 12 ..	604	733
D. & P. L. 44-51	530	640

The use of improved varieties and practices in cotton production has increased the income of cotton farmers in Missouri. The rate of improvement (grade and staple) in the quality and yield of Missouri cotton since 1936 is unprecedented elsewhere.

In 1942 a number of varieties were grown at Sikeston on Lintonia silt loam and at Hayti on Sharky clay loam. The acre yields and staple length produced were as follows:

Variety	At Sikeston			At Hayti		
	Acre Yields		Staple	Acre Yields		Staple
	Seed Cotton	Lint	Length	Seed Cotton	Lint	Length
Stoneville 2B ..	1815	635	1 3/32	1107	392	1 3/32
Ambassador ...	1740	602	1 1/32	1182	415	1 1/32
Stoneville 5A ..	1710	604	1 1/32	1077	396	1 1/32
Deltapine 12 ..	1530	595	1 1/16	1134	463	1 1/32
Deltapine 14 ..	1770	692	1 1/16	1311	537	1 1/16
Bobshaw No. 2 .	1785	562	1 1/16	1158	359	1 1/32
Delfos 531c	1695	586	1 1/8	1161	398	1 1/8
Coker-Wilds ...	1275	408	1 1/4	990	325	1 1/4

Improvement of the Missouri Soybean Crop. The soybean crop has become important in Missouri agriculture, both for the produc-

tion of beans and for forage. While there are varieties adapted to Missouri conditions that are fairly productive, a continuing search is being made for better varieties for the production of both hay and seed.

B. M. King has endeavored to develop a dual purpose type of soybean that will serve efficiently for the production of high quality forage and for the production of yellow seed, rich in oil and protein, that will meet the requirements of the soybean milling industry.

The most promising dual purpose types have been found among the segregates from a cross, Virginia x B.P.I. 37062, made in 1929. In 1941 six of these strains were grown in a hay and seed yield test in comparison with Virginia and Boone. The new variety, Boone, led in acre yields of hay and seed. However, Boone has rather coarse stems and for this reason is not a choice hay type. It is an excellent feed producer not only for Missouri but also for neighboring states in this latitude.

In 1942 nine varieties and eleven strains developed from B.P.I. 37062 x Illini, Virginia x 54610-3, Virginia x B.P.I. 37062, and Illini x Manchu were grown at Columbia. The average yield of the nine varieties was 13.6 bushels and of the eleven new strains 14.5 bushels. Strains 49-18 from Virginia x B.P.I. 54610-3 was first with a yield of 16.6 bushels. Scioto and Boone were the highest yielding of the varieties, each producing 16.3 bushels. In another test including Virginia, Boone and forty strains developed from B.P.I. 37062 x Virginia, nineteen of the forty strains outyielded Boone by .2 to 4 bushels. All strains except three outyielded Virginia.

Varietal Response of Soybeans to Nutrient Elements. In previous years Morse and Virginia Soybeans were grown at different concentrations of the six major nutrient elements (K, Ca, Mg, N. P. S.) and their response was measured in terms of forage yields. Differences in varietal responses were exhibited in the potassium and magnesium series, and to a smaller extent in the calcium, nitrogen, and phosphate series. A differential in mineral composition of plant material of these two varieties was found.

In order to test the effect of potassium in the nutrient solution upon forage yields of other soybean varieties, D. I. Allen grew the varities Scioto, Illini, Dunfield, Boone, Virginia, and Morse, in a culture series. None of these varieties behaved like the others under the different levels of potassium nutrition used.

Chemical analyses of soybean forage grown at different levels of potassium and calcium indicated that the protein fraction was not affected but the soluble nonprotein nitrogen was affected very much.

If the response of various soybean varieties to different nutrient cultures can be determined, it may aid in the recommendation of varieties for various soil conditions.

Yields of Open-Pollinated Varieties of Corn Compared with Hybrids. This project is in cooperation with the U. S. Department of Agriculture. In 1941 the growing

season for corn was somewhat unfavorable over the whole State because of floods in June, drought in July and August, and heavy rains in October and November. These conditions greatly reduced the yields in the yield-test plots.

For the purpose of testing commercial hybrids, the State has been divided into three corn-testing regions. Five tests have been grown in each region. In 1941 forty-seven different hybrids were tested for seventeen different commercial companies.

In the northern region, the average yield of thirty-five commercial hybrids was 66.1 bushels per acre while the average yield of two open-pollinated varieties was 55.9 bushels. In the central region thirty hybrids averaged 59.1 bushels per acre while two open-pollinated varieties averaged 52.9 bushels. In the southern region, twenty-one hybrids averaged 47.1 bushels per acre and three open-pollinated varieties tested in four locations averaged 42.2 bushels.

These results indicated that a majority of the hybrids sold in the State were adapted in the northern region but that they were slightly early for the central and southern regions.

In 1942 the corn breeding nursery and yield trials planted in the Missouri river bottom was destroyed by flood in late June. Breeding material was replanted at Columbia, and about 7,000 hand pollinations made. (Dean C. Anderson.)

Treatment of Seed Corn for Control of Disease. Dean C. Anderson and C. M. Tucker have been interested in obtaining information on the comparative yielding ability of corn grown from healthy and diseased seed and the efficiency of seed treatment in controlling seedling blights. In general, states to the North and East have reported favorable results from treatment while states to the South and West have been unable to find any consistent benefits from such treatments. This suggested that differences in response to seed treatment might be expected in different parts of Missouri. The field trials were, therefore, well distributed over the State.

Samples from two hundred ears each of the varieties Reid and Midland were placed in a germinator and readings made on germination and prevalence of disease. Fusarium was the principal pathogen encountered so separations into healthy and diseased seed were based entirely on the Fusarium infection. Each variety was divided into two lots—healthy and diseased. Each of these lots was divided further—one-half being treated with Semesan Jr. and the other left untreated.

Six plantings were made in various parts of the State. Seedling counts and final yields were determined on each plot. The treated seed had a very slight advantage in seedling survival but the yield differences were not significant. These results confirmed those of previous years.

Comparison and X-ray and Ultra-Violet Mutations. This project is in cooperation with the U. S. Department of Agriculture. Earlier experiments have indicated that X-ray and ultra-violet mutations differ fundamentally in genetic nature. Studies of mutations of the gene *A*,

produced by X-ray indicated that they involved loss rather than alteration of the gene but did not exclude the possibility that they were genic mutations to alleles of lowered viability.

Subsequent experiments provided genetic evidence that the X-ray mutations were minute deficiencies too small for cytological detection and that ultra-violet mutations were analogous in behavior to gene mutations occurring spontaneously.

These experiments cast doubt upon the power of X-rays to produce gene mutations in general for they showed that the deficiencies produced by X-ray treatments were so minute that they could not be distinguished from gene mutations except by special criteria which were not applicable at most loci. However, these experiments did not exclude the possibility that X-rays may increase the frequency of true gene mutations as well as that of the minute deficiencies which simulate gene mutation. The natural mutation rate of the gene *A* may be extremely low, since no spontaneous mutations of this gene have been reported. Therefore, even if the treatment produced a pronounced increase in frequency, it might not be appreciable in the experiment.

The gene A^b mutates spontaneously with a frequency high enough to permit experimental study, and the alelle produced by spontaneous mutation is phenotypically distinct from the effect of deficiency . This gene therefore provides ideal material for the comparison of X-ray and ultra-violet induced mutation with spontaneous mutation.

Further study of the spontaneous mutations previously secured showed that these were phenotypically similar to the standard *a*P. They were completely regular in pollen development and gametophytic transmission.

The effect of X-ray treatment on mutation of A^b was tested by identifying seedling loss of the A^b effect, in large progenies produced by the use of treated and untreated pollen of a single plant. In these progenies spontaneous mutations appeared as *a*P seeds which yielded *a*P plants. Mutations of the same type induced in the mature pollen would appear as *a*P plants from A^b seeds, and pseudo-mutations involving deficiency of the A^b gene, whether or not they involved detectable loss of viability, would appear as plants of *a* phenotype. The results showed that X-rays had no effect upon the frequency of mutation of A^b to *a*P, and the A^b— losses observed were in general similar to those found in the various experiment.

Another suspicious feature of X-ray induced mutation was the absence of induced dominant mutations. However, since most of the genes of the plant treated were probably already at the maximum dominant level, this necessarily did not mean that dominant mutation was any less readily induced than recessive mutation. Known recessives included in the irradiated stocks failed to mutate to their dominant alleles in seed treatments which would give a recognizable dominant sector if the mutation occurred in any one of thousands of culls. However, these recessives may themselves be deficiencies

which could not mutate to the corresponding dominant under any conditions.

With one gene in corn it is possible to give X-ray treatment an exceptionally favorable opportunity to produce detectable dominant mutations. The recessive gene *a*, as shown by Rhoades, mutates frequently to *A* under the influence of the gene *Dt*. This shows that *a* is capable of dominant mutation, although in the absence of *Dt* it appears to be wholly stable. X-ray treatment can be applied at a stage in endosperm development corresponding to that at which the dominant mutations induced by *Dt* usually occur, and mutations induced at this stage will be manifested by small spots similar to those produced by action of the *Dt* gene. A few treated ears test the occurrence of the mutation on a very large scale.

Treatments were applied to ears of *a a dt dt* x *A a, dt dt*, 70 to 76 hours after pollination. The size of the sectors produced by genetic changes resulting from the treatment would be indicated by the A-deficiencies on the colored seeds. From this it would be possible to calculate the approximate number of cells in the *a a* seeds in which dominant mutation induced by the same treatment would have been manifested by the occurrence of a colored spot on a colorless seed. Outcross tests of the male and female parent stocks showed that both were capable of showing dots when crossed with a *Dt*.

This experiment showed that X-ray treatment failed to induce dominant mutation of *a* in a population of some millions of cells, which in the presence of the *Dt* gene would have yielded a very large number of dominant mutations.

Among the defective plants included in an extensive F_1 from ultra-violet treated pollen, one showed pollen apparently wholly normal in development. When crossed on normal plants, this plant produced progenies in which 50% of the plants were similarly defective. This showed that the defective development manifested by the heterozygote was transmitted regularly through the pollen. The factor responsible was closely linked to *wx*.

The defective plants were so poor that they seldom produced seed and it has not been possible to determine whether or not the homozygote is viable. The plant was reduced in all dimensions. In segregating populations most of the affected seeds may be selected on the basis of their reduced embryo size.

This is the second dominant factor found in ultra-violet progenies, the first being a plant color factor which has been described by Sprague. (L. J. Stadler, Herschel Roman.)

The Anthocyanin Pigments of Corn. This project is in cooperation with the U. S. Department of Agriculture. According to Sando, et al., the plant pigment of purple corn (*A B Pl* R^r) is chrysanthemin. The anthocyanin pigments present in other types have not been reported previously.

The anthocyanins which occur most commonly as flower color pigments (glycosides of pelargonidin, cyanidin, delphinidin, peonidin,

malvidin and petunidin) may be identified by simple qualitative tests outlined by Robinson and Robinson. The reactions of many less commonly occurring anthocyanins and of some synthetic anthocyanins not known to occur naturally have been summarized by Karrer.

Robinson's qualitative tests have been applied to the pigments extracted from numerous genetic types of corn. Although some of the pigments were identifiable with the qualitative tests, there were several that were distinctly different in their reactions.

An F_2 of the hybrid *a pr b pl* R^g x *A Pr B Pl* R^r was examined for color variations. In addition to the familiar plant color types expected from this cross, there were various minor modifications which had not been analyzed genetically. Plant material was taken from many of these plants for analysis, and all of the plants were self-fertilized.

The *A B Pl* plants in this hybrid population fall into three fairly distinct groups: (1) deep bluish purple; (2) deep reddish purple (maroon); and (3) light, distinctly reddish purple (dilute). The anthocyanins extracted from these plants included typical pelargonidin as well as typical chrysanthemin, and also in several cases, pigments giving a typical reaction. The pigment differences were not always evident from the external appearance of the plant. Both chrysanthemin and pelargonidin were found among deep bluish purple plants and among maroon plants, but chrysanthemin was not found in the "dilute" class.

In F_3, pure breeding families of the above described types were established. One deep bluish-purple family contained typical chrysanthemin. One deep bluish purple, indistinguishable from the chrysanthemin family except by another color, contained a pigment which differed only slightly in reactions from pelargonidin 3-monoside; and one family of reddish purple (maroon) had pigment apparently identical to that of the deep purple pelargonidin type. A pure breeding "dilute" family showed typical pelargonidin 3-monoside reactions.

The pigment of *A B pl* plants showed reactions that were not typical of any of the commonly occurring anthocyanin types, although there was variation in intensity of pigmentation comparable to that among the *A B Pl* plants.

The variation in intensity of the *a B Pl* plants was correlated with that of *A B Pl plants*. In families with plants mostly deep purple, the *a* plants were mostly deep brown; and in families of "dilute" pigmentation it was difficult to distinguish *a B Pl* from *a b pl* type plants until the plants were nearly mature.

The pure breeding pelargonidin families of this stock were recessive *pr* but in many plants of this hybrid the *Pr* separation was doubtful. Therefore tests were made on different hybrids with positive *Pr* separation to establish this relation. In the first planting, the *Pr* plants (6 in number) all contained chrysanthemin and the *pr* plants (8 in number), pelargonidin 3-monoside. In tests on the *Pr* and *pr* plants from six ears of the progeny of this family (self-fertilized or backcrossed) the same results were obtained. The pigment was found to

be the same in all parts of the plant, including roots, coleoptile, sheath, husks, cob, and aleurone.

Analyses have been made of pigments characteristic of other *A* alleles in plants with *B* and *Pl*. A^b gave chrysanthemin indistinguishable from that of *A* plants of the same culture. Standard *aP*, several *aP*'s arising by spontaneous mutation from A^b and A^{lt}, which occurred as an ultra-violet mutant of *A* gave mixtures of anthocyanin and flavonol in varying proportions. The anthocyanin in these mixtures, however, was distinct from that produced by *A* and A^b, and resembled in some reactions the pigments of sun-red plants. (J. E. McClary.)

Studies in Polyploidy in Wheat and its Relatives. This project is in cooperation with the U. S. Department of Agriculture. Because common wheat is a polyploid with much duplication of chromatin and genes, the usual methods of genetic analysis have been rather unsatisfactory. It was possible to secure plants deficient for a pair of chromosones, however, and these nullisomic plants indicated directly some of the factors carried by the particular chromosome which was missing. Additional factors could be located through crosses of mutant types with the various nullisomics. Of the 21 possible nullisomics, 16 have been obtained. These have been derived mainly from the aberrant offspring of a haploid and of nullisomic III, which is partially asynaptic. Several different half-nullisomic (plants completely deficient for one arm of a chromosome) also were obtained along with various tetrasomics (duplicated for one pair of chromosomes).

Cytological study of autotetraploid *Secale cereale* indicated that disjunction was extremely regular, and that the sterility must be attributed to other events at meiosis—non-lagging univalents, bivalents without duplications or inversions, univalents with bridges at anaphase I and anaphase II, and infrequent cells with exceptional asyanpsis. A study of tetrad micronuclei seemed to demonstrate that the numbers and dispositions could not be predicted from the numbers of anaphase laggards. Losses of whole chromosomes have been frequent in this autotetreploid. Two contiguous cells occurred which had but one trivalent and three univalents in each cell; a circumstance which indicated that a cell deficient for three whole chromosomes divided at least once.

One new amphidiploid has been obtained—*Aegilops bicornis* x *Haynaldia villosa*. Hybrids of *T. vulgare* with amphidiploids involving *T. dicoccoides* and various diploid species of *Aegilops* indicated that the seven chromosomes of the C set in *T. vulgare* included homoeologues of at least four chromosomes of *Ae. speltoides* and *Ae. caudata*, two chromosomes of *Ae. sharonensis*, one of *Ae. umbellulata*, and none of *Ae. comosa*. *T. vulgare* x (*T. durum* x *Ae. cylindrica* 4n) had up to 21 pairs (plus 7 univalents), confirming the existence in *Ae. cylindrica* of homologues of the C set of *T. vulgare*.

Six of 45 combinations of mutants in einkorn wheat showed linkage. There now are six groups of linked factors comprised of 22 factors.

The factor in *T. monococum* which

makes hybrids with *Ae. umbellulata* inviable has proved inoperative when a third genom, that of *Ae. uniaristata,* was added. Certain varieties of *T. aegilopoides* were found to carry a different, non-allelic factor (or factors) which greatly reduced the vigor of hybrids with *Ae. bicornis.*

A new study of the relation of polyploidy to heat and to X-ray effects on dormant seeds of several species of cereals confirmed the observations of others that tolerance for X-rays decreased with chromosome number. The results showed, however, that the tolerance for heat did not increase with polyploidy. The data also showed that heat was much less effective than X-rays in the production of mutations in diploid wheat.

Additional data on the relation of polyploidy to the effects of X-rays on pollen were obtained. There was a big increase in the number of translocations and fragments in pollen of tetraploid and hexaploid wheat as compared to the effects of the same dose applied to the diploid. (J. G. O'Mara, E. R. Sears, and Luther Smith.)

HOME ECONOMICS

FLORENCE HARRISON, *Chairman*

Use of Consumption Credit by Missouri Farm Families. Most farm families use some type of credit. In many instances the type of credit used is quite expensive even though the family may not realize it. Sidney Korando has undertaken to determine the main types of credit used in order to urge farmers to make an effort to reduce their costs for credit. In 1941, 154 Lawrence county farm families were interviewed. Data were collected on farm income, use of credit, kinds of goods or services financed, amount of credit used and costs, and sources and attitudes toward credit.

About 80 per cent of the farmers used some type of credit. Of 306 accounts, 59 per cent were used entirely for the farm business; 26 per cent for a combination of farm business and family living needs, and 15 per cent for family living needs. In general, the accounts for family living and farm business were trade accounts and only 18 per cent were cash loans. The accounts for farm business were usually cash loans, either long or short term. Only 21 per cent of these accounts were merchant accounts.

Of the total accounts 54 per cent were cash loans and 46 per cent was merchant credit. Fifty-two per cent of the cash loans were extended for less than a year; 44 per cent for more than three years. The majority of the merchant credit was open account; only one-third was installment credit. Relatively little installment credit was used for the farm business. Long term loans averaged $1,682. Short term cash loans for the farm business averaged $190 and for the farm family-farm business, $180. Open account credit for family living and for family farm business averaged $109, and installment credit, $80.

In general, the families surveyed

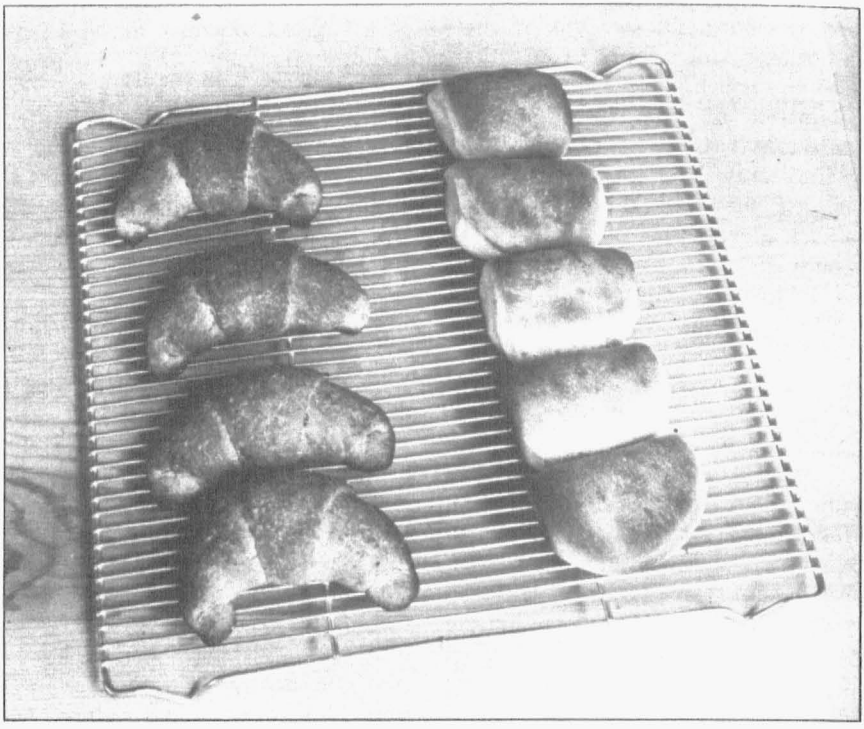
knew the financial sections of their installment contracts but few understood the legal aspects.

Relation of the Carotene and Xanthophyll Content of the Diets to the Growth of Young Chicks. Bertha Bisbey and Adelia Weis have found a direct relation between the amount of xanthophyll fed to chicks and the amount found in the tissues. Carotene was not stored to any appreciable extent with the amounts fed in these experiments. An alcohol soluble fraction prepared from egg yolks was chromatographed on an MgO adsorption column. The eluate from the MgO adsorption column manifested vitamin A activity when fed to chicks. Spectrographic analysis of this fraction showed the maxima characteristic for xanthophyll and in addition it showed a broad inflection near 3,100 engstroms. The alcohol fraction I, orange, top layer manifested no vitamin A activity when assayed with either rats or chicks. Fraction II (the pink-lavender layer and all below it) manifested vitamin A activity when fed to rats. Spectrographic analysis of Fraction II showed it to be devoid of any carotenoid pigment, however, a peak was observed near 3,100 engstroms indicating the presence of some growth-promoting compound.

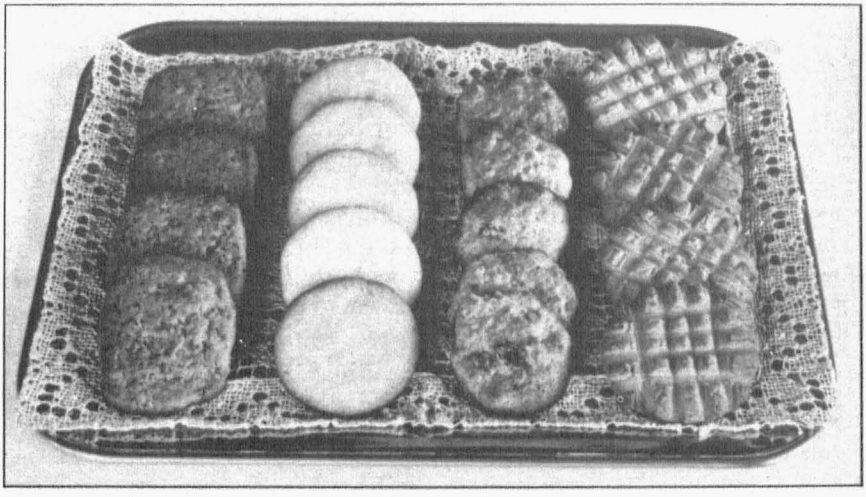
The Vitamin Potency of Pork as Influenced by the Rations. Two groups of swine were fed a vitamin A deficient ration. In addition to the vitamin A deficient ration, one group received 3 milligrams of commercial crystalline carotene per 100 pounds of live weight per day. Tissues of these animals were cooked in a pressure cooker, ground, dried in a current of warm air and tested biologically by the rat-growth method. None of the rats fed these tissues, either from those animals on the low ration or from those fed carotene, survived to the end of the experimental period of 5 weeks. Bertha Bisbey and Adelia Weis believe that the carotene fed to the one group was at a level sufficiently high to promote normal growth and prevent all signs of vitamin A deficiency but not high enough to allow for an appreciable amount of storage of vitamin A in the tissues of the animals.

The experiment was repeated feeding the swine rations high in vitamin A and high in riboflavin. The results indicated that the ration influenced the vitamin A content of the tissues. Assays showed that the storage was highest in the liver, followed by the kidney, then organ fat, and lastly jowl.

Testing Flours for Their Adaptiveness to Different Culinary Uses. Better standardization of flour qualities in Missouri will benefit both the home and commercial baker by giving them reliable quality in products with lessened risk for baking failures. If Missouri flours can be better standardized and proved to be as dependable for baking results as flours from other regions, saving in both transportation and handling costs will result. Ferne Bowman and J. M. Poehlman have made baking tests on five experimentally milled samples of flour from five pure varieties of wheats grown in Missouri and six brands of commercial flours from Missouri mills. A wide variation was found in qualities of the baked products.



Yeast rolls. Left, rolls made of 50 per cent whole wheat, 37½ per cent white and 12½ per cent soya flour. Right, rolls made of 87½ per cent white and 12½ per cent soya flour.

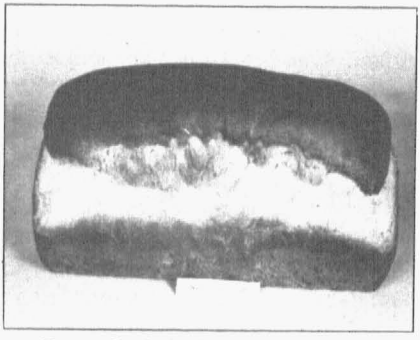


Cookies containing soya flour.

Volume and texture in white cakes, and to a lesser degree in sponge cakes, varied most with the quality of a flour. Some of the flours tested compared favorably to a commercial cake flour. Commercial flours from Missouri showed considerable variation in total scores in cakes. Differences were less marked in baking powder varieties. A change in cake formula, for example from a lean to a rich formula, for baking tests may cause one to change the evaluation of a given flour in relation to others. This may be responsible in part for variations in baking tests reported from different laboratories.

Clarkan and Early Premium wheat flours were satisfactory for cakes and for biscuits. These flours compared favorably with a standard cake flour. Cakes and biscuits made from Kawvale flour have reduced volume, poor texture, and poor color.

Prices and Qualities of Towels and Toweling. Two hundred thirty-three terry cloth towels, twenty-five tea towels, and twenty-eight different pieces of toweling have been tested for quality by Pauline Keeney. The durability of terry cloth towels was influenced by their construction. Of the towels studied, price was no indication of quality. Towels 22 x 44 inches in size varied in cost from 18 cents to $1.50. Trade marks or brand names gave no indication of quality. One nationally advertised brand had towels 16 x 30 inches in size varying in cost from eight cents to $1.59. Few manufacturers made any attempt to put informative labels on their towels. The majority of the towels tested were color fast to both sunlight and laundering. Three peach colored towels of varying prices were not fast to sunlight while only six towels showed signs of fading in laundering. The absorptive qualities of towels were influenced by the weight since the heavier towels were highest in the amount of water absorption. The length and closeness of the pile when considered together greatly affected the absorption of water. The length of pile alone did not influence the absorptive qualities to any marked extent.



Properly baked loaf of nutritious bread.

Tea towels and toweling are made from cotton, linen, and a mixture of these fibers. Rayon also has been included in large quantities recently. The thread count of the tea towels and toweling studied varied and cannot be used as an indication of durability. Towels of crash and those of glass toweling may have the same amount of strength but the size of the yarns vary considerably. The tensile strength of such materials cannot be estimated either by thread count or fiber content. Tensile strength depends upon a combination of fiber content of yarns and the amount of twist.

Good and poor materials were found in all groups of towels as evidenced by the wide variation in fiber strength. A loss of strength was found in each group containing materials made of cotton or mixed fibers. One-fourth of the total number of tea towels and toweling tested showed objectionable losses of color after 40 hours of exposure in the fadeometer. The toweling was more color fast than the ready-made towels. Only eight of the test pieces showed losses of color when laundered. Cotton towels were found to absorb a greater amount of water than the other groups. Linen towels absorbed moisture more rapidly and dried much faster than the other groups.

Of the terry cloth towels it appears that the consumer cannot use price, brand, weight, or construction solely as the basis for purchasing towels; and of the tea towels and toweling material, fiber content, price, and brand give little indication of the durability or the satisfaction to be desired from these towels.

Other work in the Department of Home Economics included basal metabolism studies upon 32 freshmen students and 35 volunteer students not restricted to any one class; studies on the effect of drying and of storage upon the nutritive value of eggs; and studies on the prices and qualities of drapery and cotton dress materials.

HORTICULTURE

T. J. TALBERT, *Chairman*

Controlling Biennial Bearing of the Apple. Some apple varieties such as Yellow Transparent, Duchess, Wealthy, and York are pronounced biennial bearers while others may drift into this habit as they become older. During the past few years biennial bearing has become an especially acute problem in the central states because of frosts and recurring droughts. Bearing may develop to the point in an orchard where there is an abundance of fruit in the "on" year and very little if any fruit in the "off" year. If some of the trees could be brought into bearing in the "off" year the production of fruit could then be distributed somewhat equally each year. With the object of securing a full or at least a part crop in the "off" year, A. E. Murneek used caustic sprays (such as creosote tar, tar oil distillate, and dinitrocyclohexylphenol) to destroy partially or completely the bloom on a large number of apple trees. Completely killing the bloom with 1.5 to 2.0 per cent spray usually resulted in the production of a crop in the "off" year excepting on Yorks of subnormal vigor. Spraying the bloom with a .5 per cent concentration reduced the crop to about one-half in the "on" year and the trees came back with a good crop in the "off" year. While the bloom was lighter in the "off" year more flowers set fruit. The yield of the treated trees over a two year period was increased. It was found that the best time to spray was in the late cluster bud stage. To kill the bloom completely, spraying must be

very thorough. Flowers on tips of branches and in the center of the tree were the most difficult to destroy. Older trees, that have a delayed or secondary bloom, also were difficult to handle, often requiring two spray applications for a complete kill of all flowers.

Another series of tests was conducted with York and Golden Delicious apple trees, 17 years old, growing on poor sandy soil. Shortly after the bloom was destroyed in the "on" year by caustic sprays some branches were ringed on a number of trees. In the following "off" year there was a light bloom and fruit set on the controls and those sprayed the year before. The girdled limbs produced an unusually fine bloom and set heavy crops of fruit. In the third year the ringed branches had but little fruit, but the control branches on the same trees produced heavily. This alternation, induced by the use of caustic sprays and ringing in parts of the same tree, therefore may be of practical significance in the control of biennial bearing of certain varieties of apples. In order to make fruiting more certain in the "off" year, flower removal by caustic spray should be supplemented with branch ringing 2 to 3 weeks later.

Physiology of Reproduction in Horticultural Plants. By disbudding, deflorating, and defruiting several types of horticultural plants A. E. Murneek has demonstrated that the reproductive capacity of a continuously developing plant was determined chiefly by the preceding reproductive activity. Two or three cycles of flowers and fruit were often produced on control plants with intermittent periods of sterility, while plants treated as above became everbloomers. This behavior was independent of the nutrient supply. Sterility of flowers and flower bud abortion were caused by the presence of fruit on the basal portions of the plants. Highly reproductive branches senesced prematurely and sometimes died, while adjoining non-fruiting branches remained in a succulent vegetative state.

When the reproductive organs were removed early in their development, the plants accumulated more dry matter and nitrogen and synthesized more carbohydrates.

It is common knowledge that developing embryos exert a profound influence upon the fruit, but it is less generally known that this influence may extend beyond the limits of the fruit to all vegetative portions of the plant. Two periodic stimulations in growth were found to be associated with sexual reproduction in higher plants. Both were associated with fertilization, one with the union of chromosomes and the other with the union of nuclei. As a result of these stimulations the metabolism of the whole plant was accelerated resulting in increased production of fresh and dry matter, greater absorption of soil nutrients, and augmentation in accumulation of the products of photosynthesis. The effects of fertilization on growth of the whole plant were secured with cucumber, pepper, and cherry. Both normal and parthenocarpic fruit were induced to form large numbers by proper pollination and application of B-indole butyric acid to the stigmas,

or just by application by B-indole butyric acid to the stigmas. The fruit was removed from some plants or branches when still very young, while other plants were disbudded and deflorated for comparison.

Increase in growth hormone formation was found to be the cause of the stimulation from sexual reproduction. Ether and other extracts were made of ovules containing very young embryos and used in making growth tests. The ether extract, dried and mixed into lanolin, was found very effective in producing parthenocarpic fruit in the pepper. Such fruit grew, like normal seeded fruit, to full size; while parthenocarpic fruit, induced by application of a synthetic growth substance, was subnormal and often dwarfed in appearance. There was evidence of a catalytic stimulation during the earliest phases of sexual reproduction as indicated by catalase activity in flower and leaf buds in two varieties of pears and plums. A peak in catalase activity was reached in the flower buds at the time the micro- or macrogametophytes were formed. This was followed by a peak a few days later in the leaf buds. A continuous removal of young flower buds before gametogenesis caused tomato and squash plants to make less growth and to accumulate less dry matter than plants on which the flower buds were allowed to develop normally.

Effect of Hormone Sprays on Fruit Set and Size of Tomato and Pepper Plants. Marglobe tomatoes were grown in glazed jars in rich potting soil which had been limed and fertilized. The soil was sterilized to eliminate wilt disease. Supplementary to hand pollination of the flowers, two duplicate groups of 14 plants were sprayed with the following growth substances: naphthyl acetamide, 20 p.p.m.; and naphthyl acetamide, 10 p.p.m. Both were applied in a water solution by means of a greenhouse hand sprayer. The spraying began when the first flowers were opening and was continued at weekly intervals for a period of 3 months during the winter, when difficulties of pollination and fruit setting usually have been experienced.

The growth substances used as sprays hastened the maturity of the fruit, increased its average size, and enlarged the total yield. The sprayed fruit developed more of the gelatinous placental tissue and had a somewhat better flavor.

The same sprays, but at half the concentration used on tomatoes, were applied to peppers of the Chinese Giant variety. Instead of increasing the fruit set and yield, the treatment decreased it. Apparently, all plants do not respond similarly to specific hormone sprays. Foliage of the sprayed plants was conspicuously greener.

The Nutrition of Vegetables. Potato scab is one of the more harmful diseases of potatoes, not only in Missouri but in many parts of the United States. Preliminary work has indicated that some plant diseases may be controlled by applications of fertilizers. In 1941 R. A. Schroeder again demonstrated that the occurrence of potato scab was associated closely with the exchangeable calcium and potassium in the soil. An excess of either,

regardless of the pH of the soil, resulted in the potatoes being attacked by the scab organism. With the proper calcium and potassium ratio, the occurrence of scab was reduced materially at all of the pH levels tested. Nutrition seemed to be of more importance in potato scab control than pH of soil or severity of inoculation.

For many years it was thought that calcium was beneficial because it neutralized the acidity of the soil and that the hydrogen ion itself was detrimental. Recent experiments have shown that instead of the hydrogen ion being detrimental it actually is distinctly beneficial since it aids materially in moving nutrient ions into the plant. This raises the question as to the advisability of liming soils to complete neutrality. Perhaps, it may be desirable to supply the nutrient cations so as not to result in a neutral soil. Calcium should be appreciated and applied as a nutrient rather than to correct soil acidity. These observations have been confirmed in a series of tests in which spinach was grown under controlled levels of pH, calcium, and nitrogen.

When spinach was grown upon an acid soil (pH 5.2), its calcium content, magnesium content, and oxalate content showed an increase with increased exchangeable calcium in the soil. There was a greater percentage and total amount of oxalate than either calcium or magnesium. However, the combined total of calcium and magnesium was greater than that of the oxalate. The difference became greater with calcium increments. This is important since only the calcium and magnesium over and above the oxalate content are useful in nutrition of the consumer.

In a series of tests with varying calcium and nitrogen applications the amounts of oxalate and calcium were greater where the larger amounts of nitrogen had been applied. The total oxalate content was greater than the calcium at the high level. At the lower nitrogen level both the percentage and total amount of oxalate were greater only at the lowest calcium level. At the other levels, there was an excess of calcium in the crop. It would seem probable that calcium in a spinach crop grown upon a neutral soil or upon a soil with an unbalanced high nitrogen content would be decidedly less available for human nutrition than if the spinach were grown upon more favorable soils.

The fresh weights of spinach plants grown at 20 levels of soil fertility demonstrated that the ratio in which the various nutrient ions were present was of considerable importance in obtaining the maximum vegetative growth. With either excessive nitrogen or calcium, the growth of spinach plants was reduced significantly. The reduction in growth was not due to excessive soluble salts.

The lower the calcium level of the soil, the smaller was the quantity of nitrogen required to give increased growth. The plants in all the treatments were healthy and, except for differences in size and to some extent differences in color, appeared quite similar.

Vitamin C determinations on the plants demonstrated that material differences resulted from soil treat-

ments. With increased nitrogen in the soil, the nutrient C content of the plant was reduced.

The ratio of one nutrient ion to another is important in making practical fertilizer recommendations. It is entirely possible to reduce yields by fertilizer applications when other ions are not present in adequate quantities. Unless fertilizer treatments are balanced properly, the yield and vitamin content of the plants may be reduced materially.

Flowers for Outdoor Planting. In 1941 sixty-four kinds of flowers were planted out-of-doors by J. E. Smith in order to determine their adaptability for home planting and commercial production of cut flowers. After careful observation during the year the following flowers were classified as of good growth and production of flowers: candytuft, cleome, gilia capitata, leptosyne maritima, larkspur, phlox drummondi, scabiosa, sweet pea, viscaria, viola, zinnia, lupine (annual), agrostis, lagurus, calendula, dianthus, stocks, shirley poppy, and nasturtium; as of fair growth and production of flowers: calliopsis and gaillardia; and as of poor growth and production of flowers: bronus, certain varieties of scabiosa, phlox, and lupines sulphureus.

Several of the so-called "tender" annuals performed very well when planted under conditions prevailing in this test. These conditions usually would be considered best for the "hardy" and "half hardy" plants only.

Commercial Production of Flowers. In 1942, J. E. Smith, Jr., grew chrysanthemum, rose, carnation, marguerite, larkspur, Didiscus, Salpiglossis, Centaurea, and Cheiranthus in soil in direct contact with a concrete bench and in a bench in which the concrete had been treated with asphalt emulsion before the soil was put in place. Growth of all plants was comparable under both treatments and indicated that the expense of asphalt treatment was not justified.

A wooden propagating bed with automatic watering trough below was designed in 1941 and has been in continuous use, without change of sand for two years. Successive batches of cuttings of many different kinds, and at all seasons of the year have not been attacked by damping off or other diseases common in the standard type of propagating bed in which overhead watering is necessary.

Poinsettia plants of the variety Oak Leaf were potted in loess and loam soils to which hoof meal, dried blood, and soybean meal had been added as fertilizing materials. Hoof meal was definitely superior as a fertilizer to incorporate with the soil at potting time. Blood and soybean meal had some inhibiting effect. The checks showed symptoms of nitrogen deficiency sooner on the loess soil, but produced a much taller plant with longer internodes than did those in loam.

The Mexican grown Easter lily variety "Shangrila" was definitely superior to the American grown varieties "Croft" and floridi". Seedlings of "White Queen" made very good plants but were less uniform in height and number of flowers produced per plant than were the other varieties started from bulbs.

Christmas Trees as a Crop in Missouri. It is estimated that over 400,000 Christmas trees are shipped into Missouri each year. Wholesale prices are 40 to 50 cents each. Since Christmas trees of adaptable species may be grown at a density of 3,500 trees per acre requiring from five to ten years to reach salable size and since they could be grown in Missouri a demand amounting to about $200,000 annually might be supplied largely from within the State. Many species of Christmas trees have been tested for Missouri climatic and soil conditions. All northern and western spruces and firs tested have proved unsatisfactory. The jack, Virginia, and pitch pines showed promise as commercial Christmas tree crops. Pruning to desired form had to be done to improve the shape of some trees. Upon testing for needle retention under arid room conditions during the winter, the trees lost their decorative value in the following order: Virginia pine, 21 days; shortleaf, jack, pitch and red pines, 45 days.

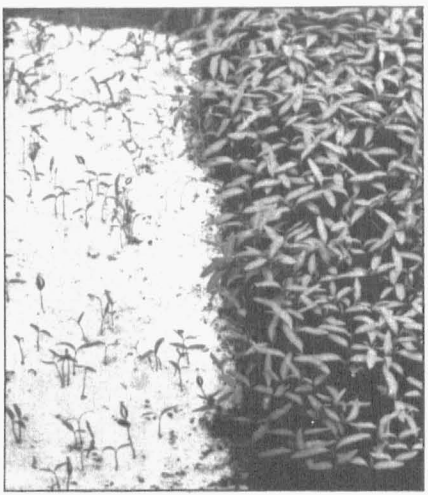
Inoculation of Garden Peas. Whether or not garden peas should be inoculated has been a problem over which there has been considerable confusion. R. A. Schroeder has grown a number of test plots of peas in which one-half of the plants were inoculated and the other half were left untreated. Inoculating the peas accounted for an increase in growth of about 13 per cent. Also, the influence of calcium and nitrogen in the soil upon nodulation and the calcium content of pea plant has been studied. The peas were grown at five calcium levels and at two nitrogen levels. In general, increased exchangeable calcium in the soil resulted in increased plant growth, increased nodulation, and increased calcium content of the plants. The higher nitrogen level gave a greater nodulation and total growth. The fertility of the soil, in a large measure, determined whether or not the inoculation of garden peas would result in increased growth and nodulation. These tests were repeated in 1943 and the results confirmed those previously obtained.

Proper Soil Management for Young Apple Trees. Apple trees of Jonathan, Winesap, Golden Delicious and Rome varieties were planted in the fall of 1938 on Grundy silt loam soil. They were divided into 4 blocks of 2.5 acres each and the soil managed as follows: (1) intercropped with corn, (2) clean cultivated, with barley cover crop in winter, (3) lespedeza cover crop and (4) grass sod.

During the first and subsequent years, trees intercropped with corn made the best growth as judged by increase in trunk diameter and linear growth of the twigs. The total twig growth per tree ranged from 626 cm. for those intercropped with corn to 286 cm. for those grown in grass sod. A. E. Murneek further pointed out that either in presence of corn or without, the intercrop cultivation conserved soil moisture. In the spring of 1942, the trees in the blocks intercropped with corn were conspicuously larger and better developed than in the clean cultivated block.

"Root Promoting" or Stimulating Substances Do Not Aid Growth and

Development of Strawberry Plants. Nursery grown strawberry plants of Premier and Aroma varieties were soaked for one hour and 12 hour periods in B_1 solution at .1 milligram and .5 milligram per 1000 cc of water concentrations and in two organic acid solutions at 2 milligrams and 50 milligrams per liter of solution. After treatment the plants were potted in a sand and loess soil mixture. The loess soil was taken from near the bottom of a deep road cut and was practically devoid of organic matter. Sodium nitrate solution was added to part of the plants to provide ample nitrogen. The established strawberry plants of Aroma, Premier, and



Tomato seedlings showing the influence of sphagnum moss on seed germination.

Blakemore varieties were watered weekly with a .1 milligram—1000 cc water solution of B_1 and sprayed weekly with a 10 milligram—1000 cc solution of indol acetic acid. Another group of plants was watered with the same concentration of naphthaleneacetic acid.

H. G. Swartwout noted no difference in the development and re-establishment of treated and untreated transplants, nor did the concentrations used affect growth and runner production of established plants. No benefit was obtained from treating strawberry plants at transplanting time or treating established plants with solutions of B_1, indol acetic acid, and naphthaleneacetic acids.

Soil Fertility Maintenance for Tomatoes Grown in Containers. Tomato plants were grown in glazed containers in the greenhouse for experimental purposes. Screened leaf mold was spread on top of the soil 1 to 2 inches thick and plants were watered with sodium nitrate periodically to maintain highest soil fertility for growth and fruiting. A. E. Murneek found that handling the plants in this manner was superior to the application of NPK fertilizer periodically. Appreciable quantities of inorganic soil nutrients were obtained from disintegration of the leaf mold.

Heavy Nitrogen Applications to Apple Trees Grown in Sod. Mature Wealthy apple trees of average or below average vigor were subjected to heavy fertilization with nitrogen in 3 successive "off" years. The rates of application of a mixture of sodium nitrate and ammonium sulfate were 7, 10, 14, and 20 lbs. per tree. Half of the fertilizer was dug in with the spade and the remainder broadcast. Six years' observation showed that heavy nitrogen appli-

cation (twice to three times the usual quantity) produced larger shoots, larger and greener leaves, and more and larger fruit. There was a delay in the maturity of the fruit and the fruit had less color. There was some marginal burning of the leaves from the high dosage. There was no change in the alternate bearing habit of the trees. A. E. Murneek believes that when commercial nitrogen fertilizers become cheaper and more readily available it would be profitable to fertilize the fruit trees grown in heavy sod on poor soil heavier than is customary at the present.

Correctives for Arsenical Injury of Apple Foliage. Most of the commonly used spraying materials are toxic to plants as well as to insects and diseases, and the margin of safety in their use usually is quite small. Under normal weather conditions there is more or less spray injury in Missouri every year. In some seasons it reaches serious proportions. There have been cases where the damage caused by the spray was as great or greater than would have resulted from the insect or disease. Nevertheless, spraying is necessary since the risk of damage from insects and diseases is greater than the risk of damage from spraying.

Safer and reasonably effective materials which could be substituted for such sprays as Bordeaux, lime-sulfur, lead arsenate, or modifications of these materials, would be of great value.

Zinc sulfate-hydrated lime mixtures have been used in checking arsenical injury on peaches. Perhaps it may be used to advantage on apples. In the earlier trials, when fairly strong concentrations were used in the early part of the season, there was an apparent zinc russeting of the fruit, especially with Golden Delicious apples.

As a late season corrective for arsenical injury to apple foliage several formulae of zinc sulfate-hydrated lime were used on Golden Delicious, Jonathan, and Ben Davis beginning with the third cover spray after the use of fungicides had been discontinued. One low concentration Bordeaux formula was included in the trials. Five applications were made on June 7, June 21, July 7, July 21, and August 13 respectively. The following formulae with powdered zinc sulfate (36 per cent zinc) and high calcium hydrated lime were used:

Zinc-lime	½-1-100 gals.
Zinc-lime	1-1½-100 gals.
Zinc-lime	2-3-100 gals.
Zinc-lime	4-6-100 gals.
Bordeaux Mix.	½-1-100 gals.

The lead arsenate was held constant at 3 lbs.-100 gals. in all the applications and plots. A check plot of lead arsenate alone and a lead arsenate-hydrated lime plot of 3 lbs.-3 lbs.-100 gals. concentration were included in the test.

By early September, 1941, it was evident that conditions were especially favorable for arsenical injury, since all the trees that received lead arsenate alone showed moderate to severe injury. The estimated loss of effective leaf area on Golden Delicious was from 20-25 per cent; on Jonathan, 30-35 per cent; and on Ben Davis, 40 per cent.

The addition of hydrated lime, 3 pounds to 100 gals. with the 3 lbs. of lead arsenate gave some reduction in arsenical injury but damage was appreciable on both Jonathan and Ben Davis, although less severe on Golden Delicious. The ½-1-100 zinc-lime mixture reduced arsenical injury about one-half on Ben Davis and Jonathan and to about one-fourth on Golden Delicious as compared with lead arsenate alone. With the 1-1½-100 zinc-lime mixture, there was no arsenical injury on Golden Delicious and very little on Ben Davis and Jonathan. The 2-3-100 and 4-6-100 formulae prevented arsenical injury almost entirely on all varieties. With the ½-1-100 Bordeaux mixture there was no injury on Golden Delicious and only five and six per cent on Jonathan and Ben Davis respectively. There was no difference in fruit russeting on any of the plots.

Therefore, it would appear that late season arsenical injury to apple foliage can be reduced by the use of a ½-1-100 zinc-lime mixture. However, for almost complete elimination a 1-1½-100 formula for varieties not very subject to arsenical injury and a 1½-2-100 formula for susceptible varieties are recommended. It seems doubtful that the added margin of protection afforded by higher concentrations is justified. The above formulae were based on the powdered 36 per cent zinc sulfate. For flake zinc sulfate (25 per cent zinc) corresponding formulae are:

(1) ¾-1-100 (2) 1½-1½-100
(3) 2-2-100

Because of the risk of copper injury Bordeaux mixtures should be used with caution.

In 1942, Bordeaux ½-1-100 to 2-3-100 beginning in the 3rd cover spray were effective in reducing arsenical injury from lead arsenate. Maximum protection was reached with the 1-2-100 formula. There was slight copper burn on Golden Delicious and Ben Davis foliage with 2-3-100 Bordeaux but none with the weaker mixture. Jonathan, Delicious, and Winesap were not injured with any of the Bordeaux mixtures. The 1942 season was very favorable to copper and arsenical injury. Bordeaux was not quite as effective in reducing arsenical burn from lead arsenate in 1942 as in 1941.

The 1-1½-100 zinc-lime mixture beginning in the 2nd cover spray was highly efficient in reducing arsenical injury. A ½-½-100 zinc-lime mixture was as effective and safe as mixtures containing greater quantities of lime. This, no doubt, was the result of the hard well water which was used in the experiment. Hydrated lime 3 lbs. with 3 lbs. lead arsenate in 100 exerted practically no protective action. Zinc-lime mixture with a liquid lime sulfur-lead arsenate spray at the calyx and 1st cover periods had no appreciable effect on the amount of russeting as compared with the same spray without the "safener".

Without effective "safeners" lead arsenate caused a 35% to 57% leaf fall by mid August on Jonathan, Golden Delicious, and Ben Davis followed by a heavy preharvest drop of Jonathan and an appreciable preharvest drop of Golden De-



Grape vineyard on contoured soil of Horticulture Farm.

licious. Copper arsenate both with and without a zinc-lime mixture in the scab sprays caused severe russeting of Jonathan fruit. Without the "safener" the leaf injury was severe but with "safener" the foliage was not affected. In the later cover sprays only, the copper arsenate again caused heavy leaf injury on Jonathan, Golden Delicious, and Ben Davis where a corrective was not used, but with a zinc-lime mixture the injury was practically eliminated. There was no fruit russeting on Jonathan, Golden Delicious. and Ben Davis from the later cover sprays of copper arsenate. The copper arsenate alone injured cherry foliage but the injury was light when zinc-lime was used with it. Microfine sulfur at 5 lbs. in 100 gallons in hot weather caused a burning of peach fruits on the side exposed to the hot sun. In severe cases there was a cracking of the fruit.

H. G. Swartwout believes that the results obtained in the last two years have shown that a ½-1-100 Bordeaux and a 1-1-100 zinc-lime mixture can be safely used by apple growers beginning in the second cover spray to reduce effectively late season foliage injury from lead arsenate and in preventing a possible heavy preharvest drop.

Black Rot Control on Grapes. Black rot is one of the most serious of grape diseases. This disease can be controlled effectively by Bordeaux mixture but late season applications are objectionable because of spray residues. Growers in Southeast Missouri have reported

difficulty with this disease. Tests were made in that area to determine the best spray schedule.

The results of the various schedules tried by H. G. Swartwout indicated that a dormant spray of 10-10-100 Bordeaux mixture with ½ gal. of a dormant miscible oil followed by a one per cent Elgertol spray preceding the regular summer applications did not aid in the control of black rot. A full bloom spray of Bordeaux mixture was of no benefit, although with an abnormally long blooming period, such a spray might be helpful. The regular summer schedule of 8-8-100 Bordeaux applied when the new growth was one-half inch long, when the new shoots were 8-10 inches long, before bloom, after bloom, and two weeks later was adequate. Copper oxychloride, four pounds to 100 gals. with ½ gal. summer oil, while indicating some control of black rot was distinctly inferior to Bordeaux mixture.

The described Bordeaux spray schedule usually was adequate in the average season for controlling black rot on Concord grapes and should be used as the chief control measure. Dormant sprays have not aided in the control of the disease. Copper oxychloride and copper ammonium silicate have proved inferior as compared with Bordeaux mixture.

POULTRY HUSBANDRY

H. L. KEMPSTER, *Chairman*

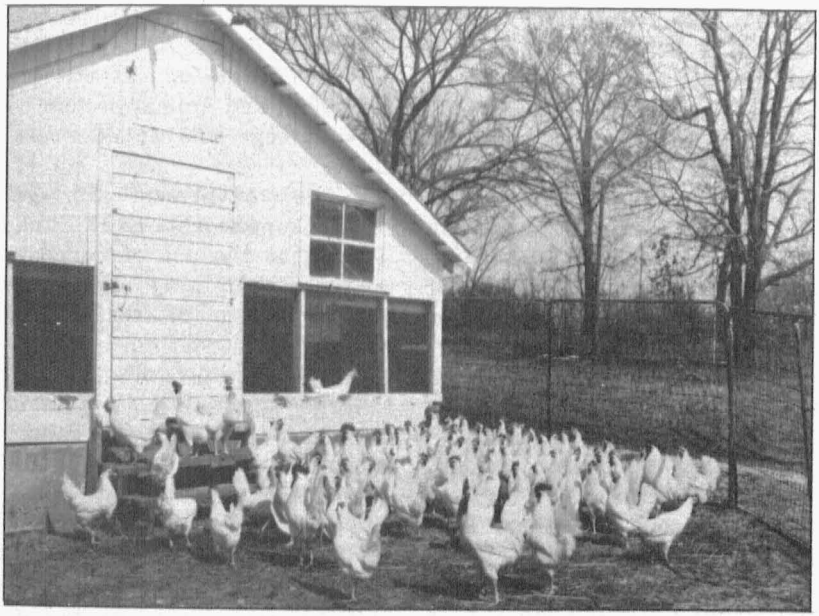
Cleaning Soiled Shell Eggs. Egg packers have been very much interested in some practical method for cleaning soiled shell eggs. In general the methods employed in cleaning soiled eggs have impaired their keeping quality. In 1942 fifty-four cases of eggs were stored for 8 months in a cold storage warehouse. Part of the eggs had been cleaned with a one per cent lye water solution and the remainder washed with water at relatively high temperatures. The losses in the eggs washed with a one per cent lye water solution and stored for 8 months were negligible, averaging less than one per cent. The eggs cleaned by washing with water at relatively high temperatures kept remarkably well, the loss being less than two per cent. E. M. Funk was in charge of this work.

Stabilizing Quality in Shell Eggs. For many years producers, handlers of eggs, and investigators have tried to develop improved methods of production and marketing whereby the consumer would receive a high quality egg, with characteristics approaching those of a freshly laid egg. The quality in shell eggs was stabilized by applying heat so that it penetrated the entire egg. When fertile eggs were treated by this process embryonic development was immediately and permanently arrested. The albumen was stabilized by this process so that the normal break-down of thick albumen was greatly retarded. Eggs treated by this process kept their commercial grade much longer than untreated eggs. Yolk blemishes and stuck yolks were minimized. Cooking tests showed that treated eggs

were definitely superior to untreated eggs. E. M. Funk believes that this process may be of value in preventing loss of quality and spoilage in eggs.

Effect of Time of Hatching White Leghorn Chicks on Egg Production. The optimum date for hatching White Leghorn pullets has been the subject of considerable controversy for some time. Experiments under the direction of H. L. Kempster indicated that apparently the latitude was much broader than formerly supposed. White Leghorn pullets were hatched at weekly intervals from February 17 to April 20. Their egg production to the end of the first laying season was observed. The February hatched pullets proved superior as egg produc- 32 eggs each from date of first egg to October 31 and 184 eggs for the ers but the margin of superiority was not significant. They averaged following year. Those hatched in March laid 10 less eggs prior to October 31 and 166 eggs from November 1 to October 31. Those hatched in April laid 5.6 fall eggs and 175 eggs for the year. From date of first egg to end of first laying year total egg production for the respective groups was as follows: February 217, March 187, and April 181.

The Normal Growth of Chickens. During the 1941 growing season the average weights of Rhode Island Red, White Leghorn, and New Hampshire pullets up to the age of 24 weeks approximately the normal established for those breeds. The differences in weight between those



Flock of White Leghorns on Experimental Poultry Farm.

hatched in April were not as marked as was sometimes experienced. At the age of 24 weeks those hatched in April averaged from 10 to 17 per cent smaller. Relatively moderate temperatures prevailed throughout the growing season with the exception of a four-week period from July 19 to August 15 when the average maximum temperature was over 90° F. The percentage normal growth declined to 80 for this period. In 1942 normal growth of chickens was experienced even though for the first time milkless rations were used. The usual differences in growth due to the time of hatching were observed. As compared with normal weights New Hampshires at various ages up to 20 weeks attained weights ranging from 96 to 107 per cent of normal. The Rhode Island Reds were normal in size at all ages. The weights of White Leghorns were slightly above normal. Chicks fed milkless rations in which the amount of meat scrap had been reduced materially were of normal weights at the age of 4 weeks. Experimental results over a period of years have indicated that growth standards and records afford a yardstick for measuring successful production. The results of this study have demonstrated the importance of selecting rapid growing strains for broiler production and the desirability of early hatching when economy of production is the goal. This work has been under the direction of H. L. Kempster.

Nutritional Requirements of Turkeys. During 1942 a strain of U. S. D. A. White Turkeys developed at Beltsville were used to ascertain their adaptability to Missouri conditions. They were found to be very efficient producers of meat.

The economy of gains made by male and female Bronze turkeys was measured and it was found that the male turkeys utilized their feed more efficiently than did the females.

The cost of gains made by turkeys receiving concentrate mixtures containing difference percentages of protein was determined. It was found that gains made by turkeys that received 40 and 36 per cent protein mixtures were more expensive than those made by turkeys fed concentrate mixtures containing 23 per cent protein. Again in 1943 results indicated that turkeys waste very large quantities of protein when fed mixtures containing relatively high percentages of protein. It also was found that turkeys held beyond 24 weeks of age actually produced gains for less cost (cents per pound and animal protein cost) than turkeys sold at 24 weeks of age.

In view of present shortage of protein supplements E. M. Funk believes that the use of concentrate mixtures containing high percentages of protein for feeding turkeys should be discontinued. He also thinks that turkeys might be grown to larger sizes and older ages without reducing economy of gains. If this were done, several million pounds of turkey meat could be added to our meat supply.

Protein Supplement in Poultry Rations. In the present emergency satisfactory poultry rations that do not contain dried milk are of particular value. Under war condi-

tions soybean acreage and soybean oil production have been expanded and the soybean oil meal resulting from this major expansion could be utilized to advantage. Also in lespedeza seed the farmer is producing at comparatively low cost an excellent vegetable protein supplement for his growing chicks. H. L. Kempster has been using these two supplements in chick rations with very satisfactory results. Rations containing lower levels of dried milk than generally recommended produced satisfactory results when the alfalfa leaf meal content was adjusted to provide 290 units or more of vitamin G per 100 grams of feed. Rations containing soybean oil meal to the extent of 25 per cent of the total ration produced gains equal to the average of the controls when fed in combination with 2 per cent or more of animal protein supplement plus bone meal.

Preliminary results indicate that lespedeza seed may be substituted for soybean oil meal to the extent of 13 per cent of the total chick ration. Sticky droppings developed when greater amounts than this were fed.

Laying mashes containing various proportions of meat scrap and soybean oil meal have been fed. The all meat scrap mash contained 20 per cent meat scrap. In the other mashes ¼, ½, ¾, and all the meat scrap was replaced by soybean oil meal. In making the substitution 1.07 pounds of soybean oil meal was used for each pound of meat scrap replaced. Bone meal was added to rations where meat scrap constituted less than one-half the protein supplement. White Leghorn hens in their second laying year were used.

No significant difference in egg production resulted from feeding laying mashes in which ¼, ½, ¾, and all of the meat scrap was replaced by soybean oil meal. Egg production from September 27 to April 30 ranged from 58 eggs per hen in the "all meat scrap pen" to 71.6 eggs for the pen in which ¾ of the meat scrap was replaced by soybean oil meal.

The Feed Purchasing Power of Eggs. Missouri usually experiences an expansion of its poultry numbers when the egg-feed ratio falls below 7. The year 1941 was characterized by a marked increase in feed purchasing power of eggs. The egg-feed ratio was 6.3. The index for feed rose from 88 in January to 118 in December or from $1.08 per 100 pounds to $1.45. Egg prices for January, February, and March were below the 1910-14 level but the index was over 150 from June to September. Egg prices rose from 13.6 cents per dozen in February to 30.7 cents in November. The average Missouri farm price of eggs for the year was 19.8 cents per dozen as compared to 14 cents for 1940. Feed averaged $1.25 per 100 pounds as compared to $1.12 for the preceding year. The eggs from a 122-egg hen would purchase 162 pounds of feed in 1941 as compared to 124.4 pounds for 1940. In 1942 extremely favorable relationships between feed and egg prices prevailed. The eggs of a 122-egg hen in 1942 would purchase 167 pounds of feed as compared to 162 pounds for 1941. Since 1910 the only years with more favorable feed purchasing power than 1942

were 1921, 1926, 1932, and 1938. The average farm price of grain for 1942 was $1.61 as compared to $1.25 for the year previous. Egg prices averaged 26.65 cents per dozen which is the highest since 1925. From an income over feed cost standpoint the production of eggs was the most profitable since 1921, being 4 cents per hen higher than for 1929. In making this analysis H. L. Kempster has used the Missouri Farm prices of feed and eggs based on data from the Department of Agricultural Economics and the normal distribution of egg production per month which was based on Missouri farm flock records.

The Comparative Value of Certain Grains in Rations for Egg Production. In 1941 rations containing 75 per cent kafir; 75 per cent corn; 50 per cent corn supplemented with 25 per cent of either oats, wheat, or barley; and 33 per cent corn supplemented with 42 per cent of either oats, wheat, or barley were fed to White Leghorn hens. Each ration contained, in addition, 15 per cent of bran and shorts combined and 10 per cent of protein concentrates in the form of meat scrap, soybean oil meal, and dried buttermilk. Results this year showed that supplementing corn with wheat, oats, or barley failed to improve rations for egg production. The production per hen from September 1 to March 15 ranged from 60 to 69.5 eggs per hen. There appeared to be no significant differences which could be attributed to the various types of grains used in the ration.

Somewhat similar results were obtained in 1942 when laying hens were fed rations consisting principally of corn, kafir, and combinations of corn and wheat, corn and oats, and corn and barley. In the corn and kafir rations 75 per cent of the ration consisted of either of these grains, from ⅓ to ½ of the total grain was corn, the balance being wheat, barley or oats.

Egg production per hen ranged from 123 eggs for the hens fed corn or corn and barley to 102 for the pen in which oats replaced half the corn. A slight advantage in favor of wheat as a supplement to corn was experienced. Barley ranked second followed by oats The difference in egg production for the various groups was not significant. This work was under the direction of H. L. Kempster.

RURAL SOCIOLOGY

C. E. LIVELY, *Chairman*

Soil Conservation and Land Use Practices as Affected by Rural Attitudes and Folkways. After locating a suitable area for this study and making the necessary contacts therein, field work was conducted near Gordonville in Cape Girardeau County. In this area, the farmers have been tilling the land much longer than farmers in Atchison county in Northwest Missouri but much less of their top soil has been lost. The sociological implications of this difference must be sought in the culture, the attitudes, and the practices of the people, as well as in the difference in soil types. This survey was made by C. E. Lively and R. K. Nelson.

The Social Aspects of Farm Labor

in Missouri. A report on farm labor in Southeast Missouri is being prepared by C. E. Lively and George Blair. Part of the information has been accumulated by the department and part of it has been collected by the Bureau of Agricultural Economics in a previous cooperative survey. In addition to this manuscript attention has been given to the current farm labor situation in Missouri. Estimates of farm labor now in use and estimates of potential manpower available have been prepared. This work has been in cooperation with the Missouri State Employment Service and the Missouri Agricultural Planning Committee.

The Rural Schools of Missouri. A study of official data from the Missouri State Department of Education has been continued by C. E. Lively and R. B. Almack. An effort has been made to determine whether or not the rural school system has characteristic variations related to the rural cultural areas of Missouri as delineated in Missouri Agricultural Experiment Station Research Bulletin 305. Results to date have indicated that a close relationship does not seem to exist. Factors independent of those socio-economic factors which determine rural cultural areas appeared to bring about the variations in the rural school systems in Missouri.

Rural Health Facilities in Missouri. In an effort to determine health facilities for rural people in Missouri, C. E. Lively and R. B. Almack have obtained schedules from 260 families in Dallas county covering a record of illness and medical care. Practitioners and other health and medical agencies in the county also have been interviewed.

In addition to the regular schedule material, a controlled interview was conducted with the members of the survey families to determine their opinions and attitudes toward health conditions and medical services. This included the use of home remedies and patent medicines.

An analysis of the physical examinations conducted by the Farm Security Administration for 800 client families in Southeast Missouri during the spring of 1941 also was used. To date approximately 75 statistical tables have been prepared from these data. Each of the cooperating agencies has been provided with a set of these tables and preliminary reports have been partially prepared.

The data from Dallas county showed that obtaining medical service was an acute problem in that area. Most rural families commonly resorted to home remedies and to numerous patent medicines offered for sale. It was indicated clearly that there was need for public education with respect to health, nutrition, and the nature of disease.

The physical examination data obtained from the Farm Security Administration clients indicated that the physical condition of these people was in need of attention. Strong evidences of malnutrition were prevalent among the younger members of the population. Recommendations have been prepared for the Missouri State Agricultural Planning Committee and a number of lines of action have been sug-

gested. Conferences with numerous officials have confirmed the fact that the scarcity of physicians during the war period will make it difficult to provide any great improvement in rural medical service until after the war. However, it is possible to stimulate educational campaigns in rural health and a number of agencies in the State are planning a coordinated rural health program.

The Handicrafts of the Ozark Highlands. A general survey of the entire Ozark highlands of Missouri to determine the major agencies producing and marketing handicraft in that area has been made by C. E. Lively, J. R. Bertrand, and H. Ruth Gardner. Much material has been collected, both by correspondence and by field work. Also, a field study of the farmers participating in handicraft production was conducted in sample areas to determine the items being produced and whether or not there were additional possibilities for such production.

Apparently, handicraft production was distributed unequally through the area. Also, the leading producers of handicraft articles were not farmers; and a high percentage of the products sold in the Ozark area were not produced there at all but were imported from elsewhere for sale in that area.

SOILS

W. A. ALBRECHT, *Chairman*

The Physical and Colloidal Properties of Heavy Clay Soils. Membrane electrodes have been used in the study of cationic activities in soil. The results have shown that the ionic environment of the plant root may be entirely different from what had been supposed previously from considerations of the total exchangeable bases present. For example, in one case where the total exchangeable Ca/K ratio was 3:1 the ionic activity ratio was 0.3:1. (C. E. Marshall.)

The Uptake of Nutrient Elements by Plants. Extensive experiments have been conducted by C. E. Marshall to determine the effect of various elements upon the uptake of others by plants. Bluegrass, redtop, sweet clover and Korean lespedeza were grown in the greenhouse using Putnam and Lindley soils. The experiments involved different levels of exchangeable calcium, magnesium, sodium and potassium, all crops receiving adequate phosphorus and nitrogen.

The results showed very clearly the influence of each of these basic elements upon the uptake of the other. In general the divalent cations depressed the uptake of monovalent cations and vice versa. The uptake of a given cationic nutrient by the plant depends chiefly on the relative ease with which it can be released by exchange from the soil. This, in turn, depends on the ease of release of the other exchangeable ions and on their relative amounts.

The same results were obtained on both the Lindley and on the Putnam soils.

Fine Lime for Legumes. The use of fine lime in a two-year rotation of corn and oats-sweetclover has

shown great promise. Annual light applications of lime have been of considerable help in improving the productivity of the soil. This has been evidenced by the application of as little as 300 pounds of ordinary limestone drilled with the oats and sweet clover seeding (the sweet clover turned under the following spring preceding corn) which has increased the annual average yield of the corn by 7.7 bushels. The increase by the use of 2 tons per acre, an application over ten times as heavy, has amounted to 17.6 bushels of corn per acre.

W. A. Albrecht believes that these facts and observations point to the possibility of using one or two heavy applications of limestone to cover past neglect of liming and then using lighter applications regularly in the rotation.

Soil Composition Influences Nitrogen Fixation and Plant Composition. Soybeans were grown on colloidal clay. Calcium and potassium were varied in the exchangeable forms while the supplies of the other nutrients were held constant. Similar trials were made using potassium and phosphorus as the variables. Results indicated that a narrow ratio of potassium to calcium was necessary for maximum fixation of nitrogen. Inoculated, nitrogen-fixing soybean plants were high in concentration of potassium as well as of calcium. The roots were more effective absorbers of the soil nutrients from the same exchangeable supply than the remainder of the plant. When the phosphorus and the potassium were varied, while the calcium was held constant, both were influential on nitrogen fixation. Phosphorus increased nitrogen fixation by increased plant mass and potassium was multiplied by increased concentration within the plant tissue. The growth of a single crop removed the nutrients from the clay so completely as to decrease the pH value by as much as two units. This excessive acidity occasioned by the crop growth did not prohibit its fixing as much as 25 per cent of its total nitrogen content at the same time. The soil acidity was beneficial rather than deleterious to nitrogen fixation. (W. A. Albrecht, G. E. Smith, N. E. Smith)

Soil Survey and Land Classification in Missouri. During 1942 the detailed classification of the soils of Holt county was completed. Holt county is one of the major corn producing counties of the State. In recent years the corn acreage has been decreased approximately one-third. This reduction was in accord with the land classification which indicated that about 25 per cent of the upland had a very limited adaptation for corn, although corn has been the major crop.

Recently the Soil Conservation Service increased the number of land capability classes from 5 to 8, which made their scheme of land classification essentially the same as the scheme adopted by the Missouri Agricultural Experiment Station in 1938. The necessity that both Federal and State agencies use essentially the same methods of classifying land is apparent. In 1943 the Agricultural Experiment Station cooperated with the Soil Conservation Service in making utility surveys of several small areas for the State Conservation

Department. These surveys were used as the basis for farm planning, and aiding in the correlation of wildlife abundance and types to soil conditions.

Soil survey data have been used extensively in establishing new air fields. Many land buyers have been using soil types as a basis for judging the value of the land. The demand for soil maps and reports has been greater than for several years. H. H. Krusekopf believes that this presages a probable post-war demand for soil information.

The Function of the Colloidal Fraction of the Soil. Results of studies conducted during the past decade have brought to light the importance of the mineral organic colloidal complex of the soil as the active agent supplying nutrients and moisture to the growing crop. Extensive studies have been made involving the growth and composition of plants in relation to the amounts, kinds, and ratios of the various nutrient elements carried on the exchange complex of the colloid. These studies have provided information on the kind and amount of the elements that should be present to produce a maximum crop of a desirable composition. Further investigations have shown that the supply of nutrients carried by the colloid was obtained from primary rock minerals which disintegrated chemically upon contact with the colloid from which the nutrients had been removed by the growing plant. Soils from which the colloidal fraction has been extracted will not retain moisture which the plant can use, whereas the extracted colloid may absorb several times its weight of water. The reasons for the droughty nature of silty soils and of soils high in clay content have been found to be associated with the amount and degree of hydration of the colloids present in the soil. The seat of plant nutrition, mineral weathering, and water absorption have all been found to be in the colloidal fraction of the soil.

In colloidal studies the nutrients carried by the colloid must be removed first in order that known quantities and kinds may be added. The colloid is obtained from the soil by passing a water suspension stabilized with sodium hydroxide through a high speed centrifuge, which removes particles larger than those of colloidal dimensions. The colloidal suspension is then concentrated in a dialysis cell where the anions and cations are removed electrolytically. The dialyzed colloid prepared in this fashion is then standardized with respect to concentration and activity. A simple and inexpensive unit for the rapid dialysis of large quantities of colloids has been perfected. This method saves large amounts of time and expense in studying soil colloids. (W. A. Albrecht, C. M. Woodruff, T. U. Yager.)

Moisture Movements Under Different Soil and Cropping Conditions. An effort has been made to improve the moisture relations of the claypan soils which are extensive throughout the State by an intensive study of the soil moisture system. A series of 27 plots was installed on the McCredie Experiment Station field in cooperation with the Soil Conservation Service in order to study the effects of subsoil tillage

and subsoil fertilization on the growth of cultivated crops through periods of drought. Laboratory studies by C. M. Woodruff suggested that moisture movement through the liquid phase was negligible at soil moisture contents below field capacity. This indicated that plants growing on soils at low moisture levels suffered from a lack of nutrient elements that did not exist in the presence of simple amounts of rain. Observations through the 1941 growing season showed that all of the common field crops had reduced the moisture content of the soil to the wilting point at a depth of 3½ feet following a period of four weeks without rain. The entire support of these crops at this stage of their growth depended on the nutrients they could extract from the clay substrata below 3½ feet. The desirability of improving the fertility relations of the deeper layers of soil for those crops which make their maximum rate of growth during the hot, dry periods of the midwestern summer, therefore is apparent. Sweet clover grown as a green manure crop on the claypan soils seemed to supply the deeper layers of soil with the necessary elements for the growth of corn, since deficiency symptoms did not appear on corn grown following sweet clover during the four weeks drought. C. M. Woodruff believes that the field studies are a necessary supplement to the laboratory work on moisture movements.

Rejuvinating Eroded Soils. A number of the plots formerly used for determining the runoff and erosion from different cropping practices lost most of the top soil. The top soil was removed from the remaining plots to study the problem of excessive runoff and erosion and low crop yields on eroded land. Such land now exists over two-thirds of the northcentral portion of Missouri. Cropping systems, soil treatments, and soil tillage practices on eroded soils are to be studied.

A study was made of the physical properties of the soil exposed by erosion and was confined to the factors affecting the capacity of the soil to absorb and deliver water to the growing plant. This study revealed that even though the soil was saturated with water it was held with such tenacity by the clay that very little could be extracted by a growing plant. The water which might be utilized by the plant saturated the soil so that essential air could not enter. Deep tillage in the late fall corrected these conditions when it was combined with the growth of sweet clover and the return of crop residues. The use of sweet clover and crop residues stabilized the structure of the soil, kept it open and receptive to rain, and increased the quantity of water stored for the growing crop. Without the sweet clover the structure produced by tillage deteriorated rapidly. (C. M. Woodruff, W. A. Albrecht.)

The Utilization of Corn Stalks and Straw in Soil Building. In this State much straw is burned after the grain has been combined. Frequently the amount of straw is so great that it presents a problem in plowing it under. In many instances the following crops suffer from a nitrogen shortage. In order

to speed up the decomposition of this straw, W. A. Albrecht has applied different amounts of nitrogen fertilizers alone and in combination with other elements to the straw as it was turned under. The yields of crops in this experiment have been extremely high. The only noticeable effect of the treatments so far has been a more vigorous growth with severe lodging on the plots receiving large amounts of nitrogen. However, there has been little difference in the yield of grain regardless of the kinds or amount of material turned under with the straw.

Experiments With Fertilizers in Missouri. Results in the use of numerous phosphates and fertilizer ratios on various soil types have indicated that in most of the State phosphate is the most needed fertilizer element. Very little difference has been noticed in the response from the soluble phosphate carriers, but those carrying phosphorus in the less available forms were definitely inferior. When the small grains were grown in rotations, including legumes and the use of limestone, potash added to the phosphate gave profitable returns. Where no limestone and no legumes were used, phosphate alone was the most economical material to use. The use of nitrogen in a fertilizer mixtures for wheat gave profitable returns only in a few instances except where the organic matter content of the soil was very low.

On some of the more highly developed and consequently more leached soils, definite magnesium deficiency symptoms have been observed in the crops and have been corrected through applications of magnesium salts. This has been the first indication of magnesium deficiency in soils of this State. These symptoms appeared only in those cases where a lime and legume program had been in operation for a number of years and were most noticeable in cropping systems where little plowing was done. Apparently the larger crop yield resulting from a lime and legume program removed large quantities of magnesium. With shallow rooting of the plants, where soils were plowed at infrequent intervals, it appeared that the magnesium content of the soil area where the plant roots fed may have become exhausted of this element. Magnesium deficiency was accompanied usually by potash starvation symptoms.

It often happens that a heavily fertilized fall seeded nurse crop smothers out the legumes or grass seeded the following spring. The decline in fertility in the soil apparently had gone to such a low level that there were not enough plant nutrients left in the soil to give the spring seeded grass or legume a good start. To overcome this difficulty it has been found to be good practice to divide the fertilizer applications, applying half in the fall and the other half with the drilled grass or legume seed in the following spring. When this was done with wheat the yield was reduced by only about two bushels but a much better stand of legume was secured. A better practice was to make a full application of the fertilizer in the fall and to apply additional fertilizer when the legume was seeded in the spring.

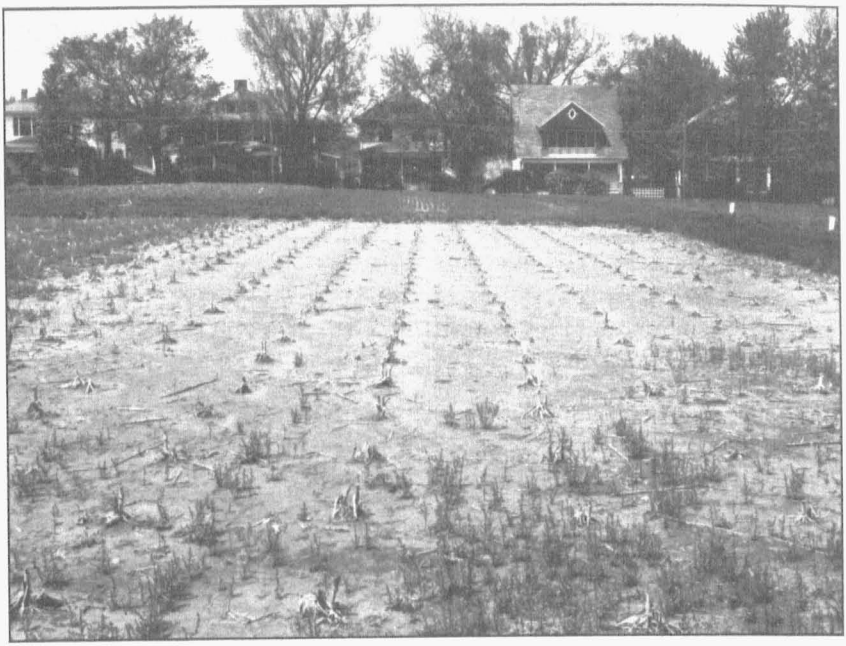
The increase in legume stand repaid the additional expenditure for the soil treatment. N. C. Smith and G. E. Smith believe that this practice shows promise as an aid in establishing stands of legumes in competition with the nurse crop for the limited soil supply of nutrients.

At Lathrop in a rotation of corn, oats, wheat, and legumes, the yield of corn has not been influenced greatly by either fertilizers or the plowing under of sweet clover or lespedeza. However, wheat has been more responsive. Where sweet clover was turned under and land was plowed twice in the rotation, the yield was about six bushels larger than where lespedeza was grown twice in the rotation and the soil plowed only once in three years. To date very little increase in yield has been obtained from the addition of fertilizer.

The 1942 season at Bolivar was especially good for the establishment and growth of legume and grass seedings because of continued optimum moisture conditions during the year. The wheat and lespedeza plots on which both lime and phosphate were used gave outstanding results in the form of additional pasture days and cattle gains. Apparently the soil at the Bolivar field was deficient in potash since all crops that received potash applications showed better growth. On this soil lime, phosphate, potash, and legumes were helpful in increasing the organic matter. Manure assisted materially in insuring a stand of legumes. Manure and 500 pounds of lime were more effective than 2 tons of lime in establishing a crop of red and sweet clover.

Fertilization of Permanent Pastures. The application of nitrogen fertilizer has increased the tonnage of grass more than any of the other fertilizers applied. Although phosphate and lime have not produced significant increases in the yield of forages, the percentage of the more desirable pasture plants in the stand has been increased markedly where these treatments have been used. Since few of the treatments have given sufficient increase in yield of forage to justify the cost of the treatment at prevailing prices, attention has been directed to the feeding value of these forages. Feeding trials using sheep and rabbits indicated a marked difference in the digestibility and nutritive value of forage from the various treatments. Preliminary results indicate that chemical analyses as measures of feeding value do not necessarily reflect the quality of the forage. W. A. Albrecht believes that some type of biological analyses using laboratory animals must be used to determine the full value of soil treatments when these values are hidden in crops harvested and used as forages.

The Function of Acid Clays in Plant Nutrition. Colloidal clay, with its large amount of absorbed hydrogen is an agent in weathering primary minerals immersed in it, even though the ions are not ionized excessively. Silt fractions of eight different soils with widely different stages of development have been weathered by clay subsoil in order to get an assay of mobility of plant



Experimental plot on Sanborn Field showing effect of 56 years of continuous corn cropping without soil treatment. Nature fails to grow her own cover.

nutrients in silts of different soils. Plants have been shown to feed by exchange of nutrients from the clay to the plant. These studies have shown that as the clay becomes more acid through hydrogen contribution to the clay by the plant in exchange for cations, this hydrogen or acidity also is active in moving cations from the primary minerals to the clay. Thus acid clays in reality function in plant nutrition because they are acid. (W. A. Albrecht, E. R. Graham.)

Nitrogen and Carbon Accumulation in the Soil. Studies have been made of the nitrogen fixation of soybeans in which both the phosphorus and potassium were variables, while a more complete list of nutrients was absorbed on the clay. Clays were used with a significant amount of hydrogen, or acidity, present. Special attention was given to the nature of the soil organic matter carried in the finer fraction of the colloidal clay used as a plant medium for growing 3 successive crops of soybeans. The original clay was prepared from the subsoil with final electrodialysis and contained 1.56 per cent carbon and .176 per cent nitrogen, or a carbon-nitrogen ratio of about 10. It was carefully separated and electrodialyzed again after growing the 3 crops of soybeans, the samples contained 1.76 per cent carbon and .285 per cent nitrogen, or a carbon-nitrogen ratio of about 6. Results indicated that the organic fraction was relatively stable as indicated by its resistance

to electrodialysis and by the fact that only 13.7 per cent of the nitrogen in the original clay could be hydrolyzed out by boiling for 45 minutes in a solution of 1½ per cent sodium hydroxide. The shift of the carbon-nitrogen ratio from that common in the soil to that more common for soil micro-organisms, and the high degree of stability of the organic matter were decidedly interesting aspects of the nature of the soil organic matter.

By withholding inoculation, soybeans were grown as a non-legume in contrast to behavior as a legume when inoculated. In this way a low nitrogen concentration in relation to its carbohydrate content was effected in the first case in contrast to the reverse in the latter. Under depleted nutrient supplies in the soil, nitrogen moved from the plant to the colloidal clay to increase its content of this element. Likewise phosphorus and potassium moved in the "reverse" direction.

Field plots for the study of nitrogen and carbon accumulation, according to different systems of soil and crop management, have indicated that a "nitrogen turnover" regularly is preferable to trying to provide large amounts to be stored in the soil. (W. A. Albrecht, C. B. Harston, C. E. Ferguson.)

VETERINARY SCIENCE

A. J. DURANT, *Chairman*

Blackhead in Turkeys. If a drug could be found for the practical prevention of blackhead in turkeys it would save the turkey industry of Missouri many thousands of dollars. In previous years various chemicals have been used by A. J. Durant and H. C. McDougle in an attempt to prevent blackhead from developing in young susceptible turkeys. One drug (phenothiazine) showed some promise and further tests were made in 1942. Forty-five birds received a normal turkey growing mash and thirty-five received the same mash and in addition one-half to one per cent phenothiazine. The birds were fed this mash continuously for 119 days. The maximum mortality in the birds on the medicated mash did not reach the minimum mortality in the control birds. Of the controls, 84 per cent developed blackhead while only 46 per cent of those on the medicated mash were affected. This experiment was repeated in 1943. Seventy-three birds were fed the normal ration and 70 were fed the same ration containing phenothiazine. Of those fed phenothiazine 48.5 per cent developed blackhead as compared with 67.1 per cent of the controls. While a very high protection has been reported for the use of phenothiazine in the prevention of blackhead, under severe conditions of exposure in conjunction with strict confinement to a small, highly infectious area the protective power of this drug was apparently rather limited. It should be noted that while the results were somewhat disappointing the drug might be more helpful under field conditions.

In 1943 the blackhead infected birds were treated with the follow-

ing drugs in order to test their efficiency in aiding recovery: Sulfanilamide, Sulfaguanidine, Gentian Violet, and Neoprontosil. While the number of birds treated was limited Gentian Violet appeared to be the most promising of the four drugs.



Taking a blood sample for a Pullorum test in poultry.

Leukosis in Fowls. Leukosis in fowls is a common and destructive disease of poultry in Missouri and a satisfactory control method would be of great value to poultry raisers. In studying methods of control for a disease of this type one of the first efforts is to endeavor to discover a regular means of transmission. Such a discovery eventually may lead to the identification of the cause of the disease and hence to methods of control. Therefore, A. J. Durant and H. C. McDougle have attempted to find a transmissible form of leukosis.

In 1942, a bird showing symptoms of leukosis was received for examination. A study of the blood seemed to indicate that the bird was suffering from this disease. Therefore, thirty day-old Buff Leghorn chicks were inoculated intravenously with from .1 to .5 c.c. of blood from the diseased chicken. An additional 30 birds from the same hatch were used as controls. After ten months, no birds in either group had developed leukosis and the original diseased bird was autopsied. She was suffering from a chronic infection of the gall bladder.

In a test of another diseased bird, emulsions from the liver and spleen were inoculated intravenously into six three-day-old Leghorn chicks. One chick showed some indication of the disease.

In another experiment twelve White Leghorn chicks, three and eleven days old, were inoculated intravenously from two birds showing symptoms and blood pictures indicating leukosis. The autopsies of the two diseased chickens showed that they were not afflicted with leukosis and all of the inoculated chicks remained healthy.

From these experiments it was concluded that diseases other than leukosis produce symptoms closely resembling those of leukosis. Apparently, this confuses and complicates the study of this disease.

In 1943 a total of 223 day-old chicks were inoculated with the blood of chicks hatched from hens visibly affected with fowl paralysis. At the same time, from the same source, a total of 211 controls were maintained for observation and control. Of the inoculated birds

14 or 6.27 per cent developed leucosis, as compared to 7 or 3.31 in the control group.

Fowl Paralysis (Neuritis of Fowls). There is a difference of opinion as to whether or not more than one virus is involved in leukosis and fowl paralysis. Therefore any discovery on the transmission of either disease may be of value in devising a means of control for one or both of the diseases. In 1942, A. J. Durant and H. C. McDougle studied the transmissibility of fowl paralysis from 15-day-old embryos from birds that showed clinical symptoms of the ocular form of neurolymphomatosis by inoculating ten one-day-old chicks with the embryonic fluid from three embryos from three diseased parents. One of the ten inoculated chicks developed fowl paralysis but so did one of the ten control chicks and therefore the results were inconclusive. Attempts to transmit the disease by nerve implants were unsuccessful.

In 1943, the blood of chicks hatched from the eggs of visibly affected hens was inoculated into day-old-chicks, beginning when the donors were one day old and extending until they were 20 days old. The results indicated a definite transmission of the disease since 39.9 per cent of the treated birds developed fowl paralysis while only 10.9 per cent of the controls developed the disease.

Stomach, Nodular, and Tape Worms in Sheep. At the beginning of the year (1942) there were 97 sheep in use in this investigation. During this year the sheep were better fed than in previous years. Only eight died, which is good proof of the value of better feeding. With one exception all deaths occurred during late July, August, and September. Fourteen sheep were killed for experimental purposes. Histopathological studies have been completed on 77 sections of tissues imbedded in paraffin and stained with hematoxylin and eosin. Cecil Elder, O. S. Crisler, and D. E. Rodabaugh found that there was greater tissue damage in animals carrying more than one species of parasite, especially when nodular worms were present. Highest stomach worm egg counts occurred between August and December 15 and the highest nodular worm egg counts between November 1 and January 15. Therefore, the best time to treat for stomach worms would be between July 1 and December 15 and the best time to treat for nodular worms about December 1. Lambs were affected more severely by stomach worms than by nodular worms.

A technique has been developed to permit an accurate determination of the numbers of different kinds of parasites present in the digestive tract of sheep. The sheep on experiment were found to harbor stomach worms, ostertagis, nematodirus, whipworms, nodular worms, tape worms, and trichostrongyles. In most cases there were three or more species present and in a few cases as high as six or seven in the same animal.

In 1943, 107 sheep were on experiment. During the year 51 of the sheep died or were slaughtered for experimental purposes. A total of 1561 microscopic egg counts were

made. A technique for washing the stomach and intestinal contents from the digestive tract of the sheep was perfected. This technique demonstrated the difficulty encountered in the recognition of eggs of certain parasites. The histopathological studies pointed out more marked changes in heavy infestations, or in infestations where more than one parasite was present. Studies on the histopathology seemed to indicate a rather similar pathology for the different gastrointestional parasites, but the nodular worm apparently produced the most pathological change. It has been found difficult to compare the pathology of the different parasites because of several factors, such as numbers of parasites, presence of different kinds of parasites at the same time, the length of time after death until the sections were imbedded.

In all cases except one, phenothiazine has been found very satisfactory for the control of nodular worms but has not been so efficient in the removal of ostertagis. It has done a fair job of removing stomach worms. Copper sulphate has been very efficient for the removal of stomach worms in all of 25 sheep except two. In some cases this treatment was used for every 14 days and in others every 28 days. Up to the present, none of the three treatments used have had any material effect upon the histopathology of the animals.

Apparently lambs suffer the most from parasite infestation. They should be protected by proper treatment. Nutrition as related to ability to withstand parasitic infestation has been proved definitely. On heavily infested pastures treatment for stomach worms would give best results if started in March or April and continued until December 15. Mature sheep should be included in the treatment.

Low Titre Reactions to the Bang Agglutination Test in Cattle. The present high price of cattle tends to make cattle owners hesitate in the disposal of cattle which react to the blood test, especially those cattle which have shown consistently low agglutination titres. If it is safe to retain such animals in the herd it would save the cattle owner considerable money, and enable him to continue his breeding program without the loss of valuable blood lines. The human health angle is very important since this is the disease which causes undulant fever in man.

In an effort to answer this question, Cecil Elder and O. S. Crisler have investigated for several years low titre reactions to the Bang agglutination test. In 1942, fifteen cows were on test. All of the cows calved except one which failed to breed on account of advanced age. The blood titres of these cows have varied from negative to incomplete 1-.50. With one exception all have been negative on one or more tests during the year. Again in 1943, 15 cows were on test. Breeding efficiency in all animals has been very high. Average gestation period was 280 days in the animals that delivered calves. The average number of services was 1.61. Of the 15 cows 11 produced calves during the year, 2 were carrying calves at the time of slaughter, and the remaining 2 failed to breed because of age.

All attempts to isolate the Brucella abortus organism have been negative in direct culture and in the 26 guinea pigs inoculated with material from the experimental cows. There has been no spread of infection from the low titre animals to the negative or control animals. No abortions occurred. Colostral milk samples failed to react higher than a complete agglutination in the 1-50 dilution. Low titres in either colostral milk or blood have been found in 11 of the 15 experimental cows. Opsono-cytophagic tests failed to show any evidence of immunity to Bang's disease.

It seems that no animal in this herd, at the present time, is dangerous from the standpoint of spread of Brucella infestation. Also, these cattle, even though giving consistently low titre reactions to the blood agglutination tests, may be kept in clean herds without fear of spread of infection. Before applying these results to herds in the field, the individual herd history should be taken into consideration. It is necessary to make several blood tests at monthly intervals, preferably over a year's time, before there can be complete assurance that an animal consistently gives low agglutination reactions.

Blood Studies on Bang's Disease. A satisfactory technique for testing blood samples which is accurate enough to measure variations in blood titre which might result from injections of various biologics has been developed. In 1942, the normal blood titre of all the animals on experiment had been determined by Cecil Elder and D. E. Rodabaugh. In studying the effects of biologics the normal titre was determined for a three-day period, using daily tests; then the animal was injected and blood samples drawn daily for six or seven days following the injections. In all, ten biologics have been used. In each case the amount injected at least equaled the therapeutic dose and in many cases far exceeded it. The products used were sub-cutaneous tuberculin, Johnin, Blackleg bacterin, blackleg aggressin, hemorrhagic septicemia serum, hemorrhagic septicemia bacterin, rabies vaccine, mixed bacterin, coli-staphylococcus-streptococcus bacterin, and normal bovine serum. All ten products, except the normal bovine serum, were injected into at least two different cows. The tests were continued in 1943. To date all of the biologics injected have failed to influence the agglutination titre for Bang's disease tests. The results have a very practical application in that it has proved that the use of biologics by veterinarians and others has not influenced the results of the blood test in the control and eradication of Bang's disease from cattle. The question of the effect of drugs and chemicals upon blood titres has remained unanswered.

A Comparison of the Tube Agglutination Test and the Plate Test on Low Reacting Sera for Bang's Disease. An effort has been made to prove whether the plate test is more or less accurate on low reacting sera than the tube agglutination test. The official test in Missouri is the tube agglutination test and the results show this to be slightly the better method. Work with the two tests checked in ap-

proximately 95 per cent of the cases. This indicated that either test probably could be used with comparative safety and accuracy. The two tests were made on 690 blood samples during the year. The work has been under the direction of Cecil Elder.

Toxemia in Sheep. In September 1942, eight ewes were placed on a ration that was considered inadequate in an attempt to produce artificial cases of toxemia or pregnancy disease in sheep. The sheep were confined in a small pen and kept on a concrete floor until the first of May. From January through April, 40 urine samples were collected and studied, in an effort to determine the practicability of such studies in the diagnosis of pregnancy disease. Acteone was found in the urine in the field cases of the disease studied. All attempts at curing field cases failed and all attempts to produce experimental cases of toxemia failed. Past experience with the disease has shown that it usually can be prevented by feeding a good ration. For the past couple of years, most sheep raisers in this area have followed the recommendations of the station with respect to the feeding of ewes and as a result less trouble has been experienced with this disease. Cecil Elder believes that the proper feeding of ewes is the best way to keep the number of cases of toxemia at a minimum.

Trichomoniasis in Turkeys. Trichomoniasis is relatively new in Missouri. The first outbreak occurred in 1927 and the spread has increased each year since that time. To date, turkeys in sixteen counties of the thirty-two principal turkey producing counties have been found to be infested.

Trichomoniasis in turkeys is a disease of the digestive apparatus. At the present time trichomoniasis of the lower digestive tract is of primary importance in Missouri and the mortality is about 50 per cent of the affected birds. The highest mortality occurs when the poults are three to six weeks of age. Trichomoniasis of the crop has affected only a few poults in Missouri but it may become economically important since Dr. Hinshaw of California has reported that trichomoniasis of the upper digestive tract has caused the greatest mortality in that state.

A. J. Durant and H. C. McDougle have attempted to determine the carriers of the trichomonad. So far, the poults were susceptible only to trichomonads found in chickens and other turkeys. No insects have been found to be carriers. It would seem that the transmission is mainly through mechanical means.

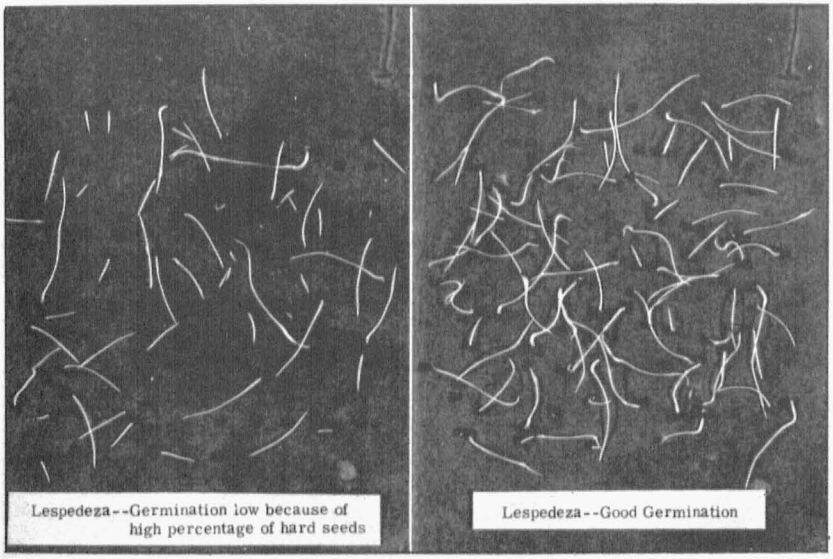
The exact nature of the disease in poults is not known but it is believed to be a form of malnutrition resulting from infestation with trichomonads. In culture media, trichomonads have been found to consume large quantities of beta carotene. When this nutrient was withheld they died in a comparatively short time. In order to establish this nutritive relationship further, several poults were placed on rations containing different levels of vitamin A. These poults then were inoculated with trichomonads. The poults on low vitamin A levels quickly became infested heavily and within one week's time

80 per cent had died. Poults that were on a medium vitamin A level became infested but it took one week longer to reach the same degree of infestation and the mortality rate was 50 per cent as compared to 80 per cent. Poults on a high vitamin A ration containing ten times the amount of vitamin A ordinarily required by the turkeys did not succumb to the infestation and only one poult became infested. Poults from this latter group were marketed in the fall and brought top market prices.

Trials have been made, using a drug that was known to kill the trichomonads in the digestive tract. Where the vitamin A levels were low the drug had no effect, but when the diets contained large quantities of vitamin A and the drug treatment was given the recovery from the infestation was 98 per cent. The poults that were infested heavily with trichomonads and given only a vitamin A diet did not recover as quickly as those which received the drug treatment in addition.

Apparently, the disease is a form of malnutrition caused by the depletion of the vitamin A store in the poult by the trichomonads.

By the most drastic sanitation program including the use of different workers for handling mature and young poults, trichomonads may be prevented from gaining entrance to the flock. The trichomonads are extremely sensitive to dessication and every precaution should be taken to keep the poults dry and away from ponds or other standing water.



(Left) Poor germination of lespedeza seed because of hard seed. (Right) Good germination of lespedeza seed.

SERVICE PROJECTS

Seed Testing Laboratory (W. C. Etheridge, Clara Fuhr.) During the year 1941-42, 5,502 samples were tested and examined. Of these 4,055 were tested for Missouri farmers and seedsmen, 718 samples were submitted by inspectors in connection with the enforcement of the Missouri State Seed Law, and 729 Federal samples were received. During the year 1942-43, 5,665 samples of seed and plants were tested and examined by the Seed Testing Laboratory. Of these 3,342 were tested for Missouri farmers and seedsmen, 1,244 samples were submitted by inspectors in connection with the enforcement of the Missouri State Seed Law, and 1,079 Federal samples were received. The number of samples tested for:

	1941-42	1942-43
Purity and germination	2,205	2,161
Germination only	1,283	1,882
Approximate purity and germination ..	1,355	560
Identification	464	278
Examination only	77	49
Examination and germination	73	614
Purity only	40	32
Purity and Examination	1	—
Samples recorded (not tested—under Federal Seed Act) ...	4	—
Federal Seed Act:		
Imported seed samples subject to Act		
Agricultural Seed	240	287
Vegetable Seed ..	40	61
Imported seed samples not subject to Act .	2	2
Inspection samples, enforcement of Interstate Federal Seed Act	215	326
Samples submitted for test under Lend-Lease	232	387
Federal Service Tests	—	16
Total number of tests made (not counting retests)	9,132	8,911
Number of samples received:		
July 1, 1939 to June 30, 1940		5,692
July 1, 1940 to June 30, 1941		4,900
July 1, 1941 to June 30, 1942		5,502
July 1. 1942 to June 30, 1943		5,665

Agglutination Blood Testing for Bang's Disease of Cattle and Swine. In 1943, a total of 87,618 tests were made by the tube agglutination method for Bang's disease in cattle. Of this number, 70,930 were tested by the Bureau of Animal Industry. Of this group 4.2 per cent were found to be reactors. The remaining 16,688 tests were state tests of which 7.5 per cent were positive to the agglutination test. This work was under the direction of Cecil Elder.

Fowl Pox Vaccine Distribution. In 1942, 15,675 doses of chicken pox vaccine were distributed to poultry owners in Missouri. In 1943, 15,300 doses were distributed. This vaccine has given excellent results in protecting birds against the disease. The work has been under the direction of A. J. Durant and H. C. McDougle.

Diagnostic Service. In 1942, 2,998 cases were examined. Of this number, 1,100 specimens were poultry and the remainder were other animals. In 1943, 3,850 cases were examined or treated. Of the total number examined, exclusive of poultry, 2,374 were treatments, 299 were autopsies and 241 were operations and 53 were cases examined for rabies. Of the 53 cases examined for rabies, 28 showed definite evidence of the disease. In 1942, only 32 cases were submitted as suspected of rabies. Of this number, 22 showed indications of the disease.

Pullorum Disease Testing. In 1942, 117,232 blood tests were made

on chickens for the detection of pullorum disease carriers. Of this number, slightly over 10 per cent were found to be infected. Also samples from 13,639 turkeys were tested showing an infection of slightly over 5 per cent. In 1943, a total of 147,604 tests on chickens for pullorum disease were made. Of these, 8.94 per cent were positive to the test. This work was under the direction of A. J. Durant and H. C. McDougle.

The Production and Distribution of Bacteria for Legumes (W. A. Albrecht). In 1942 sufficient cultures were distributed to treat 14,354 bushels of legume seed and in 1943 the bushel units distributed amounted to 9,786. The number of the bushel units furnished for the different legumes for the two years was as follows :

	1942	1943
Soybeans	8401	6321
Lespedeza	1354	1168
Sweet clover	3022	1741
Red clover	862	466
Alfalfa	702	177
Miscellaneous	13	3
Total	14,354	9,876

Service Work of the Department of Entomology. Fruit growers in the State were given weekly suggestions on spraying for the control of codling moth and other fruit insects. These reports were made for the four months of May to August, inclusive. In cooperation with the Agricultural Extension Service, victory gardeners and farmers were kept posted on the major garden insects and the best methods for their control. Farmers in a few restricted areas in the State requested and received special help with the control of chinch bugs and grasshoppers. Many home owners were given information on the control of termites. Several hundred letters were written reporting the identification and giving the best methods of control for various insect pests examples of which had been sent in to the department. During the year, 13 special circulars on insect control were published and distributed.

Identification of Plant Diseases. Diseased plants often are sent to the Station for identification of the disease involved and for recommendation of control measures. In 1941 approximately 400 letters were written regarding such plants and in response to inquiries concerning plant diseases. Records have been kept of the occurrence of new or unusual diseases. Occasionally, some research has been necessary and in a few instances studies were made of the effectiveness of control measures. This work has been carried on by C. M. Tucker, John B. Routien, P. R. Burkholder, W. E. Maneval, and O. W. Jennings. Some of the more interesting cases are reported in the following paragraphs.

Philodendron, an important greenhouse ornamental, developed brown and stunted abnormal roots in the rooting beds. These symptoms were induced by the omission of calcium from the nutrient solution supplied to sand cultures. Cuttings with abnormal roots recovered and grew normally when supplied with calcium. Under low nutrient conditions the maintenance of fairly high moisture content in closed vessels permitted better development than occurred with open bottom drainage.

Experiments on the effect of seed treatment on corn seed germination and yield were continued. Reid's Yellow Dent and Midland Yellow Dent were used. New Improved Semesan, Jr., was used on severely infected and on slightly infected seed. Plantings were made at Columbia and at several outlying experimental fields. The germination of slightly infected seed was a little better than that of the severely infected lots. The treatment had no significant effect on the yields.

A disease of Korean Lespedeza which caused the death of large plants during July and August was due to infection of the roots by *Macrophomina phaseoli.* Low soil moisture and high temperatures were conducive to the development of the disease. The various strains of Lespedeza differed widely in susceptibility.

Experimental work on a new disease of mushrooms has been continued. Practical and efficient control measures have been developed but the identity of the causal organism has not been determined.

In 1942 an unusual number of requests were received for information on the control of plant diseases. This, no doubt, was due to the wet season which was favorable to the spread and development of fungous and bacterial diseases. About 600 letters were written giving the information requested to county agents, farmers, and gardeners.

Fertilizer Control. (M. F. Miller, Director, and L. D. Haigh, Chemist.) Collection and analysis of fertilizer samples during the past two years are described in Missouri Agricultural Experiment Station Bulletin 449 and 480. A brief summary of these bulletins follows:

	1941-1942	1942-1943
Inspection		
Number of towns and farms visited	167	148
Manufacturers, dealers, farmers, jobbers, and other handlers of fertilizers visited	377	362
Samples collected for analysis	493	396
Chemical Analysis		
Total nitrogen determination	356	317
Water insoluble nitrogen and nitrogen activity determination	354	156
Total phosphoric acid and insoluble phosphoric acid determination	940	752
Water soluble potash determination	371	255

The two Missouri Agricultural Experiment Station Bulletins mentioned above contain comparisons of the guaranteed chemical compositions of the fertilizers with that found by actual analyses. In general farmers can rely on the guaranteed analyses of the fertilizers offered for sale in Missouri. Analyses of samples collected indicated that on the average farmers received about 105 per cent of the amount of plant food guaranteed by the manufacturers.

Chemical Service. (L. D. Haigh, E. W. Cowan.) During the year 1942 a total of 3,845 determinations were made for other departments within the Agricultural Experiment Station and for residents of Missouri. The determinations made were as follows: 238 samples of liver extracts and other vitamin concentrates for the determination of dry matter, 476 determinations; 648 samples of rat livers and kidneys for moisture and fat, 1296 determinations; 1 sample each of sweet potato vines, cottonboll hulls and cottonseed hulls for complete feed analysis, calcium and phosphorus, 21 determinations; 4 materials from digestibility trials for lignin determinations, 4 determinations; 1 sample leather dust for fertilizer value, 5 determinations; 51 samples of rib, lean and fat, for moisture, fat, protein and ash, 204 determinations; 1 sample of fresh sorghum, 4 samples of green alfalfa, 3 samples of green oat stalks for moisture determination, 8 determinations; 4 samples of silage for complete feed analysis, calcium and phosphorus, 28 determinations; 130 lots of tomatoes for determination of vitamin C, 162 determinations; 8 samples of special prairie grasses for complete feed analysis, calcium and phosphorus, two for water soluble nitrogen, 58 determinations; 67 samples pasture herbage from wheat and lespedeza plots and Sni-A-Bar farms for complete feed analysis, calcium and phosphorus, 469 determinations; 18 samples of bluegrass herbage for determination of lignin, 18 determinations; 23 samples of superphosphate for total and insoluble phosphoric acid, 46 determinations; 12 turkey livers for extraction of vitamin A, 12 determinations; 7 miscellaneous samples for qualitative examination of contents, 7 determinations; 5 stomach contents for arsenic, 5 determinations; 1 lamb's stomach and liver for lead, 2 determinations; 1 stomach contents for hydrocyanic acid, 1 determination; 7 feed samples, 1 stomach contents, 1 stock salt sample for qualitative examination by feeding to laboratory animal, 9 determinations; 2 feeds for protein, 1 feed for salt determination, 3 determinations; 2 flour samples for ash and protein, 3 samples of milk for total nitrogen, 7 determinations; 1 superphosphate for acid value, 1 determination; 1 waste material from federal alcohol manufacturing plant for determination feed value, 3 determinations. About 1,000 spectrographic tests for rare elements and other materials in samples.

In 1943 a total of 1,572 determinations were made. These determinations consisted of the following: 55 feed and crop samples, 195 determinations; 36 meat samples from slaughtered animals; 144 determinations; 5 materials for their fertilizer values, 9 determinations; vitamin A determinations and tests for mineral deposits in organs of animals, 36 determinations; 230 samples of pasture grass, 1,153 determinations; 9 internal organs, stomach contents, feed and suspected material for suspected content of poison, 17 determinations; 18 samples of feeds for suspected content of poisonous or injurious material, 18 determinations.

Official Testing of Dairy Cows in

1942. (H. A. Herman.) Official tests were conducted for 57 Missouri breeders on 1,520 purebred cows. This represented 2,320 one-day and 456 two-day Advanced Registry or Register of Merit tests on 275 cows and 1,594 one-day herd improvement registry tests on 1,245 cows. The number of cows now on some form of official test is three times greater than 5 years ago.

The highest butterfat producing cow for the year and the highest Advanced Registry butterfat record ever reported for Missouri, was made by U-Mo Vesper Man-O-War Ormsby Freda 1876318, a Holstein cow bred and owned by the University of Missouri producing 24,135 pounds of milk containing 937.3 pounds of butterfat. The cow was then 5 years and 3 months of age.

Official Testing of Dairy Cows in 1943. (H. A. Herman.) In cooperation with national dairy cattle breed associations, official tests were conducted on 1,213 cows owned by 71 Missouri breeders.

Several state records for individual production were established. The Holstein-Friesian cow, Farmington Klaartje Pontiac 1074913, owned by State Hospital #4, Farmington, Missouri, became the breed's second greatest long-time producer with a life-time total of 241,000 lbs. milk and 8,474 lbs. fat.

The Jersey herd of Maurice Saffarrans, Palmyra, Missouri, established a new state record with 15 cows averaging 10,552 pounds of milk and 565.08 pounds of butterfat.

PUBLICATIONS

A. A. JEFFREY, *Editor*

The publications for the Experiment Station, during the year ending June 30, 1942, reached a gross of 474,000 copies distributed between 61 new publications and 5 reprints. These publications had a total content of 1,708 pages.

During this period, distribution of Experiment Station publications through mailing reached a total of 346,124 copies, including 173,699 copies sent to residents of Missouri, 166,911 copies mailed to other states, and 5,514 copies mailed to foreign countries. Many thousand additional copies were handed to residents of the State at the mailing room.

The publications issued during the year are listed as follows:

Research Bulletins

No.	Title, Series, Author, and Number of Illustrations	Pages	Copies
332	Supplementary Value of Various Feedstuffs in Brood Sow Rations, by A. G. Hogan and S. R. Johnson; September, 1941; Figs. 4.	36	2,000
333	Vitamin B, Pantothenic Acid, and Unsaturated Fatty Acids as They Affect Dermatitis in Rats, by L. R. Richardson, A. G. Hogan, and K. F. Itschner; September, 1941; Figs. 4.	12	2,000
334	Factors Affecting Temperature Changes in Dressed Poultry During Refrigeration, by I. L. Williams and E. M. Funk; November, 1941; Figs. 17.	40	2,000

335	Growth and Development LIII. Resting Energy Metabolism and Ventilation Rate in Relation to Body Weight in Growing Jersey Cattle with a Comparison to Basal Energy Metabolism in Growing Man, by Samuel Brody, H. H. Kibler, and A. C. Ragsdale; December, 1941; Figs. 7.	20	2,000
336	Amphidiploids in the Seven-Chromosome *Triticinae*, by E. R. Sears; November, 1941; Figs. 19.	48	2,000
337	Chromosome Pairing and Fertility in Hybrids and Amphidiploids in the *Triticinae*, by E. R. Sears; December, 1941; Figs. 1.	20	2,000
338	The Concentration and Metabolism of Sugar in Ram Semen, by Burton H. Moore and Dennis T. Mayer; December, 1941; Figs. 13.	36	2,000
339	The Effect of Dextrose and Sucrose Sugars Upon the Properties of Ice Cream, by W. H. E. Reid and K. R. Minert; January, 1942; Figs. 8.	28	2,000
340	The Effect of Cultures and the Relation of Acid Standardization to Several of the Physical and Chemical Properties of Ice Cream, by W. H. E. Reid and L. E. Smith; January, 1942; Figs. 12.	32	2,000
341	A Cytogenetic Study of Zea and Euchlaena, by Joseph G. O'Mara; March, 1942; Figs. 1.	16	2,000
342	Vitamins Required by Pigeons, by Jordan G. Lee and Albert G. Hogan; April, 1942; Figs. 1.	16	2,000
343	The Relation of Biotin to Perosis in Chicks, by L. R. Richardson, A. G. Hogan, and O. N. Miller; June, 1942; Figs. 0.	12	2,000
344	The Revegetation of Abandoned Crop Land in the Cedar Creek Area, Boone and Callaway Counties, Missouri, by William B. Drew; June, 1942; Figs. 12.	52	2,000
345	The Development of Loessial Soils in Central United States as It Reflects Differences in Climate, by Harvey B. Vanderford and W. A. Albrecht; June, 1942; Figs. 5.	32	2,000
346	Land Use Experience in Callaway County, Missouri, by A. M. Meyers, Jr., and Conrad H. Hammar; June, 1942; Figs. 19.	56	2,000

Reprints

323	Replacing Cane Sugar With Variable Increments of Dextrose and Cerelose Sugar in the Ice Cream Mix, and Its Effect Upon the Physical and Chemical Properties of Ice Cream at Different Serving Temperatures, by W. H. E. Reid, R. J. Cooley, and W. S. Arbuckle; Reprinted, September, 1941; Figs. 29.	52	1,000

Station Bulletins

No.	Title, Series, Author, and Number of Illustrations	Pages	Copies
430	Controlling Bot and Warble Flies of Livestock in Missouri, by Leonard Haseman and W. E. Roland, July, 1941; Figs. 15.	32	5,000
431	Poultry Housing Conditions in Missouri, by E. M. Funk, July, 1941; Fig. 3.	12	5,000

432	Registration, Labeling and Inspection of Commercial Fertilizers; 1940, by L. D. Haigh, E. W. Cowan, and L. L. Wiseman, July, 1941; Figs. 0.	56	5,000
433	Representative Missouri Weeds and Their Control, by W. B. Drew and C. A. Helm, August, 1941; Figs. 88.	216	4,000
434	The Missouri Soil Saving Dam, by J. C. Wooley, W. M. Clark, and R. P. Beasley, October, 1941; Figs. 11.	24	10,000
435	Game Bird Investigations, by E. M. Funk, James C. Hamilton, and H L. Kempster, October, 1941; Figs. 7.	16	2,500
436	A Comparison of Qualities and Prices of Sheets Available in Missouri Stores, by Norrine Grover Bennett, October, 1941; Figs. 0.	16	4,000
437	Selecting Fruit Varieties, by T. J. Talbert and A. D. Hibbard, November, 1941; Figs. 1.	52	10,000
438	Investigations of Agricultural Problems—Work of the Agricultural Experiment Station During the Year Ending June 30, 1938, by F. B. Mumford and S. B. Shirky; November, 1941; Figs. 12.	104	2,000
439	Growing Good Crops of Oats in Missouri, by J. M. Poehlman, January, 1942; Figs. 2.	12	10,000
440	Small Grain Production in the Lowland Region of Southeast Missouri, by B. M. King; January, 1942; Figs. 12.	40	4,000
441	The Value of Soybean Oil Meal in Broiler Rations, by M. Richard Irwin and H. L. Kempster; February, 1942; Figs. 1.	16	10,000
442	Missouri Woods and Wood-Using Industries, by Wm. C. Sechrist and Ralph H. Peck; March, 1942; Figs. 4.	20	5,000
443	Measuring the Productive Value of Pastures, by Homer J. L'Hote, May, 1942; Figs. 9.	36	10,000
444	Agricultural Investigations—Work of the Agricultural Experiment Station During the Year Ending June 30, 1939, by M. F. Miller, S. B. Shirky, and H. J. L'Hote; Figs. 6.	108	2,000
445	Soybean Production in Missouri, by B M. King and Denver I. Allen, June, 1942; Figs. 13.	32	15,000
446	Vitamins, by A. G. Hogan, June, 1942; Figs. 0.	16	10,000
447	Internal Parasites of Sheep, by Cecil Elder; June, 1942; Figs. 2.	8	10,000
448	Economic Aspects of Recreational Land Use in the Lake of the Ozarks Area, by J. Roger Snipe and Conrad H. Hammar, June, 1942; Figs. 16.	56	4,000

Reprints

336	Growth Standards for Dairy Cattle, by A. C. Ragsdale, January, 1942; Figs. 3.	12	5,000
365	Factors Affecting the Composition of Milk, by C. W. Turner, December, 1941; Figs. 10.	32	10,000
369	Artificial Manure Production on the Farm, by W. A. Albrecht, December, 1941; Figs. 5.	12	5,000
398	Wheat in Missouri, by W. C. Etheridge, C. A. Helm, B. M. King, and J. M. Poehlman, October, 1941; Figs 15.	44	10,000

Station Circulars

No.	Title, Series, Author, and Number of Illustrations	Pages	Copies
213	The Appraisal of Farm Buildings, by J. C. Wooley and R. P. Beasley, October, 1941; Figs. 1.	12	5,000
214	The Chigger and Its Control in Missouri, by Philip C. Stone and Leonard Haseman, October, 1941; Figs. 2.	4	6,000
215	Management of Sweet Clover in a Pasture System, by C. A. Helm, November, 1941; Figs. 2.	12	15,000
216	Commercial Strawberry Culture in Missouri, by T. J. Talbert and A. D. Hibbard, December, 1941; Figs. 10.	24	10,000
217	Adapting Horse-Drawn Mowers to Tractor Power, by L. E. Hightower, December, 1941; Figs. 5.	4	8,000
218	Liming Missouri Soils, by O. T. Coleman and A. W. Klemme; December, 1941; Figs. 14.	32	10,000
219	Ventilation of Animal Shelters, by J. C. Wooley; March, 1942; Figs. 4.	8	10,000
220	Bramble and Bush Fruits, by W. W. Smith; March, 1942; Figs. 1.	4	10,000
221	Handling Peach Trees After Winter Killing of Fruit Buds, by T. J. Talbert, March, 1942; Figs. 3.	8	10,000
222	Preventing Wormy Apples, by Lee Jenkins and Leonard Haseman, March, 1942; Figs. 2.	4	10,000
223	Home Flower Gardens, by J. E. Smith, March, 1942; Figs. 3.	12	10,000
224	Controlling Fleas, by R. E. Roselle and Leonard Haseman, March, 1942; Figs. 1.	4	10,000
225	Emergency Pork Production, by L. A. Weaver, April, 1942; Figs. 1.	4	10,000
226	Controlling Garden Insects, by Leonard Haseman, April, 1942; Figs. 1.	4	10,000
227	Buying Fertilizers Wisely, by L. D. Haigh and Wm. A. Albrecht, April, 1942; Figs. 4.	8	10,000
228	Control of Poultry Lice and Mites, by Philip S. Stone, April, 1942; Figs. 1.	4	10,000
229	Combating Stored Grain Pests, by Leonard Haseman, April, 1942; Figs. 1.	4	10,000
230	Using Feed Price Information to Reduce Production Costs, by Herman M. Haag, April, 1942; Figs. 4.	8	10,000
231	Lice and Mites of Livestock, by Harry E. Brown, April, 1942; Figs. 1.	4	10,000
232	Plow Adjustment and Operation, by Mack M. Jones and Lloyd Hightower, May, 1942; Figs. 30.	24	10,000
233	Control of Moles, Leonard Haseman, May, 1942; Figs. 2.	4	10,000
234	Grass Silage in Wartime, by H. A. Herman and A. C. Ragsdale, May, 1942; Figs. 1.	4	15,000
235	Growing Sorghum and Making Sorghum Syrup, by C. A. Helm and Robert Beasley, May, 1942; Figs. 3.	8	10,000
236	Substitutes for Nitrogen Fertilizers in Orcharding, by A. E. Murneek and A. D. Hibbard, June, 1942; Figs. 0.	8	6,000
237	Reducing the Cost of Producing Dairy and Poultry Products in Missouri, by B. E. Frame, June, 1942; Figs. 0.	8	10,000
238	Controlling Plant Diseases in the Home Garden, by C. M. Tucker, June, 1942; Figs. 0.	8	10,000

CONTRIBUTIONS TO SCIENTIFIC JOURNALS

July 1, 1941 to June 30, 1942

767. Root Temperature as It Affects the Growth of Greenhouse Cucumbers, by R. A. Schroeder, submitted July 1941, to be presented at 33rd Annual Convention, Columbus, Ohio.
768. The Electrochemical Properties of Mineral Membranes. III and IV by C. E. Marshall and W. E. Bergman, submitted August 1941 to the Journal of Physical Chemistry.
769. Factors Related to Rat Dermatitis, by L. R. Richardson, A. G. Hogan and K. F. Itschner, submitted August 1941 to the Journal of Animal Nutrition.
770. The Influence of Hydrogen Ion Concentration on Respiration Rate of Sperm, by C. F. Winchester and F. F. McKenzie, submitted August 1941 to the Proceedings for Society of Experimental Medicine and Biology.
771. Quantitative Study of the Effect of Inanition on Responsiveness of the Mammary Gland to Estrogen, by J. J. Trentin and C. W. Turner, submitted August 1941 to the Journal of Endocrinology.
772. Gonodotropic Hormone in AP of Male and Female Rabbits During Growth, by A. J. Bergman and C. W. Turner, submitted September 1941 to the Journal of Endocrinology.
773. Size of the Rabbit Mammary Gland with Successive Lactations, by A. A. Lewis and C. W. Turner, submitted September 1941 to the Journal of Dairy Science.
774. Extraction and Assay of Lactogenic Hormone in Post-partum Urine, by Joseph Meites and C. W. Turner, submitted September 1941 to the Journal of Clinical Endocrinology.
775. The Inheritance of Dwarfism in Sheep, by Ralph Bogart and A. J. Dyer, submitted September 1941 to the American Society of Animal Production.
776. Cytogenetics of a Multiplois Microsporocytes Factor in Barley, by Luther Smith, submitted September 1941.
777. Root Rot of Chamaecyparis Caused by Ohytophthora Laterlas N SP., by C. M. Tucker and J. A. Milbrath, submitted September 1941 to Mycoligia.
778. The Influence of Cell Concentration of Respiration Rate of Sperm Cells, by C. F. Winchester and Fred F. McKenzie, submitted September 1941 to the Journal of Experimental Biology.
779. Some Factors Influencing the Resistance of Bull Sperm to Unfavorable Environmental Conditions, by John F. Lasley, G. T. Easley, and Ralph Bogart, submitted September 1941 to the Proceedings of the American Society of Animal Production.
780. The Anti-Perosis Complex, by L. R. Richardson and A. G. Hogan, submitted September 1941 to the Proceedings of the Society for Experimental Biology and Medicine.
781. Effect of Stilbestrol on the Lactogenic Content of the Pituitary and on the Mammary Glands of Female Rats, by A. A. Lewis and C. W. Turner, submitted in October 1941 to the Proceedings of Society for Experimental Biology and Medicine.
782. The Influence of Environmental Temperature on the Growth of the Mammary Lobule-alveolar System, by John P. Mixner and Charles W. Turner, submitted October 1941 to the Proceedings of Society for Experimental Biology and Medicine.
783. Mammary Gland Development with Mammogen I in the Castrate and the Hypophysectomized Rat, by A. A. Lewis, E. T. Gomez, and C. W. Turner, submitted October 1941 to the publisher in Endocrinology.

784. Plant Nutrition and the Hydrogen Ion, by Wm. A. Albrecht and R. A. Schroeder, submitted in October 1941.
785. Surface Relationships of Roots and Colloidal Clay in Plant Nutrition, by Wm. A. Albrecht, E. R. Graham, H. R. Shepard, submitted October 1941 to the American Journal of Botany.
786. Variations in the Silt and Clay Fractions of Loessial Soils Caused by Cliatic Differences, by H. B. Vanderford, submitted October 1941 to the Proceedings Soil Science of America.
787. Report on Lactose in Milk. Variation in Volume of Precipitate and Effect on Accuracy of Polarimetric Determination, by E. P. Garrison and L. D. Haigh, submitted October 1941 to the Journal of the Association of Agricultural Chemists.
788. Biological Assays of Soil Fertility, by Wm. A. Albrecht and G. E. Smith, submitted October 1941 to the Proceedings of Soil Science of America.
789. Soil Development and Plant Nutrition, by E. R. Graham, submitted October 1941 to the Proceedings Soils Science of America.
790. The Physiology and Inheritance of a Hemophilia-like Abnormality in Swine, by Ralph Bogart, M. E. Muhrer and A. G. Hogan, submitted November 1941 to the Genetic Society of America.
791. The Movement and Evaporation of Soil Water in Relation to pF^1, by C. M. Woodruff, submitted November 1941 to the Soil Science Society meeting in Washington.
792. Pythium Disease of Fibrous-rooted Begonia and Its Control, by John T. Middleton, California; C. M. Tucker and C. M. Tompkins, submitted November 1941 to the Journal of Agricultural Research.
793. The Inheritance of a Hemophilia-like Condition in Swine by Ralph Bogart and Merle E. Muhrer, submitted December 1941, in the Journal of Heredity.
794. Plant Nutrition and the Hydrogen Ion. II. Potato Scab, by R. A. Schroeder and Wm. A. Albrecht, submitted December 1941 to the American Journal of Botany.
795. Relation of Sexual Reproduction to Development of Horticultural Plants. I. General Effects of Flower and Fruit Production, by A. E. Murneek and S. H. Wittwer, submitted December 1941 to the Proceedings of American Society of Horticulture Science.
796. Relation of Sexual Reproduction to Development of Horticultural Plants. II. Physiological Influence of Fertilization (Gametic Union), by S. H. Wittwer and A. E. Murneek, submitted December 1941 to the Proceedings of American Society of Horticulture Science.
797. Some Effects of Calcium and Nitrogen Upon Peas, by R. A. Schroeder, submitted December 1941 to the American Society for Horticultural Science.
798. The Effect of Progressive Iodination on the Thyroidal Activity of Iodinated Casein, by E. P. Reineke, M. B. Williamson and C. W. Turner, submitted December 1941 to the Journal of Biological Chemistry.
799. Society and Conservation, by Conrad H. Hammar, submitted January 1942 to the Journal of Farm Economics.
800. Adequacy of Simplified Diets for Guinea Pigs and Rabbits, by A. G. Hogan and John W. Hamilton, January 1942 to the Journal of Nutrition.
801. A Defect in the Coagulation Mechanism of Swine Blood, by M. E. Muhrer, A. G. Hogan, and Ralph Bogart, submitted January 1942 to the American Journal of Physiology.

802. Lactogenic Content of Pituitaries of Pseudopregnant Rabbits, by Joseph Meites and C. W. Turner, submitted January 1942 to the Proceedings of the Society of Experimental Biology and Medicine.
803. Effect of Estrone on the Lactogen Content in the Pituitary and Blood of Male Rabbits, by Joseph Meites and C. W. Turner, submitted January 1942 to the Proceedings of the Society of Experimental Biology and Medicine.
804. Growth of the Male Guinea Pig Mammary Gland with Diethyl-Stilbestrol, by A. A. Lewis and C. W. Turner, submitted Januay 1942 to the Journal of Endocrinology.
805. Increased Milk and Milk Fat Production Following the Feeding of Artificially Formed Thyroprotein (Thyrolactin), by E. P. Reineke and C. W. Turner, submitted in January 1942 to the Journal of Dairy Science.
806. The Role of Estrogen in the Stimulation of Mammary Lobule-Alveolar Growth by Progesterone and by the Mammogenic Lobule-alveolar Growth Factor of the Anterior Pituitary, by John Mixner and C. W. Turner, submitted January 1942 to the Journal of Endocrinology.
807. The Anomaly of a Normal Duke's and a Very Prolonged Saline Bleeding Time in Swine Suffering from an Inherited Bleeding Disease, by Edwin T. Mertz, submitted February 1942 to the American Journal of Physiology.
808. A Liver Concentrate as a Source of Unrecognized Vitamins Required by the Chick, by Luther Richardson, Albert G. Hogan and Richard J. Karrasch, submitted February 1942 to the Journal of Nutrition.
809. Progestrone-like Activity of Some Steroid Compounds and of Diethyl-stilbestrol in Stimulating Mammary Lobule-alveolar Growth, by John P. Mixner and Charles W. Turner, submitted February 1942 to the Journal of Endocrinology.
810. Can Estrogen Suppress the Lactogenic Hormone of the Pituitary? by Joseph Meites and C. W. Turner, submitted February 1942 to the Journal of Endocrinology.
811. Why Lactation Is Not Initiated During Pregnancy, by Joseph Meites and C. W. Turner, submitted February 1942 to the Journal of Endocrinology.
812. Can Estrogen Account for the Precipitous Increase in the Lactogen Content of the Pituitary Following Parturition? by Joseph Meites and C. W. Turner, submitted February 1942 to the Journal of Endocrinology.
813. Isolation of Crystalline Tobacco Mosaic Virus Protein Using Water Miscible Solvents, by C. B. Croston and C. G. Vinson, submitted February 1942 to the American Philosophical Society.
814. Studies of Clay Particles With the Electron Microscope II. The Fractionation of Beidellite Nontronite, Magnesium Bentonite and Attapulgite, by H. P. Humbert, Byron Shaw, O. G. Caldwell and C. E. Marshall.
815. Mammogen and Unilateral Mammary Gland Growth in the Rabbit, by A. A. Lewis and C. W. Turner, submitted March 1942 to the Journal of Endocrinology.
816. Assay of Adrenals for Lactogenic Hormone, by V. Hurst, J. Meites and C. W. Turner, submitted March 1942 to the Proceedings of the Society for Experimental Biology and Medicine.
817. Blind Halves in a Goat's Udder, by C. W. Turner and E. R. Berousek, submitted March 1942 to the Journal of Dairy Science.

818. Pituitary Weight in Growing New Zealand White Rabbits in Relation to Live Weight, by H. H. Kibler, A. J. Bergman and C. W. Turner, submitted April 1942 to the Journal of Endocrinology.
819. The Influence of Diluters, Rate of Cooling and Storage Temperatures Upon Survival of Bull Sperm, by G. T. Easley, D. T. Mayer, Ralph Bogart, submitted April 1942 to the Journal of Physiology.
820. The Electrochemical Properties of Mineral Membranes, V. Beidellite Membranes and the Determination of Sodium, by C. E. Marshall and C. A. Krinbill, submitted April 1942 to the Journal of the American Chemical Society.
821. Plant Nutrition and the Hydrogen Ion. III. Soil Calcium and the Oxalate Content of Spinach, by R. A. Schroeder and Wm. A. Albrecht, submitted April 1942 to Torrey Botanical Club Bulletin, New York Botanical Garden.
822. Lactational Performance and Body Weight, by Samuel Brody, submitted April 1942 to the Journal "Growth".
823. Field Studies of Codling Moth Larvae Attractants, by Curtis W. Wingo and Harry E. Brown, submitted April 1942 to the Journal of Economic Entomology.
824. The Effect of Stilbestrol and AP Extract Upon Lactation in Goats, by A. A. Lewis and C. W. Turner, submitted May 1942 to the Journal of Dairy Science.
825. The Relative Efficiency of Gains in Weight Made by Male and Female Bronze Turkeys, by E. M. Funk, submitted May 1942 to the Journal of Poultry Science.
826. Pituitary Weight of the Growing Male Albino Rat Related to Body Weight, by John P. Mixner and Charles W. Turner, submitted May 1942 to the Journal of Endocrinology.
827. The Relation of the Thyroid to Growth. I. The Effects of Crystalline Thyroxin Upon the Rate of Growth, Feed Intake, and Body Composition of Female Albino Mice, by Marvin Koger, Victor Hurst and C. W. Turner, submitted May 1942 to the Journal of Endocrinology.
828. Influence of Thyroxine Upon Mammary Lobule-Alveolar Growth, by John P. Mixner and Charles W. Turner, submitted May 1942 to the Journal of Endocrinology.
829. Some Possibilities For the Use of Diethylstilbestrol in Dairy Cattle, by A. A. Lewis, submitted May 1942 to the Journal of Dairy Science.
830. Various Treatments Which Affect the Growth of Mold Mycelia in Cream and Resultant Butter, by J. E. Edmondson and W. H. E. Reid, submitted May 1942 to the Journal of Dairy Science.
831. Relation of Different Mix Compositions and Methods of Processing to the Texture, Structure and Stability of Ice Cream, by C. W. Decker and W. H. E. Reid, submitted May 1942 to the Journal of Dairy Science.
832. Growth and Energy Metabolism of Thyroidectomized Cattle, by Samuel Brody, submitted May 1942, to the Journal of Dairy Science.
833. Resting Maintenance Cost in Growing Dairy Cattle, by Samuel Brody, H. H. Kibler and A. C. Ragsdale, submitted May 1942 to the Journal of Dairy Science.
834. The Effect of Thyroxine on Rate of Growth and Efficiency of Weight Increment, by Marvin Koger and C. W. Turner, submitted May 1942 to the Journal of Dairy Science.
835. Vitamin D, the Parathyroid Glands, the Calcium Metabolism, by I. L. Campbell, submitted May 1942 to the Journal of Dairy Science.
836. The Effect of Adrenalectomy on the Lactogenic Hormone and Initiation on Lactation, by J. U. Trentin, J. Meites, and C. W. Turner, submitted May 1942 to the Journal of Dairy Science.

837. The Cause of the Initiation of Lactation at Parturition, by Joseph Meites and C. W. Turner, submitted May 1942 to the Journal of Dairy Science.
838. The Chemical Formation of Highly Active Thyroprotein, by E. P. Reineke, submitted May 1942 to the Journal of Dairy Science.
839. The Effect of Thyrolactin on Milk Production, Metabolism, and Growth, by E. P. Reineke, submitted May 1942 to the Journal of Dairy Science.
840. The Influence of Thyroxine Upon the Stimulation of Mammary Lobule-Alveolar Growth, by John P. Mixner, submitted May 1942 to the Journal of Dairy Science.
841. The Breeding Efficiency of Dairy Bulls Used Both Artificially and Naturally, by E. R. Berousek, submitted May 1942 to the Journal of Dairy Science.
842. Studies of Respiration Rate of Dairy Bull Spermatozoa, by Ray E. Ely, submitted May 1942 to the Journal of Dairy Science.
843. The Biological Values of Lespedeza, Alfalfa, Corn and Milk Proteins for Growing Dairy Heifers, by Eric W. Swanson, H. A. Herman and A. C. Ragsdale, submitted May 1942 to the Journal of Dairy Science.
844. The Feeding Value of Korean Lespedeza Seed As a Protein Supplement for Milk Production, by H. A. Herman and A. C. Ragsdale, submitted May 1942 to the Journal of Dairy Science.
845. The Effect of Acidity and Temperature on the Growth of Oospora Lactis Cultures, by E. R. Garrison, submitted June 1942 to the Journal of Dairy Science.
846. Influence on Growth of Artificially Formed Thyroprotein, by Marvin Koger, E. P. Reineke and C. W. Turner, submitted June 1942 to the Proceedings of the Society of Experimental Biology and Medicine.
847. Studies Concerning the Mechanism Controlling the Initiation of Lactation at Partutition. IV. The Influence of Suckling on the Lactogen Content of the Pituitary of Postpartum Rabbits, by Joseph Meites and C. W. Turner, submitted June 1942 to the Journal of Endocrinology.
848. The Clays as Colloidal Electrolytes, by C. E. Marshall and C. A. Krinbill, submitted June 1942 to the Journal of Physical Chemistry.
849. The Energy Cost of Standing in Horses, by C. F. Winchester, submitted June 1942 to the Journal of Science.
850. Influencing Plant Development With Leaf Extracts and Other Organic Substances, by C. G. Vinson, A. D. Hibbard and D. R. Rodney, submitted June 1942 to Archives of Biochemistry.
851. Killing Codling Moth Larvae With Low Temperatures, by Leonard Haseman, submitted June 1942 to the Journal of Economic Entomology.
852. The Relation of the Mammogenic Lobule-alveolar Growth Factor of the Anterior Pituitary to Other AP Hormones, by J. P. Mixner, A. J. Bergman and C. W. Turner, submitted June 1942 to the Journal of Endocrinology.
853. The Lactogenic Hormone Content of the Anterior Pituitary Gland of the Albino Mouse as Compared to Other Species, by Victor Hurst and C. W. Turner, submitted June 1942 to the Journal of Endocrinology.
854. Metabolism and Growth Rate of Rats, by H. H. Kibler and Samuel Brody, submitted June 1942 to the Journal of Nutrition or Growth.

PUBLICATIONS

The publications for the Experiment Station, during the year ending June 30, 1943, reached a gross of 677,900 copies of 78 new publications and 11 reprints. These publications had a total content of 2,026 pages.

During this period, distribution of Experiment Station publications through mailing reached a total of 262,426 copies, including 202,442 copies sent to residents of Missouri, 56,415 copies mailed to other states, and 3,569 copies mailed to foreign countries. Many thousand additional copies were handed to residents of the State at the mailing room.

The publications issued during the year are listed as follows:

Research Bulletins

No.	Title, Series, Author, and Number of Illustrations	Pages	Copies
347.	Fertility in the Male Domestic Fowl, by Jesse E. Parker, Fred F. McKenzie, and H. L. Kempster, August 1942; Figs. 19.	50	2,100
348.	Quantitative Distribution of Nitrogen and Carbohydrates in Apple Trees, by A. E. Murneek, August 1942; Figs. 10.	28	2,000
349.	Growth and Development LIV. Age Changes in Size, Energy Metabolism and Cardio-Respiratory Activities of Thyroidectomized Cattle, by Samuel Brody and R. F. Frankenbach, September 1942; Figs. 7.	12	2,000
350.	Growth and Development LV. Resting Energy Metabolism and Ventilation Rate in Relation to Body Weight in Growing Cattle, by Samuel Brody, H. H. Kibler, and A. C. Ragsdale, September 1942; Figs. 5.	14	2,000
351.	The Use of Consumer Credit by Missouri Farm Families, by Mildred Spicer, Louise A. Young, and Sidney Korando, September 1942; Figs. 0.	20	2,000
352.	The Relation of the Endocrine System to the Regulation of Calcium Metabolism, by I. L. Campbell and C. W. Turner, October 1942; Figs. 17.	134	2,000
353.	Studies of Respiration Rate of Dairy Bull Spermatozoa, by Ray E. Ely, H. A. Herman, and C. F. Winchester, October 1942; Figs. 1.	24	2,000
354.	A Study of Some Chemical and Physical Properties of the Clay Minerals Nontronite, Attapulgite and Saponite, by O. G. Caldwell and C. E. Marshall, October 1942; Figs. 13.	52	2,000
355.	Formation in Vitro of Highly Active Thyroproteins, Their Biologic Assay, and Practical Use, by E. P. Reineke and C. W. Turner, November 1942; Figs. 17.	88	2,200
356.	Extraction, Separation, and Concentration of Some Anterior Pituitary Hormones, by A. J. Bergman and C. W. Turner, November 1942; Figs. 1.	76	2,100
357.	The Weight and Thyrotropic Hormone Content of the Anterior Pituitary of Swine, by H. D. Elijah and C. W. Turner, December 1942; Figs. 12.	28	2,000
358.	The Mummy Disease of the Cultivated Mushroom, by C. M. Tucker and J. B. Routien, December 1942; Figs. 8.	28	2,000
359.	Mineralogical and Chemical Studies of Soil Formation From Acid and Basic Igneous Rocks in Missouri, by R. P. Humbert and C. E. Marshall, January 1943; Figs. 49.	60	2,000

360.	Seasonal Variations in the Growth and Chemical Composition, by E. Marion Brown, March 1943; Figs. 14.	56	2,000
361.	Differential Growth Response of Certain Varieties of Soybeans to Varied Mineral Nutrient Conditions, by Denver I. Allen, March 1943; Figs. 26.	44	2,000
362.	Stabilizing Quality in Shell Eggs, by E. M. Funk, April 1943; Figs. 10.	38	2,500
363.	The Effect of Slope on Soil Erosion, by H. H. Krusekopf, April 1943; Figs. 15.	24	3,000
364.	Pasteurization of Shell Eggs, by E. M. Funk, May 1943; Figs. 2.	28	2,000
365.	The Rural Health Facilities of Lewis County, Missouri, by Ronald B. Almack, May 1943; Figs. 0.	42	3,000
366.	Growth and Development LVI, The Influence of Dairy Merit, Body Size, and Plane of Nutrition of the Economy of Milk Production, by Samuel Brody, May 1943; Figs. 5.	32	2,000
367.	Growth and Development, LVII. An Index of Muscular-Work Capacity, by H. H. Kibler and Samuel Brody, May 1943; Figs. 7.	20	2,500
368.	Growth and Development LVIII. Resting Energy Metabolism and Pulmonary Ventilation in Growing Horses, by Samuel Brody, H. H. Kibler and E. A. Trowbridge, May 1943; Figs. 4.	14	2,500
369.	Family Health Practices in Dallas County, Missouri, by Iola Meier and C. E. Lively, June 1943; Figs. 0.	32	2,000

Reprints

218.	Farm Building Studies in Northwest Missouri, by J. C. Wooley, Reprinted August 1942; Figs. 30.	44	1,000

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450.	Growing Raspberries and Blackberries, by H. G. Swartwout and W. R. Martin, Jr., August 1942; Figs. 16.	32	10,000
451.	Korean Lespedeza Seed as a Protein Supplement for Milk Production, by H. A. Herman and A. C. Ragsdale, August 1942; Figs. 0.	8	10,000
452.	A Study of Towels and Toweling for Consumer Use by Norrine Grover Bennett and Pauline E. Keeney, August 1942; Figs. 0.	32	5,000
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456.	Trichomoniasis of Turkeys, by D. R. Knight, H. C. McDougle, and A. J. Durant, October 1942; Figs. 4.	8	6,000

457.	Agr. Exp. Station Serves the People; Director's Report for Year Ending June 30, 1940, by M. F. Miller, S. B. Shirky, H. J. L'Hote, December 1942; Figs. 0. .	120	1,000
458.	SANBORN FIELD, Fifty Years of Field Experiments with Crop Rotations, Manure and Fertilizers, by G. E. Smith, December 1942; Figs. 10.	62	5,000
459.	Codling Moth Control, by Lee Jenkins, Harry E. Brown, Curtis W. Wingo, William Ward Smith and Leonard Haseman, December 1942; Figs. 4.	18	10,000
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462.	Korean Lespedeza Seed As a Protein Supplement in Chick Rations, by M. Richard Irwin and H. L. Kempster, March 1943; Figs. 0.	12	10,000
463.	Strawberry Insects and Their Control in Missouri, by W. W. Smith, March 1943; Figs. 13.	22	7,000
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465.	Hog Cholera, by Cecil Elder and O. S. Crisler, March 1943; Figs. 0.	8	10,000
466.	Good Pasture and Roughage in Fattening Cattle, by E. A. Trowbridge and A. J. Dyer, April 1943: Figs. 14.	12	20,000
467.	Cost of Producing Cotton in Southeast Missouri: 1941, April 1943; by B. H. Frame; Figs. 0.	28	5,000
468.	Farm Tractors, Their Care, Operation and Maintenance, by M. M. Jones and Lloyd E. Hightower, May 1943; Figs. 28.	40	10,000
469.	Soybeans and Soil Conservation, by Dwight D. Smith, May 1943; Figs. 7.	16	10,000
470.	Tomato Production in Missouri, by T. J. Talbert and Aubrey D. Hibbard, June 1943; Figs. 3.	18	10,000
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CONTRIBUTIONS TO SCIENTIFIC JOURNALS

July 1, 1942 to June 30, 1943

855. The Effect of Diethylstilbestrol on Mammary Gland Development in Dairy Animals, by A. A. Lewis and C. W. Turner, submitted July 1942 to the Journal of Endocrinology.
856. Toward Stability in Tenure, by Conrad H. Hammar, submitted July 1942 to the Journal of Land and Public Utilities Economics. Part I. Setting Up the Standards.
857. Toward Stability in Tenure, by Conrad H. Hammar, submitted July 1942 to the Journal of Land and Public Utilities Economics. Part II. Setting Up the Program.
858. Effect of Adrenalectomy on the Lactogenic Hormone and Initiation of Lactation, by Joseph Meites, J. J. Trentin, and C. W. Turner, submitted July 1942 to the Journal of Endocrinology.
859. The Practical Value of "Hormones" in Plant Cultures, by A. E. Murneek, submitted July 1942, to be printed in Proceedings of 67th Convention of American Association of Nurserymen.
860. Abnormal Capillary Resistance in Swine Suffering From An Inherited Bleeding Disease, by Edwin T. Mertz, submitted July 1942, to the American Journal of Physiology.
861. Cleistogamy and the Development of the Embryo Sac in Lespedeza Stipulacea, by Clarence H. Hanson, submitted July 1942 to the Journal of Agricultural Research.
862. Relation of Polyploidy to Heat and X-Ray Effects in the Cereals, by Luther Smith, submitted August 1942 to the Journal of Agricultural Research.
863. The Amphidiploids Aegilops cylindrice x Triticum durum and Ae. ventricosa x T. durum and Their Hybrids with T. vulgare [1/], by E. R. Sears, submitted August 1942 to the Journal of Agricultural Research.

864. The Effect of Pregnancy and Lactation Upon the Thyrotropic Hormone of the Rabbit, by A. J. Bergman and C. W. Turner, submitted August 1942 to the Journal of Endocrinology.
865. Potassium in the Soil Colloid Complex and Plant Nutrition, by W. A. Albrecht, submitted August 1942 to the Soil of Science.
866. Thyroidal Action of Synthetic Thyroprotein, by E. P. Reineke and C. W. Turner, submitted October 1942 to the Journal Clinical Endocrinology.
867. The Quantitative Evaluation of Soil Formation and Development by Heavy Mineral Studies: A Grundy Silt Loam Profile, by C. E. Marshall and J. F. Haseman, submitted October 1942 to be published in Proceedings of Soil Science Society of America.
868. Soil Development and Plant Nutrition: II Mineralogical and Chemical Composition of Sand and Silt Separates in Relation to the Growth and Chemical Composition of Soybeans, by E. R. Graham, submitted October 1942 to be published in Proceedings of Soil Science Society of America.
869. Nitrate Absorption by Plants as an Anion Exchange Phenomenon, by E. R. Graham and Wm. A. Albrecht, submitted October 1942 to the Journal of Botanical Society of America.
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871. Gonadotropic Hormone in AP of Rabbits During Pregnancy and Lactation, by A J.. Bergman and C. W. Turner, submitted October 1942 to the Journal of Endocrinology.
872. The Effect of Progressive Iodination Followed by Incubation at High Temperature on the Thyroidal Activity of Iodinated Proteins, by E. P. Reineke, M. B. Williamson and C. W. Turner, submitted October 1942 to the Journal of Biological Chemistry.
873. The Use of Membrane Electrodes in the Study of Soils, by C. E. Marshall, submitted November 1942 to the Soil Science Society of America.
874. Feed Efficiency in Terms of Biological Assays of Soil Treatments, by G. E. Smith and Wm. A. Albrecht, submitted November 1942 to the Soil Science Proceedings.
875. The Hardpan Soils of the Ozark Region, by H. H. Krusekopf, submitted November 1942 to the Proceedings of Soil Science Society of America.
876. Synthetic Thyroprotein, a New Drug Available in Veterinary Practice, by E. P. Reineke and C. W. Turner, submitted November 1942 to the Journal of the American Veterinary Association.
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880. Microscopy of Ice Cream with Polarized Light, by W. D. Keller, W. H. E. Reid, W. S. Arbuckle, and C. W. Decker, submitted December 1942 to the Journal of Dairy Science.

881. Effect of Graded Doses of Estrone Upon Hypophyseal Lactogen, Thyrotropin and Gonadotropin of Male Rabbits, by Joseph Meites, A. J. Bergman and C. W. Turner, submitted December 1942 to the Journal of Endocrinology.
882. A Blood Vessel Defect in Swine Suffering From an Inherited Bleeding Disease, by Edwin T. Mertz and Leon A. Hensel, submitted January 1943 to the American Journal of Physiology.
883. Agriculture In an Expansionist Economy, by Conrad H. Hammar, submitted January 1943 to the Journal of Farm Economics.
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885. Caustic Sprays to Modify Alternate Fruit Production, by A. E. Murneek, submitted January 1943 to the Proceedings of the American Society for Horticultural Science.
886. Effect of Branch Ringing on Biennial Bearing of York and Golden Delicious Apples, by A. E. Murneek, submitted January 1943 to the Proceedings of the American Society for Horticultural Science.
887. A Protozoon of the Genus Tetrahymena Found in Domestic Fowls, by D. R. Knight and H. C. McDougle, submitted February 1943 to the American Veterinary Medical Association Journal.
888. A Disease of Gloxinia Caused by Phytophthora Cryptogea, by John T. Middleton, C. M. Tucker, and C. M. Tompkins, submitted February 1943 to the Journal of Agricultural Research.
889. The Lactogenic Hormone Content of the AP of the Pigeon, by Victor Hurst, Joseph Meites and C. W. Turner, submitted March 1943 to the Proceedings of the Society for Experimental Biology and Medicine.
890. Studies on the Use of Point Quadrat Method of Botanical Analysis of Mixed Pasture Vegetation, by William B. Drew, submitted March 1943 to the Journal of Agricultural Research.
891. Effect of Feeding Thyroactive Iodacasein on Growth, Feathering, and Weights of Glands of Young Chicks, by M. Richard Irwin, E. P. Reineke and C. W. Turner, submitted April 1943 to the Journal of Poultry Science.
892. Compensatory Hypertrophy of a Single Kidney in the Domestic Fowl, by M. Richard Irwin, submitted April 1943 to the Journal of Poultry Science.
893. A Cellular Characteristic Necessary for the Survival of Bull Spermatozoa, by John F. Lasley and Dennis T. Mayer, submitted April 1943 to the American Journal of Physiology.
894. Additional Observations on the Chick Antianemia Vitamin, by Boyd L. O'Dell and Albert G. Hogan, submitted May 1943 to the Journal of Biological Chemistry.
895. The Recovery of Crystalline Thyroxine from Thyroactive Iodinated Casein, by E. P. Reineke and C. W. Turner.
896. The Recovery of L-thyroxine from Thyroactive Iodinated Casein, by Direct Hydrolysis with Acid, by E. P. Reineke and C. W. Turner.
897. The Occurrence of Physiologic Specialization in the Tomato Wilt Fungus, *Fusarium bulbiegenum* var. *lycopersici* (Brushi) Wr. and R., by L. J. Alexander and C. M. Tucker, submitted May 1943 to the Journal of Agricultural Research.
898. Invisibility of Intergeneric Hybrids Involving Triticum Monocaccum and T. Aegilopiodes, by Ernest O. Sears, submitted May 1943 to Genetics.

899. Practical Trials on the Use of Synthetic Thyroprotein for Increased Production of Milk and Butterfat, by E. P. Reineke, submitted June 1943 to the Journal of Dairy Science.
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903. Some Factors Affecting Biological Values of Proteins for Growing Dairy Heifers, by Eric W. Swanson, H. A. Herman and A. C. Ragsdale, submitted June 1943 to the Journal of Dairy Science.
904. The Quantitative Determination of Lactose-Fermenting Yeasts in Sour Cream, by E. R. Garrison, submitted June 1943 to the Journal of Dairy Science.
905. Artificial Breeding as a Means of Controlling Genital Infections in the Dairy Herd, by H. A. Herman, E. R. Berousek, and E. W. Swanson, submitted June 1943 to the Journal of Dairy Science.
906. A Satisfactory Method of Shipping Dairy Bull Semen Long Distances, by Eric W. Swanson and H. A. Herman, submitted June 1943 to the Journal of Dairy Science.
907. Bluegrass Terrace Outlet Channels, by Dwight D. Smith, submitted June 1943 to the Journal of Agricultural Engineering.
908. A Comparison of the Effects of Heat and X-Rays with Special Reference to Polyploidy, by Luther Smith, submitted June 1943 to the Journal of Agricultural Research.
909. Synapis and Syngamy as Stimulating Processes of Plant Development, by A. E. Murneek and S. H. Wittwer, submitted June 1943 to be published in Science.

The Farm News Service.—The Missouri Farm News Service each week carried from the College to every Missouri newspaper timely information on the results of experimental work, announcements of new publications, reports on new crops and practices, and timely subject matter bearing on current farm and home problems. This official clipsheet of the College of Agriculture, entered as second class matter at the Columbia Post Office, was mailed to all Missouri newspapers and farm journals, county extension agents, home demonstration agents, teachers of vocational agriculture, soil conservation project managers, and rural rehabilitation supervisors, as well as many others engaged in the dissemination of agricultural information.

Special Press Service.—The weekly news service is augmented by a constant flow of material designated as the Special Press Service. This Service, written as spot news especially for the news syndicates and larger dailies, announces new discoveries, tells of the more important activities of the staff, and carries information designed to meet special emergencies in farming or rural life. This service frequently includes news photographs.

Radio Broadcasts.—Radio broadcasting stations took a larger part in spreading agricultural information during the year, with additional program directors requesting the manuscript radio service of the College. Fourteen stations received the service regularly throughout the year.

INVESTIGATIONS UNDER COOPERATIVE PROJECTS

During the years 1941-42 and 1942-43 the Agricultural Experiment Station has cooperated with the United States Department of Agriculture in the following projects:

Utilization of Farm Products.
Laws and Principles Underlying the Industrial Utilization of the Soybean and Soybean Products.
Agricultural Land Use Planning.[1]
Marketing of Slaughter Livestock from Farms and Ranges to Processors, and of Stockers and Feeders from Ranges to Farms and Feedlots.
Individual Farm Unit Adjustment Study of County Land Use Planning Areas in Unified Counties.[1]
The Relation of Land Income to Land Values in Northern and Western Missouri.
A Study of Beefiness and Milk Production in Dual Purpose Cattle.[1]
Factors Influencing Quality and Palatability of Meat.
The Improvement of Viability in Poultry.
The Improvement of Swine Through Breeding.
Determination and Evaluation of Work Capabilities of Horses and Mules and Related Factors.
Physiology of Reproduction in Farm Animals.[1]
The Improvement of Pastures in the Corn Belt.
Maintenance and Development of the Hatch Dairy Experiment Station at Hannibal, Mo.—Breeding, Feeding, and Management of Dairy Cattle.
Seed Testing and Enforcement of the Federal Seed Act.
Diseases of Orchard Fruit.
Agronomic, Physiologic, and Genetic Research with Soybeans.
Physiology, Edaphology, and Breeding of Pasture Plants.
Cereal Improvement with Special Emphasis on Corn.
Improvement of Varieties of Annual Lespedeza.
Soil Erosion and Its Control.
Transportation of Livestock, Other Farm Products and Supplies Between Farm and Market.[2]
Current Land Market Activity in Missouri.[2]
Investigations on Kok-Saghyz (Russian dandelion).[2]

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[1]Cooperation in 1941-42 only.
[2]Cooperation in 1942-43 only.

RESEARCH GRANTS

Kraft Cheese Company

For the study of the composition of milk, cheese and whey from Missouri cheese factories.

Missouri Butter Institute

For the study of mold mycelia in cream and butter.

Corn Products Sales Company

For the study of problems dealing with the manufacture of ice cream.

International Cancer Research Foundation

For work in the field of genetics.

Anheuser-Busch, Incorporated

For research dealing with the use of yeast in the feeding of swine.

John and Mary R. Markle Foundation

For investigations dealing with a hemophilia-like disease in swine.

Parke, Davis and Company

For research in the field of vitamins.

Missouri Conservation Commission

For research dealing with the utilization of Missouri timber.

American Cyanamid Company

For investigations dealing with the decomposition of farm residues.

American Potash Institute

For furthering research on the role of potassium in Missouri soils.

Missouri Portland Cement Company

For use in the study of the application of precipitator dust from cement plants as a fertilizing material.

International Minerals and Chemical Corporation

For use in studies of magnesium in soils and plants.

American Academy of Arts and Sciences

For continuing the study on thyroid and pituitary hormone interrelations.

American Medical Association

For research work dealing with lactation in cattle.

Corn Products Sales Company

For research in the field of dairy products.

De-Raef Corporation

For the purpose of aiding in the study of cultures in table cream, buttermilk, cottage cheese, and ice cream.

Missouri College of Agriculture Foundation

For investigations on the use of effluent from paper mills on the soil and on crop production.

Cooperative Milk Producers, Sanitary Milk Producers of St. Louis, and Federal Market Milk Administrator

For the study of the collection of raw milk in the St. Louis milk shed.

CHANGES IN STATION STAFF FOR YEAR ENDING JUNE 30, 1942

Appointments

Joe D. Baldridge, Research Assistant in Field Crops
Albert J. Bergman, Research Assistant in Dairy Husbandry
Ernest R. Berousek, Research Assistant in Dairy Husbandry
John R. Bertrand, Research Assistant in Rural Sociology
George B. Blair, Research Assistant in Rural Sociology
George A. Carlson, Graduate Assistant in Agricultural Economics
Kenneth E. Cooley, Research Assistant in Horticulture
Joseph E. Edmondson, Research Assistant in Dairy Husbandry
Ray E. Ely, Assistant Instructor in Dairy Husbandry
Wilbur R. Enns, Graduate Assistant in Entomology
Walter Fulks, Graduate Assistant in Agricultural Economics
H. Ruth Gardner, Research Assistant in Rural Sociology
Floyd R. Haden, Research Assistant in Dairy Husbandry
William B. House, Research Assistant in Agricultural Chemistry
Pauline E. Keeney, Instructor in Home Economics

Sidney Korando, Research Assistant in Home Economics
C. Willard Leach, Research Assistant in Forestry
Maxine E. McDivitt, Instructor in Home Economics
Joseph Meites, Research Assistant in Dairy Husbandry
Ralph Ricketts, Instructor in Agricultural Engineering
Donald E. Rodabaugh, Instructor in Veterinary Science
Eugene E. Rowe, Research Assistant in Agricultural Chemistry
Aaron K. Schmidt, Assistant Instructor in Agricultural Economics
Nadene Fay Strecker, Research Assistant in Home Economics
John J. Trentin, Research Assistant in Dairy Husbandry
William W. Warbritton, Research Assistant in Soils
Victor B. Williams, Research Assistant in Agricultural Chemistry

Resignations and Withdrawals

Ronald W. Almack, Instructor in Rural Sociology
Albert J. Bergman, Research Assistant in Dairy Husbandry
E. R. Berousek, Research Assistant in Dairy Husbandry
John R. Bertrand, Research Assistant in Rural Sociology
George B. Blair, Research Assistant in Rural Sociology
Orval G. Caldwell, Research Assistant in Soils
George A. Carlson, Research Assistant in Agricultural Economics
Jessie V. Coles, Associate Professor of Home Economics
James M. Crall, Research Assistant in Botany
C. Bradford Croston, Research Assistant in Horticulture
Howard G. Fugate, Research Assistant in Agricultural Economics
Leonard F. Gieseker, Jr., Assistant in Agricultural Chemistry
Houston D. Elijah, Instructor in Animal Husbandry
Walter Fulks, Graduate Assistant in Agricultural Economics
Floyd R. Haden, Research Assistant in Dairy Husbandry
Robert M. Hamby, Assistant Instructor in Soils
Herbert E. Hampton, Research Assistant in Soils
Clarence B. Harston, Research Assistant in Soils
Marion W. Hazen, Assistant in Animal Husbandry
Warren W. Heathman, Assistant Instructor in Dairy Husbandry
Delbert D. Hemphill, Research Assistant in Horticulture
William B. House, Research Assistant in Agricultural Chemistry
Victor Hurst, Research Assistant in Dairy Husbandry
Marvin Koger, Research Assistant in Dairy Husbandry
Arthur A. Lewis, Instructor in Dairy Husbandry
William F. Lytle, Instructor in Agricultural Engineering
F. F. McKenzie, Assistant Professor of Animal Husbandry
Isidor Meites, Research Assistant in Horticulture
Joseph Meites, Research Assistant in Dairy Husbandry
Roxielee Morgan, Research Assistant in Home Economics
William J. Pettyjohn, Assistant in Soils
Eugene L. Powell, Assistant Instructor in Agricultural Chemistry
Aaron K. Schmidt, Assistant Instructor in Agricultural Economics

William C. Sechrist, Research Assistant in Forestry
John J. Trentin, Research Assistant in Dairy Husbandry
William W. Warbritton, Research Assistant in Soils
Carol C. Whitford, Research Assistant in Home Economics
Victor B. Williams, Research Assistant in Agricultural Chemistry
Irvin Lester Williams, Instructor in Poultry Husbandry
Curtis W. Wingo, Research Assistant in Entomology
Eugene Rowe, Research Assistant in Agricultural Chemistry
Nelson B. Russell, Research Assistant in Agricultural Chemistry
Elizabeth P. Simpson, Research Assistant in Agricultural Chemistry
Mildred G. Spicer, Assistant Professor of Home Economics
Isaac Frank Sweaney, Research Assistant in Agricultural Chemistry
Emil S. Troelston, Instructor in Agricultural Economics
Annabel Whiteside, Research Assistant in Rural Sociology
Carroll C. Whitford, Research Assistant in Home Economics
Warren C. Woelfel, Instructor in Agricultural Chemistry

Resignations and Withdrawals

Joe D. Baldridge, Research Assistant in Field Crops
Margaret L. Bright, Research Assistant in Rural Sociology
Robert H. Clark, Instructor in Veterinary Science
Kenneth E. Cooley, Research Assistant in Horticulture
J. Bradley Crundwell, Instructor in Veterinary Science
Clinton W. Decker, Assistant Instructor in Dairy Husbandry
Ray E. Ely, Assistant Instructor in Dairy Husbandry
Wilbur R. Enns, Research Assistant in Entomology
Howard Fugate, Research Assistant in Agricultural Economics
R. Ruth Gardner, Research Assistant in Rural Sociology
Bertha Grigsby, Technician in the Department of Veterinary Science
Arthur M. Hamby, Assistant Instructor in Soils
John W. Hamilton, Research Assistant in Agricultural Chemistry
C. B. Harston, Research Assistant in Soils
Hubert Heitman, Assistant Instructor in Animal Husbandry
H. A. Henley, Assistant in Soils
Leonard C. Hoegemeyer, Quaker Oats Fellow
Marian A. Kaeser, Instructor in Home Economics
John M. Kays, Assistant Instructor in Animal Husbandry
Delvin R. Knight, Research Assistant in Veterinary Science
Burton H. Moore, Research Assistant in Agricultural Chemistry
Merle E. Muhrer, Research Assistant in Agricultural Chemistry
Eugene Otis McLean, Research Assistant in Soils
Boyd L. O'Dell, Research Assistant in Agricultural Chemistry
Eugene L. Powell, Assistant Instructor in Agricultural Chemistry

CHANGES IN STATION STAFF FOR THE YEAR ENDING JUNE 30, 1943

Appointments

Margaret L. Bright, Research Assistant in Rural Sociology
Robert H. Clark, Instructor in Veterinary Science
J. Bradley Crundwell, Instructor in Veterinary Science
Suzanne Davison, Instructor in Home Economics
Wilbur R. Enns, Research Assistant in Entomology
Laura Mary Flynn, Instructor in Agricultural Chemistry
Bertha Grigsby, Technician in Department of Veterinary Science
Harold F. Kaufman, Instructor in Rural Sociology
Leta Gertrude Maharg, Research Assistant in Home Economics
Warren William Morse, Research Assistant in Rural Sociology
Eugene Otis McLean, Research Assistant in Soils
Roland W. Portman, Research Assistant in Entomology
William O. Regan, Assistant in Agricultural Chemistry
Nelson B. Russell, Research Assistant in Agricultural Chemistry
Elizabeth P. Simpson, Research Assistant in Agricultural Chemistry
Fred Steffan, Assistant in Agricultural Engineering
Ruth Slabaugh Stone, Assistant Instructor in Entomology
Isaac Frank Sweaney, Research Assistant in Agricultural Chemistry
Emil S. Troelston, Instructor in Agricultural Economics
Annabel Whiteside, Research Assistant in Rural Sociology
Carol Corinne Whitford, Research Assistant in Home Economics
Warren C. Woelfel, Instructor in Agricultural Chemistry
Louise A. Young, Instructor in Home Economics

FINANCIAL STATEMENT

UNIVERSITY OF MISSOURI
AGRICULTURAL EXPERIMENT STATION
in account with
THE UNITED STATES APPROPRIATION, 1942

	Hatch Fund	Adams Fund	Purnell Fund	Bankhead-Jones Fund
Dr.				
To balance from 1940-41	$.....	$.....	$.....	$.....
Receipts from the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1942	15,000.00	15,000.00	60,000.00	76,967.80
Total	15,000.00	15,000.00	60,000.00	76,967.80
Cr.				
Personal Services	14,579.75	10,764.05	40,236.79	51,253.95
Supplies and Materials	.....	3,150.25	9,834.66	15,116.55
Communication Service	.....	69.63	122.88	321.08
Travel Expenses	.....	9.24	3,230.36	409.76
Transportation of Things	.....	61.81	154.88	155.35
Printing and Illustrating Publications	.....	.....	694.27	1,598.77
Heat, Light, Water, Power, Fuel	.....	63.35	79.55	1,185.38
Contingent Expenses	.....	.....	.....	10.59
Employer Contributions to Retirement	420.25	154.10	516.24	379.11
Equipment	.....	625.16	4,180.19	4,749.59
Land	.....	.....	.....	.....
Structures and Nonstructural Improvements	.....	102.41	950.18	1,787.67
Balance	.....	.....	.....	.....
Total	15,000.00	15,000.00	60,000.00	76,967.80

FINANCIAL STATEMENT

UNIVERSITY OF MISSOURI
AGRICULTURAL EXPERIMENT STATION
in account with
THE UNITED STATES APPROPRIATION, 1943

	Hatch Fund	Adams Fund	Purnell Fund	Bankhead-Jones Fund
Dr.				
To balance from 1941-42	$.....	$.....	$.....	$.....
Receipts from the Treasury of the United States as per appropriations for fiscal year ended June 30, 1943	15,000.00	15,000.00	60,000.00	76,967.80
Total	15,000.00	15,000.00	60,000.00	76,967.80
Cr.				
Personal Services	14,553.73	10,118.36	42,540.72	47,028.34
Travel	.....	.....	1,729.07	565.49
Transportation of Things	.....	28.10	233.21	257.27
Communication Services	.....	.....	132.47	454.15
Rents and Utility Services	.....	21.00	364.03	826.28
Printing and Binding	.....	.....	1,673.24	2,585.68
Other Contractural Services	.....	84.32	713.99	1,131.20
Supplies and Materials	.....	3,518.59	11,278.57	17,995.18
Equipment	.....	993.41	809.51	2,546.08
Land and Structures	.....	80.00	27.49	2,288.15
Contributions to Retirement	446.27	156.22	497.70	697.30
Balance	.....	.....	.....	592.68
Total	15,000.00	15,000.00	60,000.00	76,967.80