FORTY-FOURTH ANNUAL REPORT

Agricultural Experiment Station
University of Minnesota

JULY 1, 1936 to JUNE 30, 1937

UNIVERSITY FARM, ST. PAUL

LETTERS OF TRANSMITTAL

UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.,
July 1, 1937

To His Excellency, Elmer A. Benson,
Governor of Minnesota.

SIR: I have the honor to transmit to you herewith the report of the Agricultural Experiment Station of the University of Minnesota for the fiscal year ending June 30, 1937.

Respectfully transmitted,
LOTUS D. COFFMAN,
President of the Board of Regents

UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.,
July 1, 1937

To the Honorable Board of Regents,
University of Minnesota.

GENTLEMEN: I have the honor to transmit herewith the report of the Director of the Agricultural Experiment Station of the University of Minnesota for the fiscal year ending June 30, 1937.

Respectfully transmitted,
LOTUS D. COFFMAN,
President of the University of Minnesota

UNIVERSITY FARM, ST. PAUL, MINN.,
July 1, 1937

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President of the University of Minnesota.

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Respectfully submitted,
W. C. COFFEY, *Director*

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FORTY-FOURTH ANNUAL REPORT

MINNESOTA AGRICULTURAL EXPERIMENT STATION

JULY 1, 1936 to JUNE 30, 1937

W. C. Coffey, Director

FOREWORD

It is not possible for an experiment station to adopt a program that undertakes the solution of all of the apparent pressing problems that confront those who engage in agriculture and closely related enterprises. Especially is this true at present because of the many marked social and economic changes rapidly occurring in our national life. It is important, however, that the experiment station be alert to changing conditions and that it endeavor to relate its discoveries to them in order that its constituency may profit by the laws, principles, and facts it discloses through fundamental investigations.

The Minnesota Agricultural Experiment Station is keenly aware of its responsibilities and of its inability to meet all of the legitimate demands made of it. Solutions of many pressing problems have been wholly or partially achieved, but many of the important and even urgent problems relating to agricultural production, distribution of farm products, and rural life still await investigation. Always, it must be remembered that researches into these problems of fundamental importance have a direct bearing, not only on the well-being of rural communities but in very large measure, also, on the well-being of the general public.

CHANGES IN STAFF

Appointments

A. A. Dowell, Ph.D., as agricultural economist, Division of Agricultural Economics, April 1, 1937.

T. M. McCall, M.S., as superintendent of the Northwest Experiment Station, April 1, 1937.

D. R. Briggs, Ph.D., as associate agricultural biochemist, Division of Agricultural Biochemistry, September 16, 1936.

Andrew Hustrulid, Ph.D., as assistant agricultural engineer, Division of Agricultural Engineering, March 16, 1937.

A. J. Bailey, Ph.D., as assistant forester, Division of Forestry, December 16, 1936.

A. C. Vogele, Ph.D., as assistant plant physiologist, Division of Plant Pathology and Botany, July 1, 1936.

M. H. Roepke, Ph.D., as assistant pathologist, Division of Veterinary Medicine, September 14, 1936.

R. C. Bevan, B.S., as assistant in agricultural economics, Division of Agricultural Economics, July 1, 1936.

S. A. Engene, B.S., as assistant in agricultural economics, Division of Agricultural Economics, July 1, 1936.

H. C. Trelogan, M.S., as assistant in agricultural economics, Division of Agricultural Economics, August 23, 1936.

J. E. Shumway, as assistant in agricultural engineering, Division of Agricultural Engineering, September 1, 1936.

M. F. Kernkamp, B.S., as assistant in plant pathology, Division of Plant Pathology and Botany, September 15, 1936.

F. E. Wetherill, as field agent, Division of Agricultural Economics, March 1, 1937.

T. H. King, B.S., Fellow, Firestone Plantations Company fund, Division of Plant Pathology and Botany, March 8, 1937.

Leaves of Absence

C. H. Bailey, agricultural biochemist, Division of Agricultural Biochemistry, without salary, November 1 to 30, 1936, to attend the International Congress on Bread Production held at Leipzig, Germany.

R. B. Harvey, plant pathologist and botanist, Division of Plant Pathology and Botany, without salary, July 1, 1936 to June 30, 1937, to conduct research work with the Florida Citrus Commission and growers of fruits and vegetables in Florida on the ripening, storage, and transportation of tropical fruits and vegetables and their conditioning for market.

A. C. Arny, associate agronomist, Division of Agronomy and Plant Genetics, without salary, June 26 to September 30, 1937, to attend the Fourth International Grassland Congress in Great Britain.

J. H. Neal, assistant agricultural engineer, Division of Agricultural Engineering, sabbatical leave, September 1, 1936, to June 30, 1937.

G. A. Sallee, assistant in agricultural economics, Division of Agricultural Economics, without salary, July 1, 1936 to June 30, 1937, to assist with the Works Progress Administration study of re-employment opportunities and recent changes in industrial techniques.

L. W. Neubauer, assistant in agricultural engineering, Division of Agricultural Engineering, without salary, July 1 to September 30, 1936, to serve the Works Progress Administration as inspector of engineering work.

Helen Hart, assistant in plant pathology, Division of Plant Pathology and Botany, without salary, May 1 to June, 30, 1937, to study at the University of Halle, Germany.

Resignations

A. A. Dowell, Superintendent, Northwest Experiment Station, at Crookston, Minnesota, to accept an appointment as agricultural economist, Division of Agricultural Economics; effective April 1, 1937.

E. C. Johnson, associate agricultural economist, Division of Agricultural Economics, to accept a position as chief economist with the Farm Credit Administration, Washington, D.C.; effective March 15, 1937.

H. B. Bull, assistant agricultural biochemist, Division of Agricultural Biochemistry, to accept an appointment as assistant professor of physiological chemistry, Northwestern University Medical School; effective June 30, 1936.

H. F. Hollands, assistant in agricultural economics, Division of Agricultural Economics, to accept an assistant professorship at Washington State College, Pullman, Washington; effective August 22, 1936.

O. W. Howe, assistant in agricultural engineering, Division of Agricultural Engineering, to accept a position as assistant agricultural engineer with the Bureau of Agricultural Engineering, United States Department of Agriculture; effective March 31, 1937.

W. M. Myers, assistant in agronomy, Division of Agronomy and Plant Genetics, to accept a position as agent with the United States Department of Agriculture in the Regional Laboratory for Pasture research, with headquarters at State College, Pennsylvania; effective June 30, 1937.

R. T. Clark, assistant in animal husbandry, Division of Animal and Poultry Husbandry, to accept an appointment as head of the Animal Genetics section, Division of Animal Husbandry, Montana State College, Bozeman, Montana; effective April 30, 1937.

R. T. King, assistant in vertebrate zoology, Division of Entomology and Economic Zoology, to accept an appointment as director of the Roosevelt Wildlife Experiment Station at Syracuse, New York; effective April 15, 1937.

F. H. Kaufert, assistant in forestry, Division of Forestry, to accept a position as pathologist with E. I. du Pont de Nemours and Company at Wilmington, Delaware; effective November 30, 1936.

C. P. Shumway, assistant in plant pathology, Division of Plant Pathology and Botany, to accept a position as instructor in Agriculture, Cambridge High School, Cambridge, Minnesota.

R. H. Loreaux, field agent, Division of Agricultural Economics, to engage in private farming in Ohio; effective February 28, 1937.

Deaths

J. Romness, M.A., assistant agricultural engineer, Division of Agricultural Engineering, January 22, 1937.

R. W. Murchie, Ph.D., rural sociologist, April 20, 1937.

PUBLICATIONS

Report Series

Forty-third Annual Report of the Agricultural Experiment Station, July 1, 1935 to June 30, 1936. 74 pages, 2,200.

General Bulletin Series

330. The Influence of Depth of Ground Water Level on the Yields of Crops Grown on Peat Lands. H. B. Roe, Division of Agricultural Engineering. 32 pages, 3,000.

331. The Twin City Milk Market. O. B. Jesness, W. C. Waite, and P. E. Quintus, Division of Agricultural Economics. 24 pages, 6,000.

332. Market Outlets for Minnesota Fruits. J. D. Winter and W. H. Alderman, Division of Horticulture, and W. C. Waite, Division of Agricultural Economics. 36 pages, 7,000.

Technical Bulletin Series

114. The Biology of *Pleurotus corticatus* Fries. F. H. Kaufert, Division of Forestry. 35 pages, 1,900.

115. A Study of the Body and Texture of Butter. S. T. Coulter and W. B. Combs, Division of Dairy Husbandry. 39 pages, 2,000.

116. Studies on the Freezing Process in Insects. R. W. Salt, Division of Entomology and Economic Zoology. 41 pages, 1,900.

117. Variation in *Fomes igniarius* (L.) Gill. A. F. Verrall, Division of Plant Pathology and Botany. 41 pages, 1,900.

118. Studies on the Physiology of Reproduction in the Sheep; IV Fetal Development. L. M. Winters and George Feuffel, Division of Animal and Poultry Husbandry. 20 pages, 2,000.

119. Studies on the Genetics of Smuts of Barley and Oats in Relation to Pathogenicity. C. C. Allison, Division of Plant Pathology and Botany. 34 pages, 1,900.

120. The Relative Toxicity of Insect Fumigants. H. H. Shepard, D. L. Lindgren, and Edw. Thomas, Division of Entomology and Economic Zoology. 23 pages, 3,000.

121. Endoparasitic Infestations in Grouse, Their Pathogenicity and Correlation with Meteoro-Topographical Conditions. R. V. Bougton, Division of Entomology and Economic Zoology. 52 pages, 1,900.

122. The Permeability of Woods to Liquids and Factors Affecting the Rate of Flow. H. D. Erickson and Henry Schmitz, Division of Forestry, and R. A. Gortner, Division of Agricultural Biochemistry. 42 pages, 2,000.

123. Factors Affecting the Pathogenicity of *Fomes lignosus* Klotzsch. J. G. Harrar, Division of Plant Pathology and Botany. 28 pages, 1,900.

124. Ecological Changes Due to Thinning Jack Pine. T. S. Hansen, Cloquet Forest Experiment Station. 84 pages, 1,500.

Agricultural Extension Service

Special Bulletin Series

178. Use of Merchant Credit by Farmers. E. C. Johnson, Division of Agricultural Economics. 8 pages, 10,000.

179. Farmstead Wiring. J. Romness, Division of Agricultural Engineering, and L. P. Zimmerman, Division of Agricultural Extension. 16 pages, 7,500.

180. Crossbred Swine for Greater Profits. L. M. Winters and W. H. Peters, Division of Animal and Poultry Husbandry; O. M. Kiser, Northwest Experiment Station, and P. S. Jordan, West Central Experiment Station. 12 pages, 10,000.

181. Sunflower Silage in Northern Minnesota. C. L. Cole, R. L. Donovan, North Central Experiment Station, and N. N. Allen, Jr., Division of Dairy Husbandry. 12 pages, 7,500.

182. Potato Pointers. A. G. Tolaas, Division of Horticulture. 56 pages, 15,000.

183. Perennial Weeds and Their Control. H. K. Wilson, Division of Agronomy and Plant Genetics, R. F. Crim, Division of Agricultural Extension, and A. H. Larson, Division of Plant Pathology and Botany. 28 pages, 20,000.

184. Packing Minnesota Fruits for Market. J. D. Winter and W. H. Alderman, Division of Horticulture, and W. C. Waite, Division of Agricultural Economics. 16 pages, 10,000.

185. Using Minnesota Apples. A. M. Child, Division of Home Economics. 24 pages, 15,000.

Circular Series

56. Fleas as Household Pests. W. A. Riley, Division of Entomology and Economic Zoology. 4 pages, 3,500.

57. Treatment of Sugar-Beet Seed Increases Stand and Yield. E. L. LeClerg, Division of Sugar Plant Investigations, Bureau of Plant Industry, United States Department of Agriculture, in cooperation with the Division of Plant Pathology and Botany. 8 pages, 5,000.

Pamphlet Series

38. Herbs—Their Culture and Uses. A. E. Hutchins and L. Sando, Division of Horticulture. 16 pages, 5,000.

39. Agricultural Outlook and Farm-Family Living Outlook for 1937. W. B. Silcox, Division of Agricultural Extension. 16 pages, 6,000.

40. Round Top Brooder House with Sun Porch. W. A. Billings, Division of Agricultural Extension. 12 pages, 10,000.

Folder Series

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56. Throw the C. T. A. Searchlight on Your Herd. Division of Agricultural Extension. 4 pages, 10,000.

57. The Dairy Herd Improvement Program. Division of Agricultural Extension. 4 pages, 10,000.

58. Cutting Costs in Poultry Feeding. H. J. Sloan, Division of Animal and Poultry Husbandry, and Cora Cooke, Division of Agricultural Extension. 4 pages, 5,000.

59. Marketing Wheat and Barley. W. W. Brookins, Division of Agricultural Extension. 4 pages, 5,000.

60. Preventing "Sticky-Crumbly" Butter. S. T. Coulter and W. B. Combs, Division of Dairy Husbandry. 4 pages, 6,000.

61. Fallow in Weed Control. H. K. Wilson, Division of Agronomy and Plant Genetics. 6 pages, 25,000.

62. Legume and Grass Mixtures, with Recommendations for Seedbed Preparation and Seeding. R. F. Crim, Division of Agricultural Extension. 6 pages, 25,000.

Miscellaneous

Dairy Herd Improvement Letter, Monthly. 1,700.

Engineering News Letter, Monthly. 950.

Minnesota Farm Business Notes, Monthly. 900.

News Letter, Weekly. 1,350.

Poultry Letter, Monthly. 250.

Turkey Letter, Monthly. 5,000.

Scientific Journal Series

1341. Wrapping tomatoes. R. B. Harvey and J. D. Caruso. *Food Industries* 7:375, 376, 416. 1935.

The use of commercial cellophane and paper wraps in relation to the keeping quality of tomatoes in storage and transport is described.

1354. The Mutillid wasps of the genus *Timulla* which occur in North America north of Mexico. C. E. Mickel. *Entomologica Americana* 17 n.s. (1 and 2):1-119. 1937.

This is a monographic revision of the Mutillid wasps belonging to the genus *Timulla* and which are known to occur in the United States and Canada. The paper includes a history of the generic concept *Timulla,* an explanation for the recognition of the sub-genus *Timulla,* keys for the separation of species adapted for each sex, nomenclatorial changes resulting from the correlation of the two sexes and other causes, historical synonymy for each species, description of 14 new species and 8 new subspecies, maps indicating the geographical distribution of many of the species, figures illustrating certain salient characters of the male, a bibliography of the literature pertaining to the species treated, and other minor notes. A total of 38 species and subspecies are described.

1368. Is wax a necessary constituent of the diet of wax moth larvae? M. H. Haydak. *Annals of the Entomological Society of America* 29(4): 581-588. 1936.

An experiment was described indicating that wax is not an essential constituent of the food of the wax moth larvae, since the latter were successfully reared to the adult stage for two generations on a number of media which did not contain even traces of wax.

A deficiency in the development of the wax moth was observed on a food consisting of powdered dried yeast mixed with sawdust.

The best development of wax moth larvae was achieved on foods having a liberal supply of all the essential food constituents as applied to rats.

A formula for an adequate food for the rearing of wax moth larvae is given.

1376. An important factor in the mechanism of specific bacterial agglutination. C. R. Donham and C. P. Fitch. *Journal of Infectious Diseases* 59:6-10. 1936.

Studies previously reported have suggested that at least one important factor in the phenomenon or mechanism of agglutination is the ratio between the amount of water in the test fluid and the agglutinating serum that are brought together in the serum-antigen mixture. Further studies using a large group of serums of variable agglutinating content confirm this opinion. A practical method of recognizing this factor in the mechanism of agglutination and for overcoming its effect on agglutination results used in the diagnosis of disease is not yet available. The results reported suggest the need for further experiments to find a more suitable suspending medium for bacterial agglutination antigens instead of being content with the time-honored saline solution.

1379. Intra-mammary duct injections in the study of lactose formation. W. R. Brown, W. E. Petersen, and R. A. Gortner. *Journal of Dairy Science* 19:243-256. 1936.

With a view to producing hyperglucemia, solutions of glucose, lactose, fructose, glutose, and hydrolyzed lactose were injected into the duct system of the udder immediately after milking. These injections produced hyperglucemia and a slight increase in the lactose content of the milk. At first there was a hypoglucemia due to the stimulation of insulin secretion which was followed by body tremors in some cases. This was followed by a marked diuresis which was thought to be related to the tremors.

1380. A study of variations in the lactose content of milk. W. R. Brown, W. E. Petersen, and R. A. Gortner. *Journal of Dairy Science* 19:81-92. 1936.

Six cows were milked hourly from 6:00 a.m. to 5:00 p.m. and blood samples taken from the jugular vein immediately before each milking. Glucose was determined on the blood and lactose on the milk and correlations on the two were attempted. Marked hourly fluctuations in both milk sugar and blood sugar were found. For blood and milk samples taken simultaneously, the correlation was insignificant. If, however, the blood samples were correlated with the milk samples of one hour later, a better correlation was secured.

1381. The decrease in the lactose content of milk following the production of artificial hypoglucemia. W. R. Brown, W. E. Petersen, and R. A. Gortner. *Journal of Dairy Science* 19:147-154. 1936.

Hypoglucemia was produced in two lactating cows by injection of insulin. Three trials were run injecting 800 to 1,000 units of insulin in 200 to 600 units per injection. The blood glucose was reduced markedly, in one case down to 0.01 per cent. Lactose, too, was reduced down to as low as one per cent, following in general the lowering of the blood sugar. No paresis or coma was noted even when the blood sugar was down to 0.01 per cent.

1383. The effect of intravenous injections of sugar upon the lactating bovine. W. R. Brown, W. E. Petersen, and R. A. Gortner. *Journal of Dairy Science* 19:177-184. 1936.

Intravenous injections of glucose and fructose produced a temporary hyperglucemic condition; this was followed by a hypoglucemia. The intravenous injection of lactose caused marked hyperglucemia. No marked effect of the injections on the synthesis of milk sugar was observed.

1393. Elasticity of wheat flour dough. L. J. Bohn and C. H. Bailey. *Cereal Chemistry* 13:389-409. 1936.

Bread dough is a plastic solid which has imperfectly elastic properties. Plastic solids are usually thought of as possessing a yield point where plastic flow commences, and after which the volume of flow is proportional to the force exerted. The yield point is influenced by the elastic properties of the plastic material.

A stress meter has been described which can be used to study the stress-strain relations of flour doughs, including a study of plastic flow by measuring the dying out of stress with time of stretching the dough.

Strong flours give higher stress readings than weak flours when stretched to five times their original length and given various relaxation times.

Wheat variety studies showed that high stress meter readings are a good indication of the ability of a dough to withstand prolonged mixing, as shown by baking tests.

1394. Characteristics of some morphological solonetz soils of Minnesota. *Journal of the American Society of Agronomy* 28(2):92-105. 1936.

Soluble salts, reaction, moisture equivalents, and exchangeable bases were determined on horizon samples from six profiles with morphological characteristics of solodized solonetz. The *A* horizon was essentially free of alkali salts, but these were present in the *B* and *C* horizons. The *A* was acid in reaction, while the *B* and *C* were alkaline. Moisture equivalents and total exchangeable bases indicated that disintegration of colloidal complex material had taken place in the *A* horizon and in this respect the profiles met the solonetz requirement. Exchangeable *Na* was low and exchangeable *Mg* very high in the *B* horizon so that the profiles did not meet the chemical requirements of solonetz as they are ordinarily considered.

1404. Phytopathology—and its future. E. M. Freeman. *Phytopathology* 26(1):76-82. January, 1936.

Plant pathology is one of the plant sciences—a modern offshoot of botany. It had its origin in the middle of the nineteenth century. It is inextricably bound to the other offshoots of botany such as plant physiology, ecology, etc. The practice of plant disease prevention has come to depend on clinics, which are the United States Department of Agriculture and the experiment stations. Commercial organizations of control will probably increase in the future, especially through farm management and other advisory service corporations. The future organization of research, teaching, and extension will probably continue as at present, but there are evidences of disturbing trends. Organization along commodity or project lines tends to disrupt the "guild" affiliations which are essential and basic to the progress of the science. The "guild" is based on specialized intensive training and like other guilds must preserve morale and efficiency in coordination and cooperation.

Plant pathology has merited and won recognition as a plant science throughout the world. Its importance in the future cannot diminish but must increase. With the inevitable and increasing complexity of agricultural industries will come more and greater specialization within the guild. But that specialization involves not so much a narrowing of training within the science itself as an intelligent coordination with sister plant sciences. New fields of professional activity have already opened up. Many more will follow. Their number and importance will depend largely on the initiative of the future members of the guild. Success will depend on their understanding not merely of the scientific facts involved, but also on a grasp of economic conditions and currents. It will require the application of scientific training to public and private enterprises. It will need scientific imagination coupled with practical knowledge and common sense. It will offer a satisfying field of combat against one of the most potent, destructive forces of nature.

1408. The value of foods other than pollen in the nutrition of the honey bee. M. H. Haydak. *Journal of Economic Entomology* 29(5): 870-877. 1936.

Young bees which had never eaten pollen were kept under controlled conditions and various foods mixed with honey were fed to them. The experiment showed that such bees can develop their bodies normally when fed meat scrap or commercial casein mixtures. The development on cottonseed meal, ground dried blood, digested tankage, whole-oats flour, and whole-wheat flour proceeded more slowly. The development of the bee body on corn flour, fish meal, and pea flour was very poor.

The lowest mortality was in colonies which produced young bees. The behavior of colonies fed meat scrap, cottonseed meal, commercial casein, digested tankage, whole-wheat flour, and whole-oats flour was normal. The colony fed ground dried blood showed restlessness, and the fish-meal, corn-flour, and pea-flour colonies were very excited.

Only the control and meat-scrap colonies and the colony fed cottonseed meal produced young bees. Those fed commercial casein, ground dried blood, digested tankage, whole-oats flour, and whole-wheat flour unsuccessfully attempted brood rearing. The fish-meal, corn-flour, and pea-flour-fed colonies did not even attempt to rear brood.

The young bees produced by the colonies fed meat scrap and cottonseed meal were normal. But the emerging bees from the former colony contained the largest amount of nitrogen, which was due to the greater nitrogen content of the abdomen of those bees.

1409. Relation of amylase activity to gassing rate. Emil Munz and C. H. Bailey. *Cereal Chemistry* 13:427-436. 1936.

In bread-sponge doughs to which no sugar was added the gassing rate was a function of time, diastatic activity, and proportion of baker's yeast. The rate was fairly constant for four or more hours when the flour used was normal in diastatic activity, and an hour or more less when a low-diastase flour was employed.

In bread doughs an additional variable appears, namely, the proportion of sugar in the formula. When three parts or more of sugar per 100 parts of flour are used in a straight dough, the gassing rate is fairly uniform through six or more hours of fermentation. Doughs prepared from previously fermented sponges were less constant in gassing rate, an appreciable reduction in the rate appearing after the fourth hour of fermentation. When no sugar was included in the formula, the normal-diastase dough showed a substantial reduction in gassing rate during the third hour, and the low-diastase dough an hour or more earlier.

When six per cent of dry skimmilk was superimposed on the sugar-dough formulas, the rate of gas production was stabilized in the instance of both straight-dough and sponge-dough methods. In the absence of added sugar, the reverse effect was registered in sponge doughs.

Increasing the H-ion concentration of a simple flour-water dough to $pH = 5.2$ by the direct addition of citric acid solution resulted in a progressively increasing mobility as a function of time through at least two hours.

1410. Effect of mixing on the physical properties of dough. L. J. Bohn and C. H. Bailey. *Cereal Chemistry* 13:560-575. 1936.

The stress in doughs, used as a measure of elasticity, tends to be reduced by excessive dough mixing, which suggests that profound physical changes occur in the plastic and other properties of dough during the mixing process. Different types of mixing or kneading machines accordingly effect various and different modifications of these dough properties during the mixing operation. Temperature of mixing (between 20° C. and 35° C.) did not affect mixing time, but the stress in dough was reduced on elevating the temperature. Increasing the proportion of water in the dough increased the time required in the mixing operation to bring the dough to the optimum physical condition and also decreased the stress readings. Stress readings tend to change substantially during the first few minutes after the dough is removed from the mixer, indicating that freshly mixed dough is in an unstable condition.

1411. The validity of a milk and honey diet in adult human nutrition. M. H. Haydak. *Bee World* 18:8-11. 1937.

A case of an exclusive milk-and-honey diet lasting for three months is described. The hemoglobin content of the blood was slightly increased. The weight remained practically constant. There was no protein or sugar in the urine. The bowels moved normally. The general feeling was good. The ability to work was not impaired. No sluggishness or tiredness was noticed.

Early symptoms of vitamin C deficiency were noticed toward the end of the period of observation. They were cured by an addition of orange juice.

1412. Refractometric methods of determining diastatic activity of flour. Emil Munz and C. H. Bailey. *Cereal Chemistry* 14:85-96. 1937.

Flour:water ratios in the range of 1:4 to 1:6 were best adapted to the refractometric method for the measurement of the autolytic hydrolysis of wheat flour. the ratio of maltose content: n_D of the digestates became narrower when the flour:water ratio was greater than 1:6.

Salts contributed by citrate buffer solutions apparently reduced the rate of increasing n_D of digestates below the rate at equivalent pH levels when the latter was adjusted by adding lactic acid solutions. Buffering materials contributed by low-grade flours do not affect the n_D values appreciably, however.

Temperature of digestion of flour suspensions in water influences the maltose: n_D ratio. A linear ratio is approached when the flour suspensions are incubated at 62° C. to 63° C. At higher temperatures there is a substantial departure from linearity, the n_D increasing faster than the maltose content.

Variability of replicated measurements of n_D was computed in the instance of several series in which variables in the techniques were progressively modified. This afforded a basis for selection of one technique which provided adequate and convenient chemical and physical conditions and at the same time was least variable. This technique, when applied to duplicated measurements of autolytic hydrolysis in the instance of 10 different flours, resulted in good agreement between the duplicates.

1414. Laboratory and field tests of the chlorine treatment of honeycombs. J. D. Hitchcock. *Journal of Economic Entomology* 29(5):895-904. 1936.

Chlorine gas in water was tested as a disinfectant of brood combs infected with Bacillus larvae. At sufficient concentration complete sterilization of the combs was obtained, but because of technical difficulties connected with the treatment, the ensuing brittleness of the combs and the corrosion of frame wires, the treatment is not recommended.

1415. The nature of the interaction of genes affecting four quantitative characters in a cross between *Hordeum deficiens* and *Hordeum vulgare*. LeRoy Powers. *Genetics* 21:398-420. July, 1936.

A method involving the analysis of variance and co-variance was used in reducing the data. The nature of the interactions of genes was such that no general rule could be drawn. However, with one exception, which was not well established statistically, the genes favorable to high weight of seed per plant gave as great or greater differences over their allels in combination with genes for higher yield than they did in combination with genes for lower yield. The same general behavior was noted for the genes affecting number of spikes per plant, height of plant, and length of awn, but cases were found in which plants of a given genotype surpassed plants possessing their allels in some combinations and were surpassed by plants possessing identical allels in other combinations. The genic variability not associated with any of the three chromosome groups identified by genes having qualitative effects was found to give a greater increased weight of seed per plant when in combination with *VVBrBr* than when in combination with *vvbrbr*. Here, again, is proof of a difference in the interaction of factors. It was found that genotypes affecting the same character may have different variances even though their means may be of similar magnitude. It was found that the more favorable the environmental conditions, the greater in absolute values would be the spread be-

tween the genes more favorable to yield and those less favorable to yield. The nature of the interaction of the factors affecting weight of seed per plant, number of spikes per plant, height of plant, and length of awn was generally speaking quite the reverse of Rasmusson's interaction-hypothesis which assumes that the visible effect of a certain factor is smaller the greater the number of factors acting in the same direction. The genes affecting the four quantitative characters are grouped into physiological defective and non-defective according to East's (1935) terminology, and the data offer some evidence in favor of his conception as to the nature of the effects of these genes. Both classes of genes showed that they necessarily did not give the same type of interaction in all genotypes.

1416. The denaturation and hydration of proteins. I. Hans Neurath and H. B. Bull. *Journal of Biological Chemistry,* 115:519-528. 1936.

The densities of natural, heat-denatured, and surface-denatured egg albumin were measured, and it was found that natural egg albumin had the lowest density and that surface-denatured protein had the greatest density. Heat-denatured protein was intermediate. The volume contraction in water was 53.30 and 24.5 cubic millimeters per gram for natural, surface-denatured, and heat-denatured protein, respectively. Apparently there are two forms of water in protein systems, loosely bound water and firmly bound water. The former is rather readily altered, the latter is highly resistant to removal. Firmly bound water is approximately 0.36 gram per gram natural egg albumin, 0.19-0.20 gram per gram surface-denatured egg albumin, and 0.15-0.17 gram per gram heat-denatured egg albumin. Denaturation is in part a dehydration phenomenon. In addition, it appears to "unroll" the protein molecule and bring into the surface "active" groups which were "buried" in the interior of the natural protein.

1417. Studies leading to a modified technic for agglutination in Brucella infection. C. R. Donham and C. P. Fitch. *Journal of Infectious Diseases* 59:287-295. November, December, 1936.

According to a previous article by the authors, water included in *Brucella abortus* antigen produces an inhibitory effect on agglutination. A modified technique of agglutination is described in which there is a minimum amount of added water in the serum antigen mixture. This technique appears to offer a superior method of agglutinin testing, but due to additional cost and a relatively small advantage, the method does not seem practical for the routine diagnosis of Brucelliasis in animals. A very few tests have been carried out with the modified technique of cases of undulant fever in man. The results seem to be quite encouraging.

1421. Observations pertaining to standards of interpretation of agglutination titres in the diagnosis of Bang's disease. C. R. Donham and C. P. Fitch. *Journal of the American Veterinary Medical Association* 89 n.s. 42(2):176-186. 1936.

These data emphasize two important points pertaining to the control of Bang's disease. First, the great effect, from a percentage standpoint, of the lack of uniformity in standards of interpretation of the agglutination test. Second, the recognized fact that one of our problems in the control of Bang's disease is to differentiate between non-specific and specific agglutination reactions.

The necessity for using a fixed standard of interpretation of agglutination reactions can be largely avoided by basing diagnoses of suspicious cases on a consideration of the complete status of the entire herd rather than only on the agglutination titre of the individual animal. These data are based on a survey of the prevalence of Bang's disease in Minnesota.

1424. A study of scab resistance in the potato. H. M. Darling. *Journal of Agricultural Research* 54:305-317, 7 figs. 1937.

The scab resistance of about 300 inbred potato seedlings was tested in the field on scab-infested soil. There was a wide range in susceptibility in the material tested, but no immune sorts were found. There was no consistent association of scab resistance with a russet skin. The progeny of certain inbred resistant seedlings were nearly all resistant, indicating their possible value as breeding stock.

The structure of the lenticels of a resistant seedling was compared with that of a susceptible seedling. The lenticels of the susceptible seedling were larger than those of the resistant seedling, and the cells were rounder and more loosely arranged. In the resistant seedling the periderm was suberized earlier and extended farther into the lenticels, apparently affording greater protection against infection. The structure of the lenticel is considered as one of the factors in scab resistance.

1425. Associations of microorganisms in relation to seedling injury arising from infected seed. J. J. Christensen. *Phytopathology* 26:1091-1105. 1936.

Studies on antibiosis of soil microorganisms indicate that the microflora of the soil at University Farm, St. Paul, did not prevent or appreciably decrease seedling blight or foot and root rot arising from barley seed naturally infected with *Fusarium* spp. and *Helminthosporium* spp., the organisms commonly associated with seedling injury. The behavior of infected seed lots was quite similar whether sown in the field or greenhouse, in sterilized or nonsterilized soil.

Antibiosis apparently is of little importance in suppressing seedling blight or root rot arising from naturally infected seed. The addition of *Trichoderma lignorum* and several other fungi and bacteria to naturally infected barley seed or to sterilized or nonsterilized soil did not inhibit or delay the parasitic action of seed-borne parasites. Soaking infected seed in an extract of these organisms also gave negative results. However, the addition of *T. lignorum* and certain other fungi and bacteria to seed or sterilized soil inoculated with *Helminthosporium sativum* increased the stand, decreased the number of deformed and stunted plants, and suppressed seedling injury.

Seed naturally infected with *Fusarium* spp. and *Helminthosporium* spp. is apparently one of the primary sources of seedling injury in Minnesota and should not be sown unless properly treated. Treating naturally infected barley seed with Ceresan improved the stand, decreased seedling injury, and materially increased plant vigor.

1427. Studies of physical properties and agglutinability of *Br. abortus* plate antigens from several sources. C. P. Fitch and C. M. Thompson. *Cornell Veterinarian* 26(3):222-230. 1936.

A study has been made of 13 plate antigens used in carrying out the plate agglutination test for Bang's disease. Eight of these antigens were purchased from

commercial manufacturers. The price ranged from $3.61 to $11.76 for 60 ml. The remaining antigens were sent to us without charge by various official agencies throughout the United States. Using Ridgway color standards, a great variation in pigment was noted. Only two of the 13 different antigens examined were classified as having the same color. Relative viscosities determined by means of the Ostwald Viscosimeter varied from 1.2 to 2.1. Surface tension was determined with the Du Noüy apparatus and very little variation was found. Bacterial concentration was determined by a centrifuge and the bacterial content ranged from 2.5 per cent to 25.5 per cent. The plate agglutination test was carried out with these 13 antigens on 76 different sera. There was a wide range in agglutination content.

1430. The effect of milk solids on fermentation reactions. Oscar Skovholt and C. H. Bailey. *Cereal Chemistry* 14:108-120. 1937.

Diastatic activity in dough is reduced somewhat on introducing milk solids due to the buffer effect of the latter and the consequent reduction in hydrogen-ion concentration. On the other hand, gas production is accelerated in yeast-leavened doughs by the presence of milk solids if sufficient fermentable sugar is present. When the sugar supply is limited, the reverse is true, due to restricted diastatic activity. With yeast that was treated to inhibit reproduction of cells, there was evidence that milk solids accelerated zymase activity or the fermentation enzyme complex.

1431. The histology of the intradermic tuberculin reaction in cattle. W. H. Feldman and C. P. Fitch. *Archives of Pathology* 22:495-509. October, 1936.

A review of the literature shows little information on the histologic study of the intradermic tuberculin reaction in cattle. With the assistance of the veterinarians of the State Live Stock Sanitary Board, tissue was excised for biopsy from the reactive process of the caudal fold of 66 animals (representing 33 separate herds) from which sections were prepared for histologic study. Tissue was also removed for biopsy at the site of injection of tuberculin from the caudal folds of four calves, three of which had previously been injected with virulent tubercle bacilli. It was found that the intradermic tuberculin reaction in cattle presents a rather definite cellular reaction, which is predominantly histocytic in character and which shows a predilection for the perivascular and perineural areas of the derma. Local reactive processes are confined in most instances to the papillary and reticular zones of the dermis. It may, if the inflammatory response be severe, extend into the tissues of the subcutis. No correlation was found between the intensity of the histologic alteration and the results of the tuberculin test as observed clinically. There were no distinguishing criteria observed in the histopathology that would indicate whether demonstrable lesions of tuberculosis were present in a given animal, and in all the cattle in which these characteristic changes occurred, uniformity in reaction suggests the possiblity of the existence of a common or closely related sensitizing agent.

1432. The influence of individual technique on flour and loaf characteristics. M. C. Markley and A. E. Treloar. *Cereal Chemistry* 14: 305-315. 1937.

Three lots of wheat were aliquoted and five-pound lots of each were sent to 12 cereal laboratories. Each of these laboratories milled the three samples according

to its own method and sent the flour to the Minnesota Agricultural Experiment Station. Commercially milled flours were also available from each of these three wheats. The flours were analyzed for moisture, ash, crude protein, and diastatic activity by a single analyst, thereby eliminating one source of error. The flours were then baked by another technician. In this manner the milling was held as the principal variable between the 13 lots of flour from each of the three wheats. The data from the analytical and the baking tests were subjected to statistical analysis. The flours milled at the different laboratories differed significantly in the analytical properties of ash, moisture, protein, and diastatic activity, but were not differentiated in the baking tests.

1433. Biochemical distinctions between barley varieties. J. A. Shellenberger and C. H. Bailey. *Cereal Chemistry* 13:631-655. 1936.

For a normal steeping period of about 50 hours the variations in inhibition rates for different barley varieties were small. The variety Spartan absorbed water at a slower rate than the six-row barleys. The varieties Oderbrucker and Peatland imbibed water at a more rapid rate than the other varieties studied. The variety Trebi absorbed water at an average rate for the first few hours, but later this rate was reduced.

The barleys grown at Crookston, Minnesota, imbibed less water per unit time than did the same varieties grown at University Farm.

Of the varieties tested, Oderbrucker gave the most uniform acrospire growth during germination. Trebi barley had the slowest rate of acrospire growth. The acrospire growth classification of Wisconsin No. 38 for the exceedingly dry year of 1934 was very poor.

The diastatic activity of barley and malt is correlated when measured by the Lintner method, but not when the Blish-Sandstedt method is employed. Neither is there any correlation between the results of the two methods when applied to either malt or barley samples.

Two barley varieties showed definite trends in diastatic activity as measured by the Blish-Sandstedt method. The variety Velvet was consistently high and Peatland consistently low. By use of Lintner's method no varietal differences in the diastatic activity of barleys was noticeable.

Malting and drying increased the resistance of starch to the action of taka-diastase. There was a significant negative correlation between the diastatic activity of barley, as measured by the Blish-Sandstedt method, and starch resistance for barley; but a positive correlation existed between the Blish-Sandstedt values for green and dry malt and starch resistance. No varietal differences in starch resistance of barleys to enzymatic action were found.

Trebi barley was decidedly deficient in liquefying power, but when germinated it became normal in this respect. There were no other varietal differences. The liquefying power of malt was not changed appreciably by drying, while the saccharifying power increased by this process. The liquefying action of barley could not be correlated with the saccharifying action of the same barleys as determined by the Lintner method.

1434. Improving drain-tile resistance to alkali conditions. D. G. Miller. *Journal of American Society of Agricultural Engineers* 17(12): 513-515, 544. December, 1936.

This paper represents results of experiments at University Farm, St. Paul, Minnesota, in the drain-tile laboratory operated under a cooperative agreement be-

tween the Department of Agriculture of the University of Minnesota; the Division of Drainage and Waters of the Department of Conservation, State of Minnesota; and the United States Department of Agriculture, Bureau of Agricultural Engineering.

Under identical exposure conditions, concrete made of highly resistant Portland cement may last ten times as long as that made of a cement of low resistance. With Portland cements differing so greatly in resistance to sulphate action, certainly the first consideration for all concrete that is to be so subjected should be the cement itself, and, regardless of all other precautions, the use of a cement of low resistance should be avoided. Until a more accelerated test of equal reliability is developed, the 16-week test is recommended.

Resistance of concrete is markedly increased by curing in water vapor at temperatures of 212 to 350° F., almost to the point of immunity for the most favorable temperatures and curing periods. Resistance is not increased, however, by raising the curing temperatures until 212° F. is reached, except in connection with certain admixtures.

Apparently about equal resistance is secured by curing for the time periods and temperatures as follows: 212° F. for 8 days, 230° F. for 4 days, 260° F. for 2 days, 285° F. for 1 day, 315° F. for 12 hours, and 350° F. for 6 hours.

Calcium chloride used as admixture in concrete cured in water vapor at temperatures between 100 and 155° F. appreciably increases resistance, but check tests are too limited as yet to justify specific recommendations.

Regardless of all other factors, care should be observed in all particulars to obtain the highest practicable 28-day strength with any given cement and any predetermined condition of curing. Strength, although fallible for comparing different concretes, has much value as an index of the permeability and sulphate resistance of the products made of the same cement and by the same methods of manufacture. This is particularly true where rich mixes are used, as is the case in the manufacture of high-quality drain tile.

1435. Changes in weight of new-born dairy calves as related to the method of feeding. C. L. Cole. *Journal of Dairy Science* 20:(2)113-116. February, 1937.

Fifty-three Guernsey calves were used and divided into three groups. They were all weighed at birth and at 24-hour intervals thereafter until they reached the age of 14 days.

Group I consisted of 13 calves that were taken from their dams immediately following birth without having nursed. They were hand fed with their dam's milk at all times.

The 26 calves of Group II were left with their dams 48 hours after birth. Food was then withheld for 24 hours and they were hand fed thereafter.

The third group contained 14 calves that were left with their dams 96 hours and then cared for in the same manner as Group II.

Group I suffered a slight weight loss for the first two days and then a continued gain for the balance of the 14 days, at which time they showed an advantage of 7.9 pounds and 10.5 pounds in average weight increase over Group II and Group III, respectively.

Group II made a daily gain for the first two days, then a decided loss on the third day and a daily increase for the balance of the 14 days.

Group III made a daily gain for the first four days. The next three days showed a daily weight loss and then a daily gain for the balance of the 14-day period.

Group II made a slightly larger average gain during the course of the experiment than did Group III.

The experiment clearly shows that dairy calves do not suffer a natural weight loss following birth. Also that calves not allowed to nurse their dams seem to get a much better start during their first two weeks than those allowed to nurse. They are also much easier to teach to drink when never allowed to nurse.

1437. Experimental design of vertical drop culverts. H. B. Roe. *Journal of American Society of Agricultural Engineers* 10:426-432, 11:477-481. October and November, 1936.

The experiments on which this paper is based were initiated as a result of the great interest in soil-saving dams with vertical drop outlet culverts in the early days of the national campaign against soil erosion and were greatly stimulated by the serious lack of scientific knowledge on which to base reliable and economical design of such structures. The experiments dealt with what seem to be the essential problems arising in design.

The experiments indicate that open vortex occurrence can be effectively controlled in practice by submerged or partially submerged baffles set vertically to intercept longitudinal or rotational flow of water. An open vortex formation seems ultimately to result from a combination of rotational flow of the water in corkscrew fashion downward to the outlet and of atmospheric pressure on the surface. Its logical primary control seems to be in the surface plane. Hence, prevention of the direct pressure of the atmosphere upon successive differential vertical sections of the whirling and sinking water seems the logical method of attack. The approximate maximum radius of orbit of vortices seems to be about four diameters of the culvert.

A square, light, wooden float four diameters on a side is effective in all cases tried in eliminating vortex occurrence, and except for relatively very low heads on the lip of the culvert does not increase the loss of head.

By preventing the formation of open vortex and the resultant increase in internal pressure that causes rapid rise in lost head, such a float also has appreciable effect in limiting the height to which head will develop over the culvert for any given set-up.

Within the physical limits of the apparatus used in this study, and with particular reference to the diameters of tube used, the value of lost head for lengths of tube of approximately five and a half diameters is expressed apparently within a fair range of accuracy, in term of Q, d and H, by equation (10):

$$h = 0.04610\ Q^{2.0028} d^{-4.0349} H^{-0.0031}$$

or in terms of v, d, and H, by equation [11]:

$$h = 0.02842\ v^{2.0028} d^{-0.0293} H^{-0.0031}$$

or in terms of d, H, and velocity heads by equation [12]:

$$h = 1.8279\ v^{2.0028} d^{-0.0293} H^{-0.0031}\ (v^2/g).$$

To assume that these formulas are applicable beyond sizes of tube and values of head on the lip in diameters used in this study, to tubes of any diameter and for all values of head on the lip, may not be fully warranted owing to limited extent of the tests and to small diameters of tubes tested.

Therefore, more extended experimentation is desirable, the more fully to establish the law applicable to all cases. It seems to the author that such additional research should cover physical tests with a number of tubes of increasingly greater diameter and with heads on the lip relatively much higher than were employed in these tests.

1438. Nature of variation in *Helminthosporium sativum*. J. J. Christensen and F. R. Davies. *Mycologia* 29:85-99. 1937.

Variants occur frequently in *Helminthosporium* spp. either in the form of sectors or "patches." The conidia and germ tubes of *H. sativum* are multinucleate, whereas hyphal cells are uninucleate to multinucleate, and young conidiophores are usually uninucleate. True hyphal anastomosis is common between races of *H. sativum*. It is rare between *H. sativum* and other dark-spored species, although pseudo-hyphal fusion within this group is not uncommon. Cultural comparisons were made of 524 conidial isolates taken from 205 individual conidiophores obtained from mixtures of two distinct races of species growing on agar drops, or from colonies derived from barley tissues infected with two or more races or species of Helminthosporium. All the isolates from the same conidiophore, with two exceptions, were identical culturally.

Cultural comparisons also were made of 207 hyphal-tip isolates obtained from 103 germinating conidia taken from colonies giving rise to variants, or from mixed colonies on agar drops. All the isolates from a single conidium were identical. Two hundred and sixty monosporous isolates were selected at random from mixed colonies on agar drops, and in all cases only the parental cultures were reisolated.

Genetic variations in *Helminthosporium sativum* were induced readily by growing it on potato-dextrose agar rendered stale by certain bacteria. The results indicate that variation in *H. sativum* is due primarily to nuclear change rather than heterocaryosis.

1439. A race of crown rust to which the Victoria oat variety is susceptible. H. C. Murphy and M. N. Levine. *Phytopathology* 26:1087-1089. 1936.

The article deals with the discovery of a new physiologic race of crown rust of oats, *Puccinia coronata avenae*. This new race is interesting because of its ability to attack Victoria oats severely. Up to this time Victoria had been extremely resistant to every one of the 40 known races of crown rust of oats.

1440. The effect of certain nitrogenous compounds on the rate of decay of wood. Henry Schmitz. *American Journal of Botany* 23:635-638. 1936.

The effect of asparagine and ammonium nitrate on the rate of decay of the heartwood and sapwood of Norway pine *(Pinus resinosa)* and paper birch *(Betula papyrifera)* was determined. The addition of asparagine was found to increase definitely the rate of decay of Norway pine heartwood and sapwood by *Polystictus versicolor*, but did not seem to cause consistent differences in the rate of decay of the birch heartwood by the latter fungus. With one exception, the addition of ammonium nitrate to sapwood and heartwood of Norway pine and paper birch did not cause any significant increases in their rate of decay. The only case in which ammonium nitrate appeared to cause an increase in the rate of decay was when an 0.5 per cent solution was added to Norway pine heartwood. In all other cases, the addition of an 0.5 or a 1.0 per cent solution of this salt caused statistically significant decreases in the rate of decay.

1441. Effect of fermentation, certain dough ingredients, and proteases upon the physical properties of flour doughs. L. J. Bohn and C. H. Bailey. *Cereal Chemistry* 14:335-348. 1937.

Fermentation decreased the stress readings of flour doughs, indicating that the yield point and elastic properties of the dough decrease and the mobility increases. Sodium chloride markedly increased the stress readings and increased the width of the farinograph curve, indicating that it has a toughening effect upon the gluten. Shortening, within limits, slightly decreased the stress readings, bearing out the idea that it acts as a lubricant in bread dough. Milk solids *not fat* markedly decreased stress readings after mixing and increased the time of mixing required to reach optimum development as shown in the farinograph. Good-quality milk powders appear to make a greater contribution to "strength" and give higher stress readings than poor-quality milk powders, as well as showing greatest tolerance to mixing.

Enzyme papain preparation did not affect stress readings when added to dough in small amounts. Larger additions appreciably decreased stress readings. This agrees with the hypothesis that small additions of papainase act as a coagulant upon wheat proteins, whereas larger amounts are liquefying. Barley malt extract and malted wheat flour decreased the stress readings of fermented doughs and appear to decrease the elastic and increase the mobile properties of dough.

1443. The cooking process. IX. Pulping wood with alcohols and other organic reagents. S. I. Aronovsky and R. A. Gortner. *Industrial and Engineering Chemistry* 28:1270. 1936.

Aspen sawdust was cooked with aqueous solutions of aliphatic monohydroxy and polyhydroxy alcohols and of glucose, mannitol, dioxane, and urea. The normal primary alcohols were better pulping agents than the secondary or tertiary alcohols. Normal butyl and amyl alcohols yielded better pulped residues than were obtained with the other alcohols. There appeared to be a definite relation between the aqueous solubilities of the monohydroxy alcohols and their pulping properties. The pulping efficiencies of the alcohols also seemed to be related to the zeta potentials at the cellulose-alcohol interfaces. Aspen chips cooked with normal butyl alcohol yielded a pulp which was comparable to the usual commercial aspen soda pulp in strength characteristics. Coniferous woods were not pulped by butyl alcohol as readily as the aspen. The residual liquors of the cooks made with normal butyl and amyl alcohols consisted of two layers; the top alcoholic layer contained the organic substances extracted from the wood, and the lower aqueous layer contained only small quantities of water-soluble substances. This pulping procedure provides a means of obtaining the ligneous material of the wood uncontaminated by inorganic compounds not present in the original wood.

1444. Pyelonephritis of cattle and horses. W. L. Boyd and L. M. Bishop. *Journal of the American Veterinary Medical Association* 90 n.s. 43:154-159. 1937.

Pyelonephritis of cattle has been recognized in the United States since 1918, at which time it was regarded as a rare disease. Since this time the disease has

been recognized in practically all sections of the country where cattle breeding is an important industry. The authors describe this disease and also report that they have found the infection in horses. The symptoms and pathology of the disease are similar in these two animals. There is frequent passage of bloody urine, progressive emaciation, inappetence, and, in the case of the cow, decreased lactation. In advanced stages, pronounced symptoms of colic are frequently observed. Diagnosis of this disease may be made by a physical examination of the bladder and ureters. A chemical examination of the urine shows the presence of albumin, and a microscopic examination of the sediment shows the presence of erythrocytes, leucocytes, diptheriods, and, at times, streptococci. Chemical examination of the blood shows a retention of urea. The accumulation of calcareous material in an exudate covering the mucous membrane of the bladder in the mare is a constant finding and represents the main marked differential pathology. Both kidneys are usually enlarged and increased in weight. The surfaces may present grayish opaque areas of various sizes, and normal lobulation is diminished in the case of the bovine. Sometimes small abscesses of the cortical region cause adherence of the capsule. Histopathologic changes consist mainly of areas of marked leucocytic cellular infiltration with purulent centers. The capillaries of the glomeruli are unchanged, though bacteria may at times be found within Bowman's capsule. The epithelium of the tubules is destroyed and the tubules thus affected are greatly contracted if not entirely disintegrated. Other tubules contain accumulations of leucocytes, and the interstitial tissue may be increased as a result of fibrosis.

1445. Streaming of liquids through small capillaries. H. B. Bull and J. P. Wronski. *Journal of Physical Chemistry* 41:463-468. 1937.

The purpose of the study was to determine the effect of molecular structure on the rate of streaming through small capillaries. The liquors used were the first seven of the normal aliphatic alcohols. Diaphragms of quartz, glass, and cellulose were employed. The rate of flow per unit of pressure through a given diaphragm appears to be a function both of the viscosity of the liquid and of the degree of attraction between the liquid and the material of which the diaphragm is composed. The critical pore radius below which anomalous flow occurs lies between 8.85×10^{-4} and 3.12×10^{-4} cm.

1446. The relation of plot size and shape to potato yield variations. T. M. Currence and F. A. Krantz. *American Potato Journal* 8(11): 310-313. 1936.

Standard errors in per cent of the mean were calculated for 24 different sizes of plots. The figures show that the error was very little reduced between plots two rods long and nine rods long. The 18-rod plots were distinctly more uniform than 9-rod ones. Considering the above variations, calculations were made to show the number of replicates of the various sized plots needed to give a standard error of the mean of 3.5 per cent.

It is pointed out that more replications of small plots are preferred to few replications of large plots when it is desired to plant a small area. Conditions which might favor the reverse are also indicated.

1448. A technic for the sectioning of mammalian ova and blastocysts. W. W. Green, Catherine Barrett, and L. M. Winters. *Stain Technology* 12(2):43-47. April, 1937.

Ova and blastocysts are fixed in Bouin's fluid. Gradual dehydration through the alcohols to 70 per cent follows. Eggs and blastocysts are stored in 70 per cent alcohol.

THE EGG.—The 70 per cent alcohol is reduced gradually to 30 per cent. Agar (1.7g) is dispersed in 98 cc. distilled H_2O by heat. Hot agar (5-6 drops) is placed on a 50 x 75 mm. microscope slide. After the agar has cooled slightly, the eff is placed in the agar and the agar allowed to gel. The agar is trimmed to about a 2-3 mm. block. The agar with the egg is pushed on a piece of lens paper which is folded about it. The folded lens paper with agar is placed in Bouin's fluid, and the following day run up to 70 per cent alcohol. It is then run back to water and stained with Heidenhain's iron hematoxylin. After being passed through the alcohols, it is cleared in cedar oil. Embedding in paraffin follows.

THE BLASTOCYST.—The blastocyst is stained with Delafield's hemotoxylin. It is carried to absolute alcohol. The alcohol is reduced to a minimum and the bottom of the dish coated with glycerin. Cedar oil is substituted for the alcohol. The cedar oil is washed out with a 2-3 minute change of xylol which is replaced with paraffin-xylol. Three changes of paraffin-xylol are made during the next 2-3 hours. Five changes of paraffin are made during 1½ hours of infiltration. All changes of fluid are made under the microscope and by drawing the fluid off and adding new fluid with pipettes rather than moving the blastocyst. Between changes of paraffin the bulbs are removed and the pipettes placed in a warm oven.

1449. Further observations on the quantitative changes in the microflora of cream and butter during manufacture, storage, and shipment. H. Macy. *Hammer Panegyric* pp. 19-29. 1937.

1. Data were obtained at nine Minnesota creameries and at an Eastern market on the quantitative changes in the microflora of cream and butter during manufacture and shipment.

2. Pasteurization of the cream was effective in most instances in reducing the numbers of microorganisms.

3. The churn in many cases was shown to be an important source of contamination.

4. Changes in the microflora of the butter did not follow any consistent pattern.

5. The number of microorganisms was usually greater in the more acid cream, although the number present in so-called "sweet cream" was often remarkably high.

6. The amount of salt in the butter often influenced the trend of the mold, yeast, and bacterial counts, but this effect was not uniform.

7. No positive relationship was established between the temperature of the creamery coolers or refrigerator cars involved in these studies and the changes in the microflora or market grade of the butter.

8. Neither a mold, yeast, or bacterial count of the butter would have served as a reliable index of the market or keeping quality of the butter made at these creameries. There was a tendency toward higher scores, however, when the butter was made from cream which was low in mold, yeast, or bacterial count before pasteurization.

1451. The response to full release of white pine planted under jack pine. T. S. Hansen. *Journal of Forestry* 35:263-265. 1937

White pine planted under jack pine in 1913 was given full release in 1924. Release stimulated growth in height by 50 per cent. Weevil damage was greater in released portion. The effect of release became apparent during the third season following it.

1452. New species and records of Mutillidae (Hymenoptera) from Borneo and the Solomon Islands. C. E. Mickel. *Annals Magazine of Natural History.* Series 10, 19:441-456. 1937.

This paper contains records of 28 species of Mutillidae collected by the Oxford University Expedition in Sarawak, Borneo, in 1932, by Mr. G. E. Bryant in Sarawak in 1913 and 1914, and by Mr. H. T. Pagden in the Solomon Islands in 1933-34. In addition to the records, five new species are described—four from Sarawak and one from the Solomon Islands. Notes on new synonymy are also included.

1453. Failure of diakinesis and metaphase pairing and the behavior during meiosis of univalent chromosomes in *Zea mays*. LeRoy Powers and A. O. Dahl. *Journal of Agricultural Research* 54:655-668. 1937.

The material consisted of plants with the normal chromosome complement of 20, of a strain with 22 chromosomes, 2 of which are a little less than half the length in the prophase stage of chromosome 10, and the F_1 crosses between these two types. Failure of diakinesis and metaphase pairing and the behavior during meiosis of univalent chromosomes are reported. The distribution was random during anaphase I for univalents in meiocytes possessing only two univalents. A positive association was found between the degree of failure of pairing during diakinesis and metaphase I and chromatin loss. The data indicate that the degree of failure of pairing during diakinesis and metaphase I is affected by the environment. The behavior of the extra univalent chromosome during meiosis was unique as compared to the normal complement in that it always preceded the members of the bivalent complements to the poles and was not lost in either division I or II. The 21-chromosome F_1 plant was backcrossed with the 20- and 22-chromosome parents. When the F_1 was used as a female, the ratio of plants carrying the extra chromosome to those not carrying it was 24:26; when the F_1 was used as the male, a ratio of 15:34 was obtained. The importance of meiotic instability in relation to breeding was emphasized, as well as the necessity of further research to learn desirable experimental methods for studying this character.

1454. New world Mutillidae in the Spinola collection at Torino, Italy. (Hymenoptera) C. E. Mickel. *Revista de Entomlogica* 7:165-207. 1937.

This paper gives a detailed account of all the new world Mutillidae in the Spinola collection at the Museum of Zoology and Comparative Anatomy of the University of Torino, Italy. One hundred six species from the new world are discussed and all the data available in the collection at Torino are given for them. Thirteen new species and one new variety are described, and one new generic name is proposed.

1455. Variability in carotenoid pigment content of individual plants of *Triticum vulgare* and *Triticum durum*. M. C. Markley. *Cereal Chemistry* 14:400-409. 1937.

The carotenoid pigment content of a large number of samples of wheat collected from single plants of known pedigree was determined. The variability between plants of the same genotype grown within a small area of land was first determined. This variability was found to form a definitely skewed distribution with a significant negative correlation between carotenoid pigment content as parts per million of the whole wheat meal and the mean weight of the kernels (as high as $r = -0.86$). Then the carotenoid content was recalculated to basis of weight of pigment per kernel of wheat. Now the correlation between carotenoid content on this base and the kernel weight was positive (as high as $r = +0.96$). By means of the regression coefficient, a method was developed for correcting the carotenoid content of a fixed kernel weight. By this method the variability was reduced to essentially that of the method itself for a number of lines. In other lines there was not as good success.

A number of hybrid durum F_2 plants were studied for the mode of inheritance of total carotenoid pigmentation. The results indicated quantitative inheritance exceeding the limits of either parent with no evidence of Mendelian segregation.

1456. Electrokinetics. XVIII. Interfacial energy and the molecular structure of organic compounds. IV. The electrokinetic behavior of charcoals in aqueous solutions of organic acids. V. L. Frampton and R. A. Gortner. *Journal of Physical Chemistry* 41:567-582. 1937.

It is not possible to distinguish between various aliphatic acids by mobility studies of charcoal suspended in their aqueous solutions.

Calculations of the charge per unit area on charcoal particles suspended in solutions of propionic acid indicate that the charge is constant and is independent of the concentration of the acid or the quantity of acid adsorbed on the char. The interpretation is that the adsorption is apolar.

Mobility studies of various carbons suspended in solutions of acetic acid indicate that there is no difference in the surface electrical properties of the carbons such as may be detected by electrokinetic studies.

Mobility studies of charcoal suspended in solutions of formic acid indicate that adsorption of formic acid on charcoal is apolar.

Adsorption of hydrochloric acid on charcoal is polar, since the charge on the surface of the char suspended in aqueous solutions of this acid increases with an increased concentration of acid, as is typical of inert surfaces in solutions of electrolytes not reversing the sign of the charge.

"Activation" apparently does not affect the electrokinetic properties of charcoal, since the migration velocity of various charcoals suspended in water is remarkably constant. Even graphite and diamond dust showed speeds of the same order of magnitude as the more highly "activated" carbons.

No electrokinetic data were obtained that would support the theory that adsorption of acids and alkali hydroxides on carbon is associated with "acidic" and "basic" oxides of carbon on the surface of the charcoal.

No evidence was found that activating charcoal at higher temperatures in the presence of carbon dioxide resulted in a "positively charged" carbon.

1457. Factors influencing the formation of periderm in aspen. Frank Kaufert. *American Journal of Botany* 24:24-30. 1937.

Because of the presence of a persistent periderm, the bark of aspen (*Populus tremuloides* Michx.) remains permanently smooth unless injured. Fungi, lichens, and mechanical injury may stimulate formation of abnormal periderm, with consequent development of rough, fissured bark.

Macrophoma tumefaciens Shear appears to be the most common cause of rough bark. The mycelium penetrates the periderm layers and stimulates the formation of new layers below those last formed. This fungus appears to be more prevalent on aspen growing on poor soils than on aspen on good soils.

Lichens occur very abundantly on many trees with rough bark and appear sometimes to have at least an indirect connection with abnormal periderm formation.

Mechanical injuries of several types appear to cause rough bark in some cases.

1458. Breeding better flax varieties for Minnesota. A. C. Arny. *Proceedings of the Minnesota Academy of Science* pp. 29-38. 1936.

A study was made of correlated inheritance in flax crosses with particular reference to characters of economic importance. Bison is the most widely grown variety in Minnesota. It produces large seeds of high oil content but with low quality of oil as measured by iodine number. Segregation of individuals in hybrid material from the cross Redwing x 770B in the ratio of three low to one high in iodine number of the oil has been shown by the X^2 test. Linkage between low weight per 1,000 seeds and high iodine number was found to occur in segregates from the crosses Bison x Redwing and Bison x Common Pink. This has made difficult the recovery in the hybrids from these crosses of individuals in which was combined the medium large seed size of Bison and the high quality of oil of the other parents. Lines have been selected from the crosses Bison x Redwing and Bison x Common Pink which equal the high iodine parents in quality of oil. None of these lines are equal, but some of them approach Bison in seed size. In aggregating families of the cross Redwing x 770B, the individuals with yellow seeds averaged considerably higher in iodine number than those with brown seeds. Linkage between seed color and iodine number was determined by the X^2 for independence test.

1459. A new species of Smicromyrme from Japan (Mutillidae; Hymenoptera). C. E. Mickel. *Mushi* 9:52-54. 1936.

One new species of Mutillid in the genus Smicromyrme, from Japan, is described.

1460. A study of juiciness and flavor of standing and rolled beef rib roasts. A. M. Child and Gertrude Esteros. *Journal of Home Economics* 29:183-187. 1937.

The paper deals with a study of the quantity and quality of juice, the flavor, cooking losses, and cooking time of comparable standing and rolled beef rib roasts.

Seventh and eighth, ninth and tenth ribs were used for the standing roasts and the corresponding left cuts were rolled. Twelve pairs were cooked. All roasts were cooked to 58° C. at 149° C. in uncovered pans. Press fluid was obtained by means of the pressometer. Official score card of the Cooperative Meat Investigations was used for scoring.

From a statistical analysis of the data, the following conclusions were made:

Standing beef rib roasts had a larger quantity of juice than the corresponding rolled roasts.

There was a slight tendency for the standing roasts to have a richer quality of juice than the rolled.

There was no consistent difference in flavor between standing and rolled beef rib roasts.

The total losses were greater for rolled roasts than for standing roasts.

The total cooking time and the minutes required per pound were greater for rolled than for standing roasts.

1461. Further studies on the interrelationship of insects and fungi in the deterioration of felled Norway pine logs. J. G. Leach, L. W. Orr, and Clyde Christensen. *Journal of Agricultural Research* 55(1):129-140. 1937.

As part of a study of the interrelation of insects and fungi in the deterioration of Norway pine logs, the changes occurring in felled logs during the second and third years after felling were studied. During this period, in fully exposed logs, the entire sapwood and a considerable portion of the heartwood were decayed. *Peniophora gigantea* was primarily responsible for the decay of both sapwood and heartwood.

No evidence was obtained to show that this fungus was dependent upon insects for dissemination or ingression. It is apparently disseminated readily by wind and may enter through cracks in the bark or through holes made by several species of insects.

The decay develops very rapidly in the sapwood but advances more slowly in the heartwood. Its spread in the heartwood is especially slow radially and tangentially but is more rapid in a longitudinal direction.

Several different species of insects were found in the logs during the period. Two species of cerambycid beetles (*Monochamus scutellatus* Say and *M. notatus* Drury) and two species of buprestids (*Chrysobothris dentipes* Germar and *Chalcophora virginiensis* Drury) were the most prevalent wood-boring beetles.

There was a fair degree of correlation between the number of *Monochamus* beetles in the logs and the amount of heartwood decayed. The larvae of these insects appear to hasten the decay by facilitating the radial and tangential invasion of the heartwood by *Peniophora gigantea*. The open larval tunnels formed by these insects are especially favorable for the spread of the decay.

The buprestid beetles have little influence on the rate of decay of the heartwood. The closed buprestid tunnels appear to be less suited for the spread of decay, and possibly this condition is largely responsible for the failure of these insects to influence the rate of decay.

Other species that inhabit the bark and outer layers of the sapwood appear to have little influence on wood decay.

1464. A new species of cestode, *Dendrouterina nycticoracis* (Dilepidiidae), from the Black-Crowned Night Heron (*Nycticorax nycticorax hoactli* [Gmelin]). O. W. Olsen. *Proceedings of the Helminthological Society of Washington* 4:30-32. 1937.

A large number of the cestode *Dendrouterina nycticoracis* n. sp. was found infesting the adult and juvenal night herons from a rookery near St. Paul.

1467. Studies in wood decay. VI. The effect of arsenic, zinc, and copper on the rate of decay of wood by certain wood-destroying fungi. F. Kaufert and H. Schmitz. *Phytopathology* 27:780-788. 1937.

A study has been made of the effect of arsenic, zinc, and copper on the rate of decay of Norway pine sapwood sawdust by certain wood-destroying fungi. The addition of low concentrations of arsenic trioxide to Norway pine sawdust appears definitely to stimulate its decay by *Lenzites trabea* and by *Lentinus lepideus* while even the lowest concentration tested, namely, 50 parts per million, appeared to be toxic to *Trametes serialis* and *Polyporus anceps.*

Zinc chloride at concentrations of from 100 to 400 parts per million appeared to increase the rate of decay of Norway pine sapwood sawdust by *Lenzites trabea* and *Lentinus lepideus.* Concentrations above 400 parts per million appeared to be definitely toxic to both fungi.

The results with copper sulphate are inconclusive insofar as showing a significant increase in the rate of decay of Norway pine sapwood by *Lenzites trabea* and *Lentinus lepideus* is concerned. It appears that *Lentinus lepideus* is considerably more resistant to copper sulphate than *Lenzites trabea,* but the latter fungus is far more resistant to arsenic trioxide than the former.

1468. The quality and toxicity of coal-tar creosote extracted from red oak ties after long periods of service, with special reference to the decay resistance of treated wood. Henry Schmitz. *Proceedings of the American Wood Preservers Association* 33:55. 1937.

The quality and toxicity of coal-tar creosote extracted from red oak ties after long periods of service and the decay resistance of the treated wood was determined. It was found that changes in the character of the creosote in treated wood occur during the period of service. These changes are most pronounced in the outer layers of the treated wood and are less extensive in the deeper layers of the treated wood.

Toxicity tests made by the Petri dish method of the creosotes extracted from 18 different regions in each of two ties showed great differences in toxicity after comparatively long periods of service. Despite rather wide limits in toxicities of the extracted creosotes, these are of little practical significance. The ties from which they were extracted were not only sound at the time of their removal, but the treated wood from all parts of both ties was decay resistant even when exposed for 10 months to actively growing wood-destroying fungi under optimum conditions of growth.

The continued protection of the outer layers of the wood where the toxicity of the creosote is low appears to be due, in part at least, to the movement of toxic constituents of the creosote in the inner layers to that of the outer layers of wood. This conclusion is strengthened by the observation that even those test blocks with no visible penetration of creosote were resistant to decay when exposed to wood-destroying fungi for 10 months under optimum conditions of growth.

1469. An improved device for the artificial feeding of aphids. D. J. Pletsch. *Journal of Economic Entomology* 30:211-212. 1937.

This paper gives a description of a small glass cage for confining aphids and feeding them liquids through animal membranes, also directions for making such cages from test tubes. The advantages of this device are discussed.

1470. Further studies of the absorption of water by red raspberry foliage, and some evidence relative to the movement of water within the plants. W. G. Brierley. *Proceedings of the American Society for Horticultural Science* 34:385-388. 1936.

Raspberry plants grown in tubs and allowed to wilt were restored to a turgid condition by spraying the foliage with tap water or by immersing the tops in water. When certain parts of these wilted plants received water, other parts regained turgidity, indicating that water is absorbed by the foliage and conducted downward or throughout the entire plant to the parts where the water supply is deficient. Reversal of the direction of flow was further demonstrated in the field by splitting canes so that strong fruiting laterals were isolated from the upward flow of water. When water-conducting capacity was reduced by the removal of as much as one-half of the stem at the base, no disturbance was noted except in a part of the more severe treatment indicating that the water-conducting capacity of the cane is in excess of actual needs.

1471. The relation of catalase activity to growth in the Latham red raspberry. W. G. Brierley and R. H. Landon. *Proceedings of the American Society for Horticultural Science* 34:381-384. 1936.

Studies of catalase activity in new and fruiting canes of the Latham red raspberry were carried on throughout the growing seasons of 1933 and 1934. The data obtained in 1933, when growing conditions were nearly normal, indicate a high catalase activity in the raspberry. Throughout the season the catalase activity was lowest during the period of most active growth, and the rate was approximately the reciprocal of the growth rate. During the very dry season of 1934 catalase activity was not as regular. Normal catalase activity apparently accompanies normal growth in the Latham raspberry and abnormal catalase activity accompanies subnormal growth.

1472. Some evidence relating to the downward movement of photosynthate in fruiting canes of the red raspberry. W. G. Brierley and R. H. Landon. *Proceedings of the American Society for Horticultural Science* 34:377-380. 1936.

Fruiting canes of the red raspberry were girdled at the base before growth started in 1935 and 1936. Microchemical methods were used to detect differences in the concentration of sugar and starch in the girdled canes compared to comparable canes not girdled. In both seasons callus overgrowth above the girdles began to develop about the time of full bloom. The presence of starch and sugar previous to hydrolysis could not be detected. Reducing sugar usually was plentiful after hydrolysis. There was no noticeable difference in the concentration of sugar until the terminal berries had grown to full size. From that time until the foliage failed there was a noticeable increase in sugar in the region just above the girdles. This increase was noted in canes with abundant foliage but was not found in canes with sparse foliage. It appears likely that in the fruiting cane of the red raspberry after the demands for growth and fruit development have been met, any existing surplus of sugar may be transported downward to other parts of the plant until the normal senescent breakdown of the phloem occurs.

1473. The denaturation and hydration of proteins. II. Surface denaturation of egg albumin. H. B. Bull and Hans Neurath. *Journal of Biological Chemistry* 118:163-175. 1937.

The dependence of the rate of surface denaturation on protein concentration was studied, and it was found that the higher the protein concentration (three concentrations of 2.10, 1.10, and 0.55 per cent), the lower was the rate of denaturation. The extent of surface denaturation was investigated as a function of *pH* for salt-free solutions, as well as solutions containing *KCL*, K_2SO_4, and $BaCl_2$. Surface denaturation is greatly dependent on *pH* and proceeds fastest at the isoelectric point. The *pH* was found to change during surface denaturation, and this was studied as a function of *pH*. *n*-Heptyl alcohol was found to have marked inhibitory powers on surface denaturation.

1474. The biology of some Minnesota Trichoptera. D. G. Denning. *Transactions of the American Entomological Society* 63:17-43. 1937.

This paper dealt with the biologies of eight Minnesota species, which were collected and reared from various localities in the state. A summary of previous work on this subject was included. Characters of taxonomic importance, with characteristic cases of immature stages, were drawn.

1475. Influence on grass growth of various proportions of peat in lawn soils. L. E. Longley. *Proceedings of the American Society for Horticultural Science* 34:649-652. 1936.

Various amounts of peat were well mixed with lawn soils before seeding as follows: One inch, two inches, and four inches. Three different types of peat were used. With all depths and all types of peat used, there was a depression of germination except when the peat was well moistened before application. Later, however, a more luxuriant growth resulted on all the peat plots than on the checks. An application of approximately two inches was found to give the best results. Heavier applications produced a soft, spongy lawn surface.

1476. Influence of soil temperature and soil moisture on infection of stem smut of rye. Lee Ling and M. B. Moore. *Phytopathology* 27: 633-636. May, 1937.

Repeated experiments were made in 1932 and 1934 to determine the effects of soil temperature and soil moisture on the infection of rye by the stem-smut fungus, *Urocystis occulta*. Infection occurred between 5° and 25° C. with optima at 13° to 17° C. There is a possibility that the lower optima are correlated with shallow planting, the lower temperature prolonging the stage of susceptibility of the rye seedlings. High soil moisture (65 per cent of water-holding capacity) is unfavorable for infection.

1477. The colloidal behavior of flour doughs. I. The thixotropic nature of starch-water systems. M. C. Markley. *Cereal Chemistry* 14: 434-436. 1937.

The viscosity of a starch paste composed of 7 parts of water to 10 parts of wheat starch is at its maximum when the system is quiescent and falls continuously when the system is agitated in a recording dough mixer. Upon stopping the mixer and allowing the system to rest for a time, the original high viscosity is again

attained. This indicates that a starch paste is thixotropic in nature. The recognition of the thixotropic nature of starch pastes is a distinct advance in our knowledge concerning the physical behavior of flour doughs, since it affords a reasonable explanation of the stiffening of doughs upon standing after a severe overmixing treatment.

1478. Impacts of the agricultural program on rotations, fertility, efficiency, and profits. G. A. Pond. *Journal of Farm Economics* 19(3): 688-690.

The agricultural conservation program increased the income of Minnesota farmers in 1936. Complete compliance with the program by all farmers in the state would result in cropping systems that would maintain or increase fertility in all parts of the state. By choosing the more productive soil-building crops and by shifting the emphasis from small grain to corn in the soil-depleting group, it would be possible, under normal weather conditions, to increase the production of total digestible nutrients as much as 25 per cent. Since the increase would consist largely of feed crops, especially roughages, there would doubtless be a material increase in livestock production. Costs of farm operation would not be increased materially, if at all. The effect on net income would depend entirely on the effect of the shifts in this and in other states on the price of the products which the farmer sells.

1479. Cephalosporium canker of balsam fir. C. M. Christensen. *Phytopathology* 27:788-791. 1937.

A hitherto undescribed canker of balsam fir was found in natural stands at several localities in Minnesota and Wisconsin. The cankers originate most frequently at branch stubs, are slightly sunken, with no very definite border, and the diseased inner bark is brown. The causal organism is a species of Cephalosporium. Trees were inoculated with pure cultures of this fungus, and cankers up to 12 inches long were formed within a year.

1480. Experimental durum milling. M. C. Markley. *Northwestern Miller* 190(5):52. 1937

A flow sheet for the production of semolina from small samples of durum wheat was developed. In this system the wheat is passed through four pairs of corrugated rolls to separate the endosperm from the bran. The product of each successive grinding is bolted in a sifter into three fractions, branny material, flour, and coarse middlings. The coarse middlings from each break were purified upon a laboratory middlings purifier. The small clean middlings were separated as semolina, while the larger and more impure middlings were reground on a finely corrugated roll, rebolted, and repurified. The results of a typical run are as follows:

	Grams	Per cent
Wheat at 13:5 per cent moisture	2,000	100
Bran	180	9
Shorts	315	16
Purifier dust	125	6
Clear flour	275	14
Semolina	1,025	51
Milling loss	80	4

1483. Material for the breeding of winter-hardy pears. A. N. Wilcox. *Proceedings of the American Society for Horticultural Science* 34:13-15. 1936.

Observations are summarized on the winter-hardiness of more than 50 varieties and species of pears which have survived to date at the University of Minnesota Fruit Breeding Farm. More than 20 forms have been practically uninjured, 8 of which have been tested for 10 or more years—Minnesota Numbers 3, 4, 5, 6, and 7, Sapronsky, Phiel seedling, and a Russian sand pear.

1484. Apple breeding studies. II. Fruit shape. A. N. Wilcox and Ernest Angelo. *Proceedings of the American Society for Horticultural Science* 34:9-12. 1936.

The present study concerns the relative length and breadth of fruit and the occurrence of cones, or tapered fruit, on 1,706 seedling trees grown from 25 crosses between varieties of the apple. The crosses were listed in order with respect to average relative length of fruit, and the significance of differences was determined by the X^2 test of independence.

The tendency toward relatively long fruit was transmitted most consistently by the parents Delicious and Black Ben Davis and in a high degree in certain cases by Grimes Golden. The parents most effective in transmitting oblateness included Jonathan, King David, Patten Greening, Wealthy, and Wolf River. Duchess of Oldenburg was intermediate. A significant difference between the reciprocal crosses of Grimes Golden and Oldenburg, with a definite trend in the progeny toward the maternal parent, which was previously reported in the study on fruit color, was confirmed with respect to fruit shape. No significant difference was found in the other reciprocal crosses which were studied.

1488. The influence of a pure carbohydrate diet on newly emerged honeybees. M. H. Haydak. *Annals of the Entomological Society of America* 30:258-262. 1936.

In the life of the honeybees there may be a period during which they are confined to a pure carbohydrate diet. In the majority of cases it happens during the winter. However, wintering bees may consume pollen, and then they start brood rearing. This may happen as early as the latter part of January. According to Farrar, the brood rearing once started continues as long as pollen is available. It may happen that newly emerged bees from the last brood do not have any pollen for consumption in the hive and consequently have to sustain on a pure carbohydrate diet for a shorter or longer time. Under such circumstances they undoubtedly do not have any source of protein to cover the losses of the nitrogen katabolism. The question arises: Can such newly emerged bees live on the expense of proteins present in their bodies; are they able to restitute the losses which occurred during the protein starvation and start the brood rearing normally? The present experiment was started in order to elucidate the problem. It was found that newly emerged bees could subsist on a pure carbohydrate diet for a relatively long time. The dry weight and nitrogen content of their bodies diminished. The greatest percentage loss of nitrogen was in the heads and abdomens, the lowest in the thoraces. The amount of nitrogen lost by each of these parts of the bee body was about the same. The mortality of the bees was high. When pollen was added to the diet of such bees, they developed their bodies and commenced brood rearing normally. The resulting bees were normal.

1489. Further contribution to the study of pollen substitutes. M. H. Haydak. *Journal of Economic Entomology* 30:637-642. 1937.

Colonies composed of bees which have never eaten pollen were kept in confinement. Various foods were given to them in order to find out whether or not they can substitute for pollen, the normal food of bees. Data on the development of these bees, their mortality and brood rearing activity, as well as the quantity and quality of young bees produced by colonies, were obtained. Bees can develop their bodies normally when fed soybean flour, soybean meal, peanut meal, and linseed meal, or soybean meal, linseed meal and cottonseed meal, each mixed with powdered skimmilk (20 per cent by weight). The lowest mortality was observed in the linseed-meal-fed colony, the highest in that which had soybean meal for food. The behavior was normal in all the experimental colonies. Only those colonies which had pollen and soybean flour and those which had soybean meal or cottonseed meal, both mixed with skimmilk powder, produced young bees. The largest number was reared by the control colony. The young bees produced by the colonies which reared brood were normal, but those produced by the colony fed soybean meal and skimmilk powder had the lowest weight and nitrogen content. Building activity was normal in all the colonies.

1491. Relative efficiency of randomized-block and split-plot designs of experiments concerned with damping-off data for sugar beets. E. L. LeClerg. *Phytopathology* 27:942-945. 1937.

Field and greenhouse uniformity trials were made to determine the relative efficiency of randomized-block and split-plot designs of experiments when concerned with damping-off data for sugar beets. It was found that the split-plot arrangement of plots in field tests or pots in greenhouse tests gave a lower experimental error and thus were more efficient than a random arrangement. The results also indicate that soil-borne pathogenes are not uniformly distributed in the field and that variations in environmental conditions on plant tables in the greenhouse may lead to bias in judgment of results. The variance assignable to these factors may be determined and removed from consideration by use of a split-plot design where this is feasible.

1493. *Brucella abortus* in raw market milk. C. P. Fitch and L. M. Bishop. *Cornell Veterinarian* 27:37-41. 1937.

A survey for the presence of *Brucella abortus* in the raw market milk sold in one city was made. Seventeen or 25.4 per cent of the milk tested from 67 dairies was found to be positive. Agglutinins for *Brucella abortus* were demonstrated in only 8 of 17 positive samples. The lowest dilution tested was 1:25. If agglutinins for Brucella can be demonstrated in a 1:25 dilution of raw market milk, living Brucella organisms can usually be found. All 17 strains isolated were found to be of the abortus type. However, of 112 strains of Brucella isolated from cattle, four were found to be suis. The possibility of suis strains being found in raw milk is not remote.

1494. A new species of cestode, *Dendrouterina lintoni* (Dilepididae), from the little green heron (*Butorides virescens* [Linn.]). O. W. Olsen. *Proceedings of the Helminthological Society of Washington* 4(2):72-75. 1937.

Specimens of a cestode obtained from the little green heron at Woods Hole, Massachusetts, were submitted for identification and found to constitute a new species, *Dendrouterina lintoni.*

1495. The carbon metabolism of *Gibberella saubinetii* on glucose. L. E. Hessler and R. A. Gortner. *Journal of Biological Chemistry* 119: 193-200. June, 1937.

Gibberella saubinetii is a fungus of the genus *Fusarium* and is the pathogenic agent causing barley scab. Since scabby barley is toxic to swine, the metabolic products of the fungus grown on glucose were studied. It was found that the organism produces a typical alcoholic fermentation, as is characteristic of the other Fusaria which have been studied. The chief products were ethyl alcohol and carbon dioxide. Minor products isolated and identified were citric acid, tartaric acid, and acetic acid. These five compounds together with the mycelium account for nearly 98 per cent of the carbon metabolized by the fungus.

1496. Electrokinetics. XIX. Interfacial energy and the molecular structure of organic compounds. V. The electric moment at an Al_2O_3: benzene-nitrobenzene interface. R. A. Gortner and H. B. Bull. *Proceedings of the National Academy of Sciences* 23:256-258. 1937.

Pure benzene produces no electric moment at interfaces. Nitrobenzene produces a high electric moment. In this study mixtures of these compounds were used. It was found that when benzene was in excess of 50 mol per cent in the mixture, the electric moments produced were of small magnitude, whereas when nitrobenzene was in excess of 50 mol per cent in the mixture, the electric moments were large. The results are interpreted as being due to a compound present in the mixture and compound of benzene-nitrobenzene in a 1:1 molecular ratio, and that in this compound the non-polar benzene molecule masks the highly polar nitro group of the nitrobenzene. It is suggested that studies such as these may serve to demonstrate the presence of compounds in solution, under conditions where the direct isolation and identification of such compounds is either extremely difficult or impossible.

1497. Ruffed grouse management. R. T. King. *Journal of Forestry* 35(6):523-532. June, 1937.

Suggestions are made for the management of ruffed grouse based on the results of seven years' study of this species in Minnesota. In addition to ordinary variation in numbers, this species is subject to periodic and at present uncontrollable fluctuations, which, at approximately ten-year intervals, wipe out about 90 per cent of the stock.

The three major management questions are: (1) How can we determine in advance which years should be open? (2) How can we provide for the greatest number of such open years in every ten-year period? (3) How can we provide

the greatest amount of grouse shooting during each of these open years? The answer to the first question is careful and continued census taking. A satisfactory census method has been developed. Through its use population declines may be discovered sufficiently early in the year to allow for any adjustment of regulations that may be required. The provision of the greatest practicable number of open years is largely a matter of maintaining the maximum breeding population, which in Minnesota is a bird per four acres. This is the April maximum, and in order to provide it there must be a margin at the beginning of winter (and after the hunting season) of approximately 20 per cent to cover winter losses. Providing the greatest amount of grouse shooting during each of the open years is a function of the annual productivity of young. Juvenile mortality is normally about 75 per cent or higher; probably the greatest cause is weakness of eggs due to their production by the hen at a period when the food supply is reduced to the minimum both as to quantity and variety. Any improvement of the late winter and early spring food supply, therefore, will be advantageous. Cover is just as essential as food and must be of several types suitable for drumming, nesting, brooding, molting, and wintering. Suggestions are given as to each of these types. Water requirements and the interspersion of food and cover are discussed.

Cyclic decimations are not the result of over-population and can neither be eliminated nor reduced in severity by increased shooting. Every protection should be given the birds from the very beginning of the decline so as to preserve the 4- to 6-year-old individuals necessary for reproduction, and which have also the greatest powers of resistance to the decimating factors.

1498. American commercial beekeeping. M. C. Tanquary and M. H. Haydak. *Ukrainian Agricultural Institute Lectures* 1 and 2:1-14. 1937.

Part I gives a historical account of the introduction of the honey bee, *Apis mellifica* L., in the early part of the 17th century and traces its gradual spread from the Atlantic coast country westward until it reached California in 1848. The change in the character of the beekeeping industry in the United States from its earliest period to modern times is indicated. The importance of bees for pollination is noted. A description of methods used by American beekeepers is given, especial attention being given to spring management as practiced by beekeepers under varying conditions.

1501. Correlation between means and standard deviations in field experiments. F. R. Immer. *Journal of the American Statistical Association* 32:525-531. 1937.

It appears that an inherent negative correlation exists generally between the mean yield of plots and the standard deviation of samples within such plots for uniformity trial data from field experiments. It appears also that the mean yields and standard deviations of varieties or strains of crop plants tested in replicated field experiments are essentially independent. Very little correlation can be expected between means and standard errors of different experiments conducted in different years or in different parts of the state, under the conditions of these experiments. Consequently, the standard deviation in bushels per acre as calculated from the separate tests would seem to be a more satisfactory measure of variability than would the standard error expressed in percentage of the mean.

1506. Studies of quality in canning corn. C. W. Doxtator. *Journal of the American Society of Agronomy* 29:735-753. 1937.

Puncture tests for tenderness for 1929-30 by means of the puncture machine described, for 11 inbred lines of Golden Bantam sweet corn, showed highly significant differences. Significant differences were obtained also at the canning stage of maturity for the 66 single crosses studied. Inbred lines showing low puncture indices tended to give crosses having a low puncture index. The parent-progeny correlation coefficients which were obtained indicated that tenderness was intermediate in F_1 crosses in comparison with the parents. An interannual correlation for puncture indices of the years 1929 and 1930 on 60 crosses was higher but not significantly higher than the correlation for yield in the same crosses. A significant seasonal difference in tenderness was obtained for 11 cultures of Golden Bantam grown in a five-year test. In 1933 three F_1 crosses and normal Golden Bantam were harvested at eight different stages of maturity. The puncture index was positively correlated with date of silking and negatively correlated with yield in 66 crosses grown for two test years. Percentage of husk appeared to have no relation to tenderness. Stage of maturity as measured by percentage of moisture at harvest was negatively and very significantly correlated with puncture index for four cultures tested. In a study of pericarp thickness on four cultures of Golden Bantam, differences were observed between the pre-canning and post-canning stages of development for all cultures. No significant difference between cultures was observed. In a study of sampling technique for purposes of increasing the accuracy of the collection of tenderness data with the puncture machine, it was found that when twice the number of ears were sampled with half the number of puncture tests taken on each ear, the accuracy of the test was almost doubled.

1509. The thermal fractions of gluten proteins and their relationship to baking strength. R. H. Harris and C. H. Bailey. *Cereal Chemistry* 14:182-200. 1937.

Wet crude gluten was washed from 20 samples of *vulgare* wheat flour and nine samples of flour milled from various non-*vulgare* wheats. These glutens were then fractionated into three distinct components by dispersion in O.1N acetic acid, addition of K_2SO_4, of ethyl alcohol to 50 per cent concentration by volume, then progressively lowering the temperature when glutenin came down at 18° C. to 20° C., mesonin at 8° C. to 10° C. Gliadin was determined upon an aliquot of the residual solution. These fractions were quite distinct in appearance and physical properties, although the mesonin appeared to be intermediate between the other two. Whether the electrolyte was added before or after the alcohol influenced the relative quantities of glutenin and mesonin isolated. Gliadin was also affected to a lesser degree. Addition of the K_2SO_4 to the acetic acid dispersion before the alcohol was added (Method II) appeared to yield more satisfactory results in point of clear separation of the respective gluten protein fractions. These results were also in better agreement with the values for glutenin and mesonin previously obtained by other workers.

The quantity of gliadin obtained by fractionating 5 grams of wet crude gluten washed from the various flours was significantly and positively correlated with crude protein and loaf volume. This was not true in the instance of the other two fractions. When the three proteins were computed as per cent of flour, positive

significant correlations with loaf volume were evident in every case. This was probably due to the influence of crude protein.

No further information relative to the loaf volume of the flours appeared to be gained by thermal fractionation of the gluten proteins in addition to that obtained from a knowledge of crude protein. The gliadin *b*/glutenin *b* or gliadin *b*/mesonin *b* ratios were not correlated with loaf volume.

Vulgare wheat flours appeared to have more of the crude protein present capable of forming crude gluten than is the case with other species. *Vulgare* wheats also appear to have more of the glutenin and mesonin fractions present in the crude protein, and less of gliadin, than do wheats of non-*vulgare* varieties.

Miscellaneous Journal Series

325. Sorghums and cyanide poisoning in farm animals. W. L. Boyd and C. F. Rogers. *Norden News* 10(4):4-5. September and October, 1936.

When cells of the sorghums are damaged they liberate whatever *HCN* may be present in combined state. If this takes place in the animal, and the animal absorbs poisonous quantities at once, harm may result. About the year 1900 when *HCN* was discovered in sorghum by Avery of Nebraska, it was noted that intensity of poisoning increased with decrease of rainfall, and naturally it was concluded that the cause of poisoning was *HCN*. This idea is questioned.

The symptoms of cyanide poisoning, the *post mortem* findings, and the treatment are described.

327. Herbs, their culture and uses. A. E. Hutchins and L. Sando. *Minnesota Horticulturist* 64(1):3-4, (2):31-32, (3):48-50, (4):69-70, (5):90-91, (6):112-113, and (7):131-133. 1936.

A series of articles describing herbs which because of their aromatic and healing properties are used in the home for medicinal, ornamental, perfuming, or flavoring purposes.

331. Practical experimental milling. M. C. Markley. *Northwestern Miller* 188 (2) Sec. 2:20-23. 1936.

Experimental mills are divided into two categories, those operated by the batch method and those more or less of a continuous flow type. The most common type for small sample work is the batch mill such as the Allis type. It is adapted to sample for 2 to 6 pounds of wheat. An interesting variant is the micromil of Geddes and Frizell for 100-gram samples. Larger experimental mill units have frequently been built in a manner similar to small commercial mills. These units require from 1 to 1,000 bushels of grain for a test.

A series of three diagrams for the operation of the small-batch-type experimental mill are shown. These vary from a simple flow sheet designed for a unit of minimum equipment to one of the most elaborate, yet practical, experimental flows yet designed. The rolls for grinding the wheat should have as nearly as possible the same size and style of corrugations as those used in commercial practice. The limitations of equipment in many laboratories make the application of this rule difficult, so the applications of this rule are discussed.

For example, if only a single pair of break rolls is available, the corrugation should be designed for the production of middlings rather than the cleaning of the bran. Bolting is difficult to handle in the laboratory due to the irregular loading of the bolter as compared with the uniform load flowing over the silks of the commercial bolter. The wheat should be well screened and dry-scoured before milling. The scourer should be adjustable. The tempering of the wheat prior to milling differs in experimental practice from commercial in certain biochemical details, so that it is difficult to secure exactly the same results. The operator of the experimental mill should be a competent miller. It is one of the most difficult of all the operations of the laboratory and requires much judgment on the part of the operator.

332. New Minnesota fruits named. W. H. Alderman. *Minnesota Horticulturist* 64(2):23-24. 1936.

An article announcing the naming and introduction of two new fruits produced by the University of Minnesota Fruit Breeding Farm.

Beacon apple (Minn. No. 423): This is a richly colored, all-red variety produced from open-pollinated seeds of Malinda planted in the spring of 1908. The variety ripens with Duchess or slightly later but is superior to the latter variety in color, flavor, and keeping quality.

Ember plum (Minn. No. 83): A late-season plum originating from a cross made in 1913 between Shiro and a selected seedling of *Prunus americana* from the South Dakota Experiment Station. The fruit is medium to large, of excellent quality, and remains in good condition for three to four weeks after maturity, either in storage or when left hanging to the tree.

336. Progress in breeding potatoes suitable for peat land. F. A. Krantz. *Transactions of the Iowa State Horticultural Society* 70:316-317. 1935.

A brief, popular review of the potato breeding work, the objectives, and the progress made toward these objectives, with particular reference to the development of types suitable for growing on the peat soils of southern Minnesota and northern Iowa.

341. Sudan and sorghum in hot weather. C. F. Rogers. *Successful Farming* 34(4):43-44. October, 1936.

The presence of *HCN* in young sorghums and the death of animals which have eaten it have been taken for cause and effect, possibly incorrectly. Drouth-damaged plants are not more cyanogenetic than others. Beginning of recovery after drouth shows greatest *HCN* content in the plant. Frost may increase the danger of *HCN* poisoning for a few hours, but dried frosted plants are usually harmless.

342. The flea problem on ranches. W. A. Riley. *American Fur Breeder* 9(4):10, 12. 1936.

Fleas, usually the same as those infesting dogs and cats, rank high among the minor pests on fox ranches. The life history and methods of control are discussed.

343. Sources of internal animal parasites of fur bearers. W. A. Riley. *American Fur Breeder* 9(5):4, 6. 1936.

Without a knowledge of the sources and method of development of animal parasites, rational control is impossible. Typical illustrations of the important infestations occurring on fur farms are considered.

344. The tropical, or Oriental, rat flea, *Xenopaylla cheopis,* established in Minnesota. W. A. Riley. *Journal-Lancet* 56:591-592. 1936.

The so-called Oriental rat flea became established in Minnesota in spite of the long and cold winters. An infestation of the dairy barn on the campus of the College of Agriculture is reported as are records of recovery of the species from wild rats.

345. The problem of wind erosion. M. C. Markley. *Northwestern Miller* 189:15, 24. 1937.

In the level lands west of the 100th meridian the sandy soils have been found frequently to be more productive in dry years than the adjacent tight clays. So the farmers have tended to concentrate upon the sandy lands. Clean cultivation of the sandy land in the semi-arid region often results in excessive blowing of the soil. Photographic illustrations are given of the effect of the removal of the soil-holding shinnery oak and grasses and the clean cultivation of the soil in Gaines County, Texas.

The southwestern sandy soils are far richer in plant food than are the glacial sands of Minnesota. They are wind-deposited soils composed of quite large particles which had been deposited first in the ancient dust storms which formed the finer sands of southwest Kansas and the clays of the Missouri valley. The sandy soils naturally support a varied flora in contrast to the limited flora of the tighter clay steppe lands.

The clay soils can be profitably farmed in the southwest only by irrigation, so even though they do not blow, their utility is limited to the available supplies of irrigation water. But little expansion can be expected in the irrigated regions; abandonment of land is more to be expected. These irrigated clay lands when abandoned usually are reclaimed by native vegetation. The abandoned sandy lands, on the contrary, are only slowly reclaimed by grasses. Farms of the Indians, abandoned these hundreds of years, are still unproductive wastes of sand.

These sandy lands are too valuable to waste. Their potential productivity will be essential in years to come. Such measures as strip farming will help. The development of more suitable crops such as a perennial wheat, by the experiment stations, will some day allow the full utilization of these sandy lands.

346. The color of flour and semolina. M. C. Markley. *Northwestern Miller* 189(2):50. 1937.

The bread-flour trade demands a nearly white flour, while the macaroni trade is equally insistant upon a creamy yellow semolina. So the plant breeders have to select bread wheats low in pigmentation of the endosperm, while the reverse is true in the selection of durums. The principal pigments of the patent flours and better grades of semolina are the carotenoids, principally xanthophylls and carotenes. Carotene is the lesser of the two classes of carotenoid pigments, and consequently the carotene in the bread is of little importance in furnishing vitamin A

in the average American diet. Flour bleaching is not of serious consequence as a vitamin-destroying process.

The carotenoid pigments are greatly affected by climatic factors. During the past season the wheats grown in the northern Red River Valley were abnormally low in pigmentation. This is entirely environmental and not due to any change in the genetic make-up of these wheats. The genetics of the carotenoid pigments has not as yet been clearly worked out, but varieties are known to differ genetically in their pigmentation.

The lower grades of flour contain large amounts of yellow flavone pigments. These appear to be associated with the fibrous structure of the endosperm. While the carotenoids can readily be bleached, there is no bleaching agent which will decolorize the flavones without damage to the baking properties of the flour. The bran contains red pigments of as yet unknown nature.

The physical structure of the endosperm also affects the flour color. A soft starchy endosperm always produces a whiter flour than a hard vitreous one of the same pigmentation. The size of the flour or semolina particles also influences the color.

347. Growth of the potato. F. A. Krantz. *Transactions of the Iowa State Horticultural Society* 71:300-303. 1936.

A popular review of the literature concerning the growth and composition of the potato plant during the development of the crop.

348. Agricultural research in China. H. K. Hayes. *Science* 85 (2205 and 2206):321-325, 347-350. April 2 and April 9, 1937.

A summary was made of the present status of agricultural research in China with particular reference to studies in crop improvement, soils and fertilizers, plant pathology, entomology, horticulture, forestry, animal husbandry and veterinary science, and sericulture. The most extensive work is in crop improvement. Some idea can be gained of the extent of this work by listing the number of stations working on crop breeding. These consist of 56 stations that are breeding cotton; 48, wheat; 38, rice; 15, millet; 17, kaoliang; 17, soybeans; 16, corn; and 37, miscellaneous crops. The rapid expansion of agricultural research in China in recent years is one indication of the widespread interest among Chinese leaders in improving the living conditions of the people.

349. The forest tentless caterpillar. A. G. Ruggles. *The Minnesota Horticulturist* 65(2):30-31. 1937.

This insect, called the "army worm" in the northern part of the state, has been running rampant the last few years, destroying leaves of basswood, poplar, and birch. In this article the life history of the insect is given, some of the ecology of the insect and the control methods best suited to the situation. Recommendations are made concerning an organization set up for control around resorts and homes.

351. Arithmetic and emotional difficulties in some University students. C. F. Rogers. *The Mathematics Teacher* 30:3-9. January, 1937.

Student difficulties and deficiencies are listed under 24 items with stress upon student illiteracy, fears, and the resulting generated incapacities, which it is contended are escapable by proper kinds of teaching. These difficulties are traceable not so much to native inability as to improper training in elementary schools where habits of learning and doing are largely built, or the good results of home influences are degraded.

It is contended that the bases of an education are still the three "R"s taught until students can read with understanding, can approach some problem in a logical manner, and can express themselves with some accuracy and a little ease. Dr. Gortner's addendum insists that the parents are the ultimate authority, and that they should exercise their right to have subject-matter adequately taught.

352. Cabbage yellows in Minnesota. J. G. Leach. *The Minnesota Horticulturist* 65:44-45. March, 1937.

A popular article pointing out the increasing prevalence of cabbage yellows in Minnesota and advising growers to grow resistant varieties. A list of the available yellows-resistant varieties is included.

353. Latest facts about pollen substitutes. M. H. Haydak. *Gleanings in Bee Culture* 65:274-275. 1937.

This is a popular article on the experiments on pollen substitutes which were conducted during the summer of 1936, with practical advice as to how the most promising pollen substitutes should be fed to bees in the apiary.

354. Storm damage on the Cloquet forest. T. S. Hansen. *Journal of Forestry* 35:463-468.

An analysis of the loss due to a severe windstorm in August, 1934, and a heavy sleet storm in March, 1935. Nine and five tenths per cent of the spruce volume and 15.3 per cent of the balsam volume were lost in the windstorm. In the sleet storm 2.9 per cent of the jack pine volume was lost. In a series of thinning plots, the degree of thinning did not increase the amount of damage.

355. Notes for the Minnesota horticulturist (spraying). A. G. Ruggles. *The Minnesota Horticulturist* 65(5):90-91. 1937.

Information is given concerning several of the most used insecticides. Formulae are given for amounts to use in combination with fungicides, and definite control measures are given for several insects of the garden and orchard.

356. Tree injection. A. G. Ruggles. *The Minnesota Horticulturist* 65(4):70. 1937.

Around the state there have been a number of so-called tree surgeons injecting trees to prevent the work of insects and disease. This article condemns such practices because no experiments ever made have shown trees to take up enough poison to kill the insects and not kill the tree.

357. Pollen substitutes and how to use them. M. H. Haydak. *American Bee Journal* 77:271. 1937.

This paper gives a popular account of the present knowledge of pollen substitutes with practical advice for their use in case they are needed.

359. Pollen substitutes. M. H. Haydak. *El Apicultor Argentina* 2(20):30-31. 1937.

A popular account of the principles underlying the study of pollen substitutes, giving a review of the work done at the University of Minnesota, and containing suggestions as to how to offer those pollen substitutes which appear to be the most promising to the bees in the apiary, is given in this paper. It was written for the information of Spanish-speaking beekeepers.

366. "Einzelstammwirtschaft" or management of the individual tree. T. S. Hansen. *Journal of Forestry* 35:277-281. 1937.

A discussion of the single tree method of management as practiced in German forests.

SUMMARY OF PUBLICATIONS

Kind of publication	Number issued	Number of pages	Number of copies in edition
Forty-third Annual Report	1	74	2,200
General Series Bulletins	3	92	16,000
Technical Series Bulletins	11	443	21,900
Special Series Bulletins	8	172	95,000
Circulars	2	12	8,500
Pamphlets	3	44	21,000
Folders	8	36	96,000
Miscellaneous			
Dairy Herd Improvement Letter	12	12	1,700
Engineering News Letter	12	12	950
Minnesota Farm Business Notes	12	48	900
News Letter	52	52	1,350
Poultry News Letter	6	12	250
Turkey News Letter	12	24	5,000
	142	1,033	270,750
Papers			
Scientific Journal Series	85	875	.....
Miscellaneous Journal Series	25	80	.....
	252	1,988	

PROJECTS

Agricultural Biochemistry

101. Analytical service. (C. H. Bailey, G. S. Taylor, E. G. Rupp, M. C. Markley)

Subproject: Nitrogen determinations for the Division of Agronomy and Plant Genetics.

Subproject: Protein determinations and milling and baking tests of wheat samples for Division of Agronomy and Plant Genetics.

Subproject: Feed analyses for the Division of Animal Husbandry.

Subproject: Miscellaneous analyses for the Divisions of Dairy Husbandry, Agricultural Biochemistry, Home Economics, and Veterinary Medicine.

103. Investigations of proposed official methods of analysis. (C. H. Bailey, M. C. Markley)

Subproject: Oil content of flax. (Dormant)
Subproject: Experimental baking methods.
Subproject: Studies of moisture test ovens.

104. The strength of wheat flour. (Cooperative with the State Testing Mill and the State Department of Agriculture) (Adams)

Subproject: Dough plasticity and flour strength. (C. H. Bailey, M. C. Markley)

Subproject: Refractometric studies of amylase activity. (C. H. Bailey, C. H. Hills)

Subproject: Properties of wheat starch. (C. H. Bailey, Olaf Stamberg)

105. Biochemistry of milling and baking. (Purnell)

Subproject: Carotinoid pigments of wheats. (C. H. Bailey, M. C. Markley)

Subproject: Experimental milling. (C. H. Bailey, M. C. Markley)

Subproject: The use of dried skimmilk in macaroni products. (C. H. Bailey, Olaf Stamberg)

Subproject: Effect of soya products on bread properties. (C. H. Bailey, Wesley Steller)

202. Chemical and biological studies in animal nutrition.

Subproject: The fundamental food requirements of animals.

(1) Relation between the nutritive character of the diet and its utilization for gain in weight. (L. S. Palmer, Cornelia Kennedy, O. E. Mydland)

(2) Physiological and metabolic factors related to the efficiency of food utilization for growth. (L. S. Palmer, Cornelia Kennedy, C. E. Calverley)

Subproject: A study of the nutritive value of lake weeds. (L. S. Palmer, J. W. Nelson)

Subproject: Studies on the use of the flour beetle (*Tribolium confusum* Duval) for the quantitative biological estimation of the anti-neuritic vitamin B. (L. S. Palmer, B. B. Migicovsky)

Subproject: Calcium and phosphorus nutrition of horses. (Cooperative with Division of Animal Husbandry) (L. S. Palmer, A. L. Harvey)

Subproject: A study of the relations between the biological value of proteins when determined by biochemical and chemical methods. (L. S. Palmer, F. C. Olson) (New)

Subproject: A study of factors affecting calcium retention from foods. (L. S. Palmer, Sister Bernadette) (New)

203. The chemistry of milk as a colloidal system. (Adams)

Subproject: The colloid chemistry of rennin action.

(1) Studies on the curd tension of buttermilk. (L. S. Palmer, N. P. Tarassuk)

(2) Factors influencing the churnability of normal vs. washed cream. (L. S. Palmer) (Dormant)

Subproject: Determination of carotene and vitamin A content of normal and artificially bleached butter. (L. S. Palmer) (Dormant)

Subproject: A study of off-flavored fluid milk of the tallowy type from individual cows. (L. S. Palmer, C. D. Dahle)

Subproject: Relation of the fat globule "membrane" to properties of milk. (L. S. Palmer, N. P. Tarassuk) (Dormant)

Subproject: A study of the chemical factors involved in the browning of autoclaved milk. (L. S. Palmer, J. P. Kass) (New)

205. The relation of the mineral content of the ration to reproduction in cattle. (Joint project with Dairy Husbandry Project No. 106 and Veterinary Medicine Project No. 104) (L. S. Palmer, J. W. Nelson) (Purnell)

Subproject: The effect of a ration low in calcium on abortion and other reproductive disturbances. (Dormant)

Subproject: The relation of low phosphorus to reproduction in cattle.

301. Chemical studies of forest products.

Subproject: The cooking of wood. (R. A. Gortner, S. I. Aronovsky) (Dormant)

Subproject: The physical properties of alpha-cellulose from different woods. (R. A. Gortner, Milton Ryberg)

Subproject: A survey of the efficiency of butyl alcohol in removing lignin from various woods. (R. A. Gortner, J. M. McMillan) (New)

302. Comparative studies of the biochemistry of normal and abnormal plants. (Adams)

Subproject: Acid preservation of green feeds. (C. F. Rogers)

Subproject: Cyanogenetic plants and factors in cyanogenesis : cyanide poisoning. (C. F. Rogers)

Subproject: Effect of medium on cyanogenesis. (C. F. Rogers)

Subproject: Acidity of the rumen contents and their buffer capacities. (Cooperative with the Division of Veterinary Medicine) (C. F. Rogers, W. L. Boyd)

Subproject: Cyanides and cyanogen in gas plant effluents. (C. F. Rogers)

Subproject: The carbon metabolism of *Gibberella saubinetti* on glucose. (R. A. Gortner, L. E. Hessler) (Closed)

401. The chemical and physico-chemical properties of plant tissue fluids. (R. A. Gortner, E. O. Barnes)

403. Protein investigations.

Subproject: The acid amide nitrogen of proteins. (R. A. Gortner, W. M. Sandstrom, Philip Blickensdorfer)

Subproject: The proteins of various tree seeds. (W. M. Sandstrom, A. J. Lund)

Subproject: Alkaline decomposition of cystine. (W. M. Sandstrom, H. V. Lindstrom)

Subproject: Analyses of a series of "albumins" from pathological urines. (W. M. Sandstrom) (Dormant) (Closed)

Subproject: Enzymatic determination of amide nitrogen. (W. M. Sandstrom, Philip Blickensdorfer)

Subproject: The melanins of cow's hair. (Cooperative with the Division of Dairy Husbandry) (W. M. Sandstrom, W. E. Petersen)

Subproject: The analysis of sheep embryo. (Cooperative with the Division of Animal and Poultry Husbandry) (W. M. Sandstrom, L. M. Winters, F. L. Harrington) (Closed)

Subproject: A study of the homogeneity of zein. (R. A. Gortner, R. M. Theis)

Subproject: The denaturation of proteins. (R. A. Gortner, D. R. Briggs)

404. The fundamental properties of colloid systems with particular reference to biochemical problems. (Adams)

(a) Surface denaturation of proteins. (H. B. Bull) (Closed)

(b) Depositing of molecular layers of protein on copper and glass slides. (H. B. Bull) (Closed)

(c) Rate of flow of the aliphatic alcohols through diaphragms. (H. B. Bull, J. Wronski) (Closed)

(d) The electrokinetic behavior of carbons. (R. A. Gortner, V. A. Frampton) (Closed)

(e) The colloidal properties of starches from the various species of *Triticum*. (R. A. Gortner, Henry Reitz)

(f) The electrokinetic behavior of homologous series of the alipathic alcohols, acids, and esters on cellulose and Al_2O_3 interfaces. (Molecular structure and surface behavior) (R. A. Gortner, Max Lauffer)

(g) The reaction between metaphosphoric acid and proteins. (D. R. Briggs)

(h) The colloidal properties of serum albumin and serum globulin. (D. R. Briggs, R. A. Gortner)

(i) The cold gelatination of starch. (R. A. Gortner, R. E. Clark) (Closed)

Agricultural Economics

101. Agricultural credit. (E. C. Johnson, G. Leroy Peterson, William Gustafson)

103. Farmers' incomes in Minnesota. (W. C. Waite, D. L. MacFarlane)

104. An accounting study of farm organization for beef production. (Cooperative with the Division of Animal and Poultry Husbandry, Minnesota Agricultural Experiment Station, and with the Division of Farm Management and Costs, Bureau of Agricultural Economics, United States Department of Agriculture) (G. A. Pond, G. A. Sallee) (Purnell)

106. A study of the farm tractor in Minnesota. (Joint project with Agricultural Engineering Project No. 120) (G. A. Pond)

Subproject: A continued study of the mechanical and economic phases of the performance of tractors in the hands of experienced operators. (Closed)

108. Marketing of farm products. (O. B. Jesness, E. F. Koller, A. A. Dowell, R. J. Eggert)

Subproject: Marketing of creamery butter.
Subproject: Marketing of livestock.
Subproject: A survey of cooperative associations. (Cooperative with the Farm Credit Administration)

111. An accounting study of factors affecting the incomes of dairy farms. (Cooperative with the Division of Agricultural Extension, University of Minnesota, and with the Division of Farm Management and Costs, Bureau of Agricultural Economics, United States Department of Agriculture) (G. A. Pond, W. P. Ranney, R. C. Bevan, T. R. Nodland)

112. Comparison of fence posts. (L. B. Bassett)

113. Prices of farm products. (W. C. Waite, R. W. Cox, H. C. Trelogan, W. B. Garver, D. L. MacFarlane)

114. Taxation in relation to agriculture. (O. B. Jesness, E. C. Johnson) (Dormant)

116. Types of farming in Minnesota. (Dormant) (Closed)

118. A study of land tenure and farm leases in Minnesota with special emphasis on the effect of present leases and leasing systems on soil conservation and sound farm management practices. (Cooperative with the Division of Farm Management and Costs, Bureau of Agricultural Economics, United States Department of Agriculture) (G. A. Pond) (Purnell)

120. Market outlets for woodland products in northeastern Minnesota. (Dormant)

121. Factors influencing the demand for Minnesota agricultural products. (W. C. Waite, R. W. Cox, H. C. Trelogan, W. B. Garver)

122. Local prices of agricultural products in Minnesota. (W. C. Waite) (Purnell)

124. A study of farm organization affecting income on farms in northern Minnesota. (Cooperative with the Division of Agricultural Extension) (Dormant) (Closed)

125. An analysis of factors influencing farm land values in Minnesota. (A. A. Dowell) (Purnell)

126. An accounting study of farm organization in west central Minnesota. (Cooperative with the West Central Experiment Station, Minnesota Agricultural Experiment Station, and with the Division of Farm Management and Costs, Bureau of Agricultural Economics, United States Department of Agriculture) (G. A. Pond, S. A. Engene, G. M. Myers, B. M. Miller) (Closed)

127. Land utilization. (Cooperative with the Bureau of Agricultural Economics, United States Department of Agriculture) (O. B. Jesness)

128. Cash expenditures of Minnesota farmers for Agriculture. (W. C. Waite, H. C. Trelogan)

129. A study of agricultural adjustment activities undertaken under the Farm Act and their economic consequences. (W. C. Waite, G. L. Peterson) (Dormant)

130. An accounting study of dairy farm organization in the low-lime area of southeastern Minnesota. (G. A. Pond, S. A. Engene, R. H. Loreaux, F. E. Wetherill, T. R. Nodland, R. C. Bevan, G. M. Myers, B. M. Miller, B. McDonald) (Purnell)

131. A study of the organization of farms on which a definite program of soil erosion control is in operation. (Cooperative with the Division of Agricultural Extension, University of Minnesota, and the Soil Conservation Service, United States Department of Agriculture) (G. A. Pond, W. P. Ranney, S. A. Engene, T. R. Nodland, G. M. Myers, O. B. Jesness) (Purnell)

132. An accounting study of the earnings and financial progress of rehabilitation clients of the Resettlement Administration in Minnesota. (Cooperative with the Division of Agricultural Extension and the Rural Sociology Section of the Agricultural Experiment Station, University of Minnesota, Resettlement Administration, Region 2, Minnesota, and the Division of Farm Management and Costs, Bureau of Agricultural Economics, United States Department of Agriculture) (G. A. Pond, W. P. Ranney, T. R. Nodland) (Purnell) (New)

Agricultural Engineering

102. Drainage and water control investigations on peat lands. (Cooperative with the Divisions of Agronomy and Plant Genetics and Horticulture) (H. B. Roe) (Closed)

103. Farm building ventilation. (H. B. White, L. W. Neubauer, C. H. Christopherson)

104. Farm sewage disposal. (A. G. Tyler)

107. Investigation of causes of failure of agricultural drain tile, the means of obviating such failures, and mapping areas where extra precautions are necessary. (Cooperative with the State Department of Conservation and with the Division of Drainage and Waters, Bureau of Agricultural Engineering, United States Department of Agriculture) (D. G. Miller, P. W. Manson, H. B. Roe)

111. Investigation of farm buildings. (H. B. White, L. W. Neubauer, C. H. Christopherson)

112. Investigations in land clearing. (M. J. Thompson, A. J. Schwantes)

Subproject: Seasonal brush cutting. (Cooperative with the United States Department of Agriculture) (Dormant)

Subproject: Preparation of stump land pasture. (Dormant)

Subproject: Use of poison in killing brush and trees, both cut and standing. (Dormant)

Subproject: Relation or influence of burning brush and stump piles (incident to land clearing) to later crop production and to seemingly sterile areas in given fields. (Dormant)

Subproject: Influence of frost in lifting stone.

Subproject: Land-clearing machinery. (Dormant)

Subproject: Relation of land valuation to clearing costs and crop production on sandy loam, clay loam, and clay soils. (Dormant)

Subproject: Land clearing costs on farms on sandy, sandy loam, clay loam, and clay soils. (Dormant)

Subproject: Economics of stump removal for pasture crops. (Dormant)

Subproject: Relation of livestock to brush control. (Dormant)

Subproject: Plowing of virgin lands to determine what influence it has on the following crop yields on sand, sandy loam, clay loam, and clay soils. (Dormant)

Subproject: Agricultural use of explosives. (Dormant)

114. The utilization of electricity in agriculture. (J. Romness)

115. Wind-power electric-lighting plants. (J. Romness) (Dormant)

119. Combine harvesting of grain and seed crops. (Cooperative with the Divisions of Agricultural Biochemistry and Agronomy and Plant Genetics, Minnesota Agricultural Experiment Station, and with the Bureaus of Agricultural Economics and Agricultural Engineering, United States Department of Agriculture) (A. J. Schwantes, J. B. Torrance)

120. A study of the farm tractor in Minnesota. (Joint project with Agricultural Economics Project No. 106) (A. J. Schwantes, J. B. Torrance)

Subproject: A continued study of the mechanical and economic phases of the performance of tractors in the hands of experienced tractor users.

Subproject: A study of the performance of tractors and their effect on farms where no tractor has previously been used.

122. A study of the influence of differing depths of drainage on the temperature of peat soil and the adjacent layers of the atmosphere, and of methods of summer frost prevention. (Cooperative with the Division of Horticulture, Minnesota Agricultural Experiment Station, and with the Bureau of Agricultural Engineering, United States Department of Agriculture) (H. B. Roe, O. W. Howe)

123. Investigation of hydraulic rams. (A. G. Tyler)

124. A study of some problems dealing with the use of flexible connectors for transmission of power on the farm. (J. G. Dent, A. J. Schwantes)

Subproject: The wearing quality of leather and metallic belt fasteners.

Subproject: The weather-resisting qualities of different kinds of rope.

127. Plow performance studies. (A. J. Schwantes, E. W. Henry)

128. Investigations of draft and power requirements for field machinery. (A. J. Schwantes, J. B. Torrance, J. E. Shumway)

Subproject: A study of draft and power requirements for field machinery.

129. Investigations in farm development and farm operating practices. (Cooperative with the Division of Agricultural Economics, Minnesota Agricultural Experiment Station, and with the Bureau of Agricultural Engineering, United States Department of Agriculture) (O. W. Howe, M. J. Thompson, A. J. Schwantes, H. B. Roe, H. B. White)

Subproject: Investigations in progressive farm development.

Subproject: Farm operating efficiency investigations.

130. Soil erosion control by engineering methods and such in conjunction with field and cropping management. (H. B. Roe)

131. A study of the effect of deep tillage on the yield of potatoes and other root crops. (Cooperative with the Northeast, North Central, and Northwest branch stations, and with the Division of Agricultural Extension) (A. J. Schwantes, T. M. McCall, R. L. Donovan, M. J. Thompson, O. W. Swenson, R. C. Rose, J. B. Torrance, J. E. Shumway)

132. Supplemental irrigation investigations in Minnesota. (O. W. Howe, H. B. Roe)

133. Determination of the optimum soil moisture conditions for growth and development of major crops and method of establishing and controlling those conditions by the adaptation of known sub-drainage principles. (H. B. Roe, O. W. Howe, R. T. McVeety, Charles Snyder, P. W. Manson, S. H. Anderson) (New)

Agronomy and Plant Genetics

101. Varietal improvement in rye. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations) (H. K. Hayes, C. L. Alexander, D. U. Harvey, R. E. Hodgson, R. O. Bridgford, O. W. Swenson, M. J. Thompson, F. R. Immer, H. K. Wilson)

Subproject: Continuous selfing and selection.
Subproject: Inheritance of degree of seed setting, kernel color, and possible other characters.
Subproject: Yield in fortieth-acre plots.

102. Varietal improvement in barley. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations) (F. R. Immer, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson, C. L. Alexander, D. U. Harvey)

Subproject: Breeding studies.
Subproject: Rod-row trials.
Subproject: Fortieth-acre plot trials.

103. Varietal improvement in spring wheat. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations, Minnesota Agricultural Experiment Station; the North Dakota, South Dakota, and Montana agricultural experiment stations, and with the Bureau of Plant Industry, United States Department of Agriculture) (H. K. Hayes, E. R. Ausemus, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Rod-row trials.
Subproject: Fortieth-acre plot trials.
Subproject: Combine studies. (Closed)

104. Varietal improvement in winter wheat. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations, Minnesota Agricultural Experiment Station, and with the Bureau of Plant Industry, United States Department of Agriculture) (E. R. Ausemus, H. K. Hayes, C. L. Alexander, D. U. Harvey, Catherine Harrington, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Breeding studies.
Subproject: Rod-row trials.
Subproject: Fortieth-acre plot trials.

105. Varietal improvement in oats. (Cooperative with the Division of Plant Pathology and Botany and with the branch stations) (H. K. Hayes, H. K. Wilson, C. L. Alexander, D. U. Harvey, Catherine Harrington, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Breeding studies.
Subproject: Rod-row trials.
Subproject: Fortieth-acre plot trials.

106. Varietal improvement of alfalfa and source-of-seed investigations. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations) (A. C. Arny, D. U. Harvey, F. J. Alway, G. H. Nesom, C. C. Allison, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Rod-row trials.
Subproject: Tests in replicated fortieth-acre plots of new strains and varieties for yield and quality of hay and for cold resistance.
Subproject: Tests in replicated fortieth-acre plots of plantings from commercial lots of alfalfa seed.

107. Varietal improvement in flax. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations, Minnesota Agricultural Experiment Station; with the Flax Development Committee, and with the Bureau of Plant Industry, United States Department of Agriculture) (A. C. Arny, D. U. Harvey, C. L. Alexander, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Rod-row trials.
Subproject: Fortieth-acre plot trials.

108. Cytology in relation to genetics. (W. M. Myers)

109. Forage and pasture crop investigations. (Cooperative with the Divisions of Dairy Husbandry and Soils and with the branch stations) (A. C. Arny, D. U. Harvey, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

110. Studies in the classification of farm crops. (Cooperative with the Bureau of Plant Industry, United States Department of Agriculture) (A. C. Arny, A. C. Dillman)

111. Methods of eradicating perennial weeds. (Cooperative with the Division of Plant Pathology and Botany and with the Northwest, Southeast, and West Central branch stations) (A. C. Arny) (Closed)

Subproject: Eradicating the perennial weeds—quack grass, Canada thistle, Austrian field cress, leafy spurge, and sow thistle, with chemicals. (Dormant)

Subproject: Amounts of reserve foods in the underground parts of these perennial weeds at different stages of development. (Dormant)

Subproject: Weed habits. (Dormant)

112. Varietal improvement and studies on the fertilizing value of sweet clover. (Cooperative with the Divisions of Plant Pathology and Botany and Soils and with the branch stations) (H. K. Hayes, I. J. Johnson, D. U. Harvey, D. C. Anderson, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Improvement phases.

Subproject: Variety tests.

Subproject: Methods of handling sweet clover in relation to the effect on the succeeding crop.

113. Physiological studies of crop plants. (H. K. Wilson, C. L. Alexander, D. U. Harvey) (Dormant)

Subproject: The wheat meal fermentation test of wheat. (Cooperative with the Division of Agricultural Biochemistry, Minnesota Agricultural Experiment Station, and with the Bureau of Plant Industry, United States Department of Agriculture)

Subproject: Service. (Closed)

114. Varietal improvement in field peas, soybeans, and field beans. (Cooperative with the Division of Soils and with the branch stations) (A. C. Arny, W. W. Brookins, D. U. Harvey, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Classification. (Dormant)

Subproject: Preliminary trials.

Subproject: Fortieth-acre plot trials.

115. Reed canary grass investigations. (Cooperative with the Division of Soils, the branch stations, and county agents) (A. C. Arny, D. U. Harvey, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson)

Subproject: Adaptation of seed. (Closed)

Subproject: Cultural methods. (Closed)

Subproject: Analyses. (Closed)

Subproject: Flowering and seeding habits.

Subproject: Improvement through isolation of superior strains.

Subproject: Comparison of the feeding value of reed canary grass hay with other grass and legume hays. (Closed)

116. Controlled pollination as a means of corn improvement. (Cooperative with the Division of Plant Pathology and Botany and the branch stations, Minnesota Agricultural Experiment Station, and with the Minnesota Valley Canning Company) (H. K. Hayes, I. J. Johnson, D. C. Anderson, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson) (Purnell)

117. The effect of self-fertilization in naturally cross-pollinated plants. (I. J. Johnson, C. L. Alexander) (Purnell)

Subproject: Red clover.

Subproject: Sunflowers.

118. Genetics of maize and barley. (H. K. Hayes, F. R. Immer) (Adams)

Subproject: Genetics studies with maize.

Subproject: The mode of inheritance and linkage relationships of certain characters in barley.

119. Varietal improvement in sugar beets. (Cooperative with the Southeast branch station, Minnesota Agricultural Experiment Station; the Office of Sugar Plants, Bureau of Plant Industry, United States Department of Agriculture, and the American Beet Sugar Company of East Grand Forks) (R. E. Hodgson, D. U. Harvey, J. O. Culbertson)

Subproject: Variety testing.

Subproject: Space allotment trials.

Subproject: Competition studies.

120. Alsike clover seed production. (Cooperative with the Divisions of Entomology and Economic Zoology and Soils and with the North Central and Northeast branch stations) (H. K. Wilson, H. K. Schultz, M. J. Thompson, O. W. Swenson, R. E. McMillan, George Berggren)

Subproject: Rate of seeding and companion crop.

Subproject: Breeding.

121. Crop rotation investigations. (Cooperative with the Divisions of Soils and Agricultural Extension; the Northeast, Northwest, and West Central branch stations) (A. C. Arny, D. U. Harvey, W. W. Brookins, R. O. Bridgford, R. S. Dunham, M. J. Thompson)

Subproject: Field C rotations.

Subproject: Field T rotations.

Subproject: Demonstration rotation trials.

122. Cooperative seed production and distribution. (Cooperative with the Northwest Crop Improvement Association, the Minnesota Crop Improvement Association, and farmers) (Carl Borgeson)

124. The development of disease-resistant varieties of farm crops. (Joint project with Plant Pathology and Botany Project No. 104; cooperative with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture) (H. K. Hayes, H. K. Wilson, E. R. Ausemus, A. C. Arny, I. J. Johnson, D. C. Anderson, F. R. Immer)

Subproject: Spring wheat.
Subproject: Winter wheat.
Subproject: Oats.
Subproject: Barley.
Subproject: Rye.
Subproject: Flax.
Subproject: Corn.
Subproject: Red clover.
Subproject: Sweet clover.
Subproject: Sugar beets. (Dormant)
Subproject: Alfalfa. (Dormant)
Subproject: Sunflowers. (Dormant)

125. Demonstration trials with new crop varieties. (Cooperative with the Division of Agricultural Extension, and with the branch stations) (R. F. Crim, W. W. Brookins, H. K. Hayes)

Subproject: Small grain and flax.
Subproject: Corn.

126. Mode of inheritance of the drying qualities of linseed oil and related characters. (Cooperative with the Division of Plant Pathology and Botany) (A. C. Arny, C. L. Alexander, Catherine Harrington)

127. Emergency fodder, hay and pasture crops. (Cooperative with the West Central branch station) (A. C. Arny, R. O. Bridgford)

128. Studies on quality of barley varieties and strains. (F. R. Immer, R. E. Hodgson)

Animal and Poultry Husbandry

101. A study of the embryological development of the bovine. (Cooperative with the Division of Veterinary Medicine and with the North Central branch station) (L. M. Winters, Catherine Barrett, R. E. Comstock, C. L. Cole) (Purnell)

Subproject: The recovery and study of prenatal specimens.
Subproject: A study of the sperm cell and artificial insemination.
Subproject: Time of ovulation in relation to heat.

102. The feeding value of dry rendered tankage for cattle. (D. W. Johnson, W. H. Peters) (Closed)

202. Reed canary grass hay as a roughage for horses. (A. L. Harvey, Kenneth Hanks) (New)

301. A study of the embryological development of the sheep. (L. M. Winters, R. T. Clark, Catherine Barrett, R. E. Comstock, C. L. Cole) (Adams) (Purnell)

Subproject: The recovery and study of prenatal stages.
Subproject: A study of the sperm cell.

302. Sheep feeding. (Cooperative with the West Central branch station) (W. H. Peters, P. S. Jordan)

Subproject: Millet seed as grain for fattening lambs. (New) (Closed)

303. The importance of size in market lamb production. (Cooperative with the Northwest branch station) (L. M. Winters, O. M. Kiser, P. A. Anderson) (Closed)

304. A study of the inheritance and the relative economic advantages of single and twin lamb production. (Cooperative with the Northwest Experiment Station) (L. M. Winters, O. M. Kiser, P. A. Anderson)

305. The most profitable proportion of roughage to grain for fattening lambs. (Cooperative with the West Central branch station) (W. H. Peters, P. S. Jordan) (Closed)

306. Breeding sheep for efficiency of production. (Cooperative with the North Central branch station) (L. M. Winters, C. L. Cole)

402. The palatability and protein supplemental values of soybean oilmeals produced by different processes. (E. F. Ferrin) (Dormant) (Closed)

404. A study of the cause of the unpalatability of rye. (Cooperative with the Division of Agricultural Biochemistry) (D. W. Johnson, L. S. Palmer)

405. The nutritive value of proteins of alfalfa hay for swine. (D. W. Johnson) (Dormant) (Closed)

406. The nutritive and feeding value of dry rendered tankage for hogs. (D. W. Johnson) (Closed)

409. Variations between litters of Duroc Jersey pigs. (E. F. Ferrin)

410. Feeding scabby barley to pigs. (Cooperative with the Division of Plant Pathology and Botany) (E. F. Ferrin, J. J. Christensen)

411. The vitamin D requirement of the pig. (Cooperative with the Division of Agricultural Biochemistry) (D. W. Johnson, L. S. Palmer)

412. The comparative feeding values of corn of different market grades. (Cooperative with the Division of Agronomy and Plant Genetics) (E. F. Ferrin) (New)

414. The substitution of cane molasses for grains in swine rations. (E. F. Ferrin) (New) (Closed)

415. Genetic reactions in the fowl as influenced by various systems of breeding. (Cooperative with the West Central, Northwest, and Northeast branch stations) (H. J. Sloan, L. M. Winters, A. W. Edson, A. M. Pilkey, A. F. Dahlberg) (Bankhead-Jones) (New)

Subproject: Continuous full brother and sister matings.
Subproject: Continuous half brother and sister matings.
Subproject: A closed flock.
Subproject: A flexible system of inbreeding.

Dairy Husbandry

102. Feeding trials with crops new to Minnesota farmers. (Cooperative with the branch stations) (N. N. Allen, W. E. Petersen, J. B. Fitch)

Subproject: Sweet clover pasture experiments. (Dormant) (Closed)
Subproject: The effect of molasses on consumption of low-grade roughage. (Dormant) (Closed)
Subproject: Acid preservation of silage. (Cooperative with the Division of Agricultural Biochemistry)
Subproject: Reed canary grass hay as feed for dairy cows. (New)

103. Food requirements for cattle. (T. W. Gullickson, F. C. Fountaine)

Subproject: The deficiencies of milk as an exclusive diet for the calf. (Closed)
Subproject: The maintenance requirements of mature cows. (Dormant)
Subproject: The cause of a deficiency disease which occurs in young growing cattle on farms in Minnesota. (Closed)
Subproject: Problems in calf raising. (New)

104. Factors influencing the quantity and quality of milk. (Cooperative with the Division of Veterinary Medicine) (W. E. Petersen, N. N. Allen, J. B. Fitch, W. L. Boyd, J. C. Shaw, P. Kelly, F. Ely)

Subproject: The effect of cod liver oil upon the fat percentage. (Dormant)
Subproject: Methods of drying off cows. (Dormant)
Subproject: Alfalfa hay as the sole diet for milking cows. (Dormant)
Subproject: Fundamental studies of physiology of milk secretion.
Subproject: Blood fat studies.
Subproject: The effect of food fat upon milk fat. (Dormant)

106. The relation of the mineral content of the ration to reproduction in cattle. (Joint project with Agricultural Biochemistry Project No. 205 and Veterinary Medicine Project No. 104) (T. W. Gullickson, F. C. Fountaine) (Purnell)

Subproject: The effect of a ration low in calcium on abortion and other reproductive disturbances.
Subproject: The relation of low phosphorus to reproduction.

107. A comparison of two systems of dairy management in northern Minnesota. (Cooperative with the North Central branch station) (C. L. Cole, R. L. Donovan, J. B. Fitch, N. N. Allen) (Dormant)

108. A study of the blood precursors of milk. (Cooperative with Division of Veterinary Medicine) (W. E. Petersen, J. C. Shaw, J. B. Fitch, W. L. Boyd) (Bankhead-Jones) (New)

202. Factors influencing the composition and market qualities of butter. (Cooperative with the State Creamery) (H. Macy, W. B. Combs, S. T. Coulter, F. E. Nelson, Spencer George, D. J. Thompson, D. L. Gibson) (Purnell)

Subproject: Moldiness in butter.
Subproject: Cheesy flavors in butter.
Subproject: The cause and prevention of crumbly butter. (Dormant)
Subproject: The manufacture of unsalted butter.
Subproject: The relation of the water supply to butter quality.
Subproject: The relation of the feed of the cow to the composition of butterfat, the churning qualities of the cream, and the keeping qualities of the butter. (Dormant) (Closed)

205. The loss of fat in churning sweet cream and methods of control. (Cooperative with the State Creamery) (W. B. Combs, S. T. Coulter, Howard Goforth, S. A. Lear)

Subproject: Methods of fat determination in buttermilk. (Dormant)
Subproject: Factors influencing the loss of fat in sweet cream churnings.

209. The value of proven sires in building up a dairy herd. (N. N. Allen, W. E. Petersen, J. B. Fitch)

210. The utilization of skimmilk on dairy farms. (W. E. Petersen) (Dormant)

212. Development of foreign types of cheese in Minnesota. (W. B. Combs, H. Macy, S. T. Coulter, F. E. Nelson, Arthur Melgaard, Spencer George, D. J. Thompson, J. A. Erekson)

Subproject: Manufacture of Roquefort and related types of cheese.
Subproject: Manufacture of miscellaneous types of foreign cheese.

213. Factors influencing the composition and market qualities of ice cream and frozen dairy products. (W. B. Combs, H. Macy, S. T. Coulter, F. E. Nelson, J. D. Winter)

Subproject: Relation of ice cream ingredients to the market qualities of ice cream. (Dormant)
Subproject: Composition of ice cream made in Minnesota.
Subproject: Bacteriology of ice cream.
Subproject: The use of Minnesota fruits in ice cream. (Cooperative with Division of Horticulture)

214. Factors influencing the composition and market qualities of milk and cream. (H. Macy, W. B. Combs, S. T. Coulter, F. E. Nelson, R. F. Bonney, S. A. Lear, P. Rivers)

Subproject: The methylene blue reduction test as a method for grading sweet cream and methods to be followed in improving the grade of cream as indicated by this test. (Dormant)
Subproject: The effect of the condition of the cream can on the quality of cream.
Subproject: Study of the methods of cooling cream on the farm. (Dormant)
Subproject: Methods to be used for reducing the extraneous matter in cream and for determining sediment in cream. (Dormant)
Subproject: Factors influencing the production of off flavors in milk.
Subproject: Factors influencing the sanitary quality of the pasteurized milk supply of the Twin Cities.

215. A study of color inheritance in cattle, using albino as foundation animals. (Cooperative with the Divisions of Animal Husbandry and Agricultural Biochemistry) (Dormant) (Closed)

Entomology and Economic Zoology

102. Biologic and taxonomic studies on the Mutillidae (Hymenoptera). (C. E. Mickel)

103. The bronze birch-borer, *Agrilus anxius*. (Cooperative with the State Department of Conservation, and the Bureau of Entomology and the Forest Service of the United States Department of Agriculture) (A. C. Hodson)

107. The endoparasites of domesticated and game animals. (Formerly, "The endoparasites of man and domesticated animals.") (Cooperative with the Division of Veterinary Medicine) (W. A. Riley, O. W. Olsen)

110. Greenhouse insects. (A. G. Ruggles) (Closed)

111. Insect collection. (C. E. Mickel, W. D. Murray, D. G. Denning)

Subproject: Insect collection, University Farm.
Subproject: Insect collection, Itasca Park. (Dormant) (Closed)

112. Insect defoliators of forest trees. (Cooperative with city water department of St. Paul) (A. G. Ruggles, A. C. Hodson)

Subproject: The jack pine sawfly. (Dormant)
Subproject: The larch sawfly. (Dormant)
Subproject: The forest tentless caterpillar.

113. Insectary work. (A. G. Ruggles)

114. Insects infesting stored food products. (H. H. Shepard, E. L. Thomas)

Subproject: Measures for protecting flour and other cereal products from insects.
Subproject: The protection of dried fruits from insects.

116. Insecticides. (A. G. Ruggles, A. C. Hodson)

Subproject: Orchard spraying.
Subproject: Scale insect control. (Dormant) (Closed)

119. The parasites and symbionts of insects. (W. A. Riley, C. H. Yen)

121. Soil insects (White grubs). (A. A. Granovsky, D. J. Pletsch, E. E. Ivy)

124. A study of the role of temperature and humidity in the development and control of insects in flour and other cereal products and in cereals while in storage. (H. H. Shepard, E. L. Thomas, F. W. Fisk, S. Easter)

127. Field crop insects. (A. G. Ruggles)

Subproject: Grasshoppers.
Subproject: Armyworms.
Subproject: Chinch bugs.

128. Effect of temperature and humidity on the wintering of bees. (Cooperative with the Dow Chemical Co., Midland, Michigan, and Röhm

and Haas Co., Bristol, Pennsylvania) (M. C. Tanquary, M. H. Haydak)

131. The toxicity of insecticides. (H. H. Shepard, E. L. Thomas, S. Easter, F. W. Fisk)

Subproject: The measurement of toxicity.
Subproject: The examination of new materials.
Subproject: The relation to insect physiology. (Dormant)
Subproject: The relation to the physiology of the plant. (Dormant)

133. Methods of bee management. (M. C. Tanquary, M. H. Haydak)

134. Bees as a factor in pollination. (M. C. Tanquary) (Dormant)

136. Bee diseases. (M. C. Tanquary, Joseph Reinhardt)

137. Ectoparasites of game and fur-bearing animals. (Formerly, "The animal parasites of fur-bearing animals with particular reference to those of mink and foxes.") (W. A. Riley, O. W. Olsen) (Adams)

139. The relation of insects to the spread, transmission, and development of plant diseases. (Joint project with Plant Pathology and Botany Project No. 117) (A. A. Granovsky, J. G. Leach, E. E. Ivy, D. J. Pletsch, A. C. Hodson, Louise Fulton)

Subproject: Miscellaneous dipterous insects and bacterial soft rots.
Subproject: The relation of insects to the decay of felled timber.
Subproject: The cucumber beetle in relation to cucumber wilt.
Subproject: The relation of insects to the storage rot of apples. (Dormant)
Subproject: The association of leaf hoppers with the alfalfa yellow top disease.
Subproject: The relation of the white grubs and other subterranean insects to the raspberry crown gall.
Subproject: The relation of insects to the transmission of virus diseases.

140. Ecological studies of ruffed grouse. (Cooperative with the Bureau of Biological Survey) (R. T. King) (Closed)

141. The preferential ground covers for oviposition by the June beetles. (A. A. Granovsky, D. J. Pletsch) (Adams)

142. Use of pollen substitutes by bees. (M. C. Tanquary, M. H. Haydak)

143. Flukes of the genus *Prosthogonimus* as parasites of poultry. (W. A. Riley, R. W. Macy) (Adams)

144. Mosquito pests of man and animal in Minnesota. (W. A. Riley, C. E. Mickel, W. B. Owen) (Closed)

145. The food value of honey. (Joint project with Agricultural Biochemistry Project No. 207) (M. H. Haydak, L. S. Palmer)

146. Nutrition of the wax moth larvae. (M. H. Haydak, M. C. Tanquary)

147. Insect defoliators of deciduous forest and shade trees. (A. G. Ruggles, A. C. Hodson) (Adams) (New)

148. A study of the nutrition of the honey bee. (M. H. Haydak, M. C. Tanquary) (New)

149. A study of the nutritive value of bee foods. (Cooperative with the Division of Agricultural Biochemistry) (M. H. Haydak, L. S. Palmer) (New)

Forestry

106. Studies of forest planting. (T. S. Hansen) (Dormant)

107. Thinning of jack and Norway pine. (T. S. Hansen)

110. Studies in yield and volume. (R. M. Brown, J. H. Allison)

Subproject: Lake Vadnais plots.

120. The value of "Treater Dust" as a wood preservative, particularly for fence posts and poles. (Henry Schmitz)

127. The determination of the rate of moisture movement through wood. (Cooperative with the American Creosoting Company) (L. W. Rees, H. D. Dickinson, S. J. Buckman)

128. A study of the efficacy of wood preservatives. (Henry Schmitz)

129. Silvicultural aspects of the farm wood lot management in the hardwood region of Minnesota. (Dormant)

131. A new method of classifying sandy forest soils by means of the texture of the upper six inches. (Cooperative with the Division of Soils and with the Lake States Forest Experiment Station) (E. G. Cheyney, P. R. McMiller, Paul Rudolf)

132. A study of tree roots. (E. G. Cheyney) (Closed)

133. A study of the causes of deterioration of windbreaks and shelterbelts in western Minnesota and how they may be rehabilitated. (Revived) (Henry Hansen)

Subproject: A resurvey of the demonstration shelterbelts in the prairie region of Minnesota.

134. Statistical correlations of Cloquet weather data and the diameter growth of trees at the Cloquet Forest Experiment Station. (Formerly, "Statistical correlations of Twin City weather and the diameter growth of trees in the vicinity of University Farm and the Vadnais plantation.") (R. M. Brown, T. S. Hansen)

135. Study of Cloquet as a market for farm woodlot timber products. (Cooperative with the United States Forest Service Timber Survey, Lake States Forest Experiment Station) (J. H. Allison, R. N. Cunningham)

136. Maximum temperature relationship of forest trees. (Cooperative with the Division of Plant Pathology and Botany) (R. W. Lorenz)

137. A study of the factors affecting the durability of wood. (Henry Schmitz) (New)

138. The preparation of a manual of forest pathological practices for the stands of the Lake States. (Cooperative with the Division of Forest Pathology, Bureau of Plant Industry, and Forest Service, United States Department of Agriculture) (F. H. Kaufert) (New)

139. A study of the structure of wood and wood products. (A. J. Bailey) (New)

140. A study of the chemistry of cellulose, lignin, wood, wood components, and wood products. (A. J. Bailey) (New)

141. Wood utilization. (Cooperative with the American Creosoting Company) (S. J. Buckman, L. W. Rees) (New)

Subproject: The effect of steaming on the strength of short-leaf pine and slash pine.

Home Economics

102. Relation of the diet to blood formation and regeneration. (J. M. Leichsenring, Alice Biester, Lida Burrill) (Purnell)

Subproject: The influence of vitamins on the rate of blood regeneration.

Subproject: The distribution of nitrogenous constituents of the blood during blood formation and regeneration.

104. Factors affecting the selection, care, and wearing qualities of textile materials. (E. L. Phelps, S. A. McKee, Marjorie Jewell) (Purnell)

Subproject: A study of fiber quality and physical properties in relation to cost of staple wool materials.

Subproject: A study of the serviceability of woven materials used for men's and women's underwear.

105. A study of bound and free water in meat. (A. M. Child) (Purnell) (Dormant)

106. A study of the qualities of meat which affect its palatability, methods of cooking and utilization. (A. M. Child, Pauline Paul) (Purnell, Bankhead-Jones)

Subproject: A study of juiciness, flavor, and tenderness of meat.

107. A survey of purchasing habits in the selection of silk street dresses. (E. L. Phelps, S. A. McKee) (Purnell)

109. A study of the culinary quality of Minnesota potatoes. (Cooperative with the Northwest and North Central branch stations) (A. M. Child, Alice Ebersold) (Bankhead-Jones)

110. A study of the quality and utilization of Minnesota varieties of apples. (Cooperative with the Division of Horticulture) (A. M. Child, Ruth Brand) (Bankhead-Jones)

112. A study of the properties and serviceability of cotton materials used for professional garments. (E. L. Phelps, Helen Larmore) (Bankhead-Jones) (New)

Horticulture

101. A study of ornamental varieties and their uses. (L. E. Longley, L. Sando)

102. Turf construction and maintenance. (Cooperative with the Divisions of Plant Pathology and Botany and Soils) (L. E. Longley)

Subproject: Test of vegetatively propagated creeping bents and other grasses suitable for lawns, parks, golf courses, and playgrounds.

Subproject: Test of seed-propagated grasses.

Subproject: Weed eradication.

103. Forcing of bulbs under greenhouse conditions. (L. E. Longley, L. Sando)

Subproject: Forcing of narcissus bulbs from various localities of the United States. (Dormant)

Subproject: Forcing of tulip bulbs from Holland and from various parts of the United States. (Dormant)
Subproject: Effects of various treatments on forcing of bulbs.

104. Breeding and selecting greenhouse and garden flowers. (L. E. Longley, L. Sando)

105. Effect of different media on the rooting of cuttings and layers of herbaceous and hardwood plants. (L. E. Longley, L. Sando)

106. Treatment of nursery stock for decreasing sunscald and rodent injury. (Cooperative with the Division of Plant Pathology and Botany) (E. Angelo)

Subproject: Studies of rodent repellants.

107. A study of quality, outlets, handling methods, prices, and volume of sale of certain Minnesota fruits. (Formerly, "Marketing of Minnesota fruits.") (Cooperative with the Divisions of Agricultural Economics, Home Economics, and Plant Pathology and Botany) (J. D. Winter, W. H. Alderman, W. C. Waite) (Purnell)

Subproject: A study of the packs and grades of apples sold by Minnesota growers and an analysis of the factors which cause culls and low-grade fruits.
Subproject: An analysis of the price range of various grades and varieties of Minnesota-grown and shipped-in fruits in the Twin City market.
Subproject: A study of new uses and market outlets for Minnesota fruits.
Subproject: Survey of volume.

201. Hardiness studies in fruit breeding. (W. H. Alderman, R. B. Harvey, W. G. Brierley, Ernest Angelo, L. E. Longley, A. N. Wilcox) (Adams)

Subproject: The inheritance of hardiness.
Subproject: Determination of the hardiness of seedlings by artificial freezing tests. (Dormant)
Subproject: Investigation of the fundamental differences between hardy and tender fruit plants.
Subproject: Determination of the conditions under which plants are most liable to be injured by low temperatures. (Closed)
Subproject: The relation of the condition of storage of nursery stock to hardiness. (Dormant)
Subproject: Hardiness studies on seedlings and mature ornamentals.

202. Sterility studies in fruit breeding. (W. H. Alderman, E. Angelo, A. N. Wilcox) (Adams)

203. A study of inheritance of characters in fruit. (A. N. Wilcox, W. H. Alderman, Ernest Angelo, F. E. Haralson) (Adams)

Subproject: Apple breeding.
Subproject: Pear breeding.
Subproject: Grape breeding.
Subproject: Strawberry breeding.
Subproject: Stone fruit breeding.
Subproject: Rubus breeding.
Subproject: Groselle breeding.
Subproject: Variety testing.

204. Fruit breeding and improvement. (W. H. Alderman, F. E. Haralson, A. N. Wilcox, E. Angelo, W. G. Brierley, Walter Kroening, Roy Sauter)

301. Blueberry culture. (Cooperative with North Central branch station) (W. G. Brierley, T. S. Weir)

304. Fruit variety studies. (Cooperative with the Divisions of Home Economics and Plant Pathology and Botany, the branch stations, and private growers) (W. G. Brierley, Ernest Angelo, W. H. Alderman, A. M. Child, J. D. Winter, R. H. Landon)

Subproject: Adaptability and value of different varieties of fruits for canning, preserving, or other home uses. (Cooperative with the Division of Home Economics)

305. Nut culture in Minnesota. (W. G. Brierley, W. H. Alderman)

307. Pruning studies. (W. G. Brierley)

Subproject: The effect of height of pruning upon the performance of the Latham raspberry. (Dormant)
Subproject: Pruning requirements of the hybrid plums.

402. Vegetable breeding. (Cooperative with the branch stations) (F. A. Krantz, W. H. Alderman, T. M. Currence, A. E. Hutchins)

Subproject: Pea breeding. (Dormant)
Subproject: Tomato improvement.
Subproject: Inheritance studies with tomatoes.
Subproject: Bean improvement and inheritance studies.
Subproject: Radish breeding. (Dormant)
Subproject: Melon breeding.
Subproject: Studies of vegetable varieties.
Subproject: Cucumber breeding and genetic studies.
Subproject: Pepper breeding and genetic studies.

408. Potato breeding. (Cooperative with the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, and the Northeast, Northwest, and North Central branch stations) (F. A. Krantz, A. G. Tolaas, Harold Mattson,

T. M. McCall, Otto Swenson, M. J. Thompson, Catherine Becker, Martin Odland)

Subproject: Development of improved varieties of potatoes through inbreeding and subsequent crossbreeding.
Subproject: Inheritance of certain characters in the potato.
Subproject: Tests of new varieties and seedlings.

413. Hastening maturity and development of vegetable crops. (T. M. Currence, F. A. Krantz, A. E. Hutchins) (Closed)

414. The development of disease-resistant varieties of vegetable crops. (Joint project with Plant Pathology and Botany Project No. 118) (Cooperative with the Bureau of Plant Industry, United States Department of Agriculture) (F. A. Krantz, J. G. Leach, A. E. Hutchins, T. M. Currence)

Subproject: Disease resistance in potatoes.
Subproject: Cabbage breeding for resistance to club root.
Subproject: Breeding wilt-resistant muskmelon strains.

Plant Pathology and Botany

101. Cereal and forage crop diseases. (Cooperative with the Bureau of Plant Industry, United States Department of Agriculture) (E. C. Stakman, J. J. Christensen, M. B. Moore, R. H. Bamberg, E. W. Hanson)

Subproject: Imperfects of cereals.
Subproject: Smut treatments.
Subproject: Scab of cereals.
Subproject: Ergot of cereals.
Subproject: Black chaff of wheat.
Subproject: Miscellaneous diseases of flax.
Subproject: Smuts of sorghums.

103. Dendropathological work. (Cooperative with the Division of Forestry, Minnesota Agricultural Experiment Station, and with the Forest Service, United States Department of Agriculture) (E. C. Stakman, C. M. Christensen, E. W. Hanson, T. H. King)

Subproject: White pine blister rust. (Dormant)
Subproject: Miscellaneous diseases of shade and forest trees.
Subproject: Biology of wood-rotting fungi. (Dormant)
Subproject: Experiments relating to the propagation, protection, and collection of plantation rubber. (Cooperative with the Firestone Tire and Rubber Company)

104. The development of disease-resistant varieties of farm crops. (Joint project with Agronomy and Plant Genetics Project No. 124; cooperative with the Bureau of Plant Industry, United States Department of Agriculture) (E. C. Stakman, M. B. Moore, M. N. Levine, R. H. Bamberg, E. L. LeClerg, J. J. Christensen, E. W. Hanson)

Subproject: Spring wheat. (Cooperative with the Office of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture)
Subproject: Winter wheat.
Subproject: Oats.
Subproject: Barley.
Subproject: Rye.
Subproject: Flax. (Cooperative with the Office of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture)
Subproject: Corn.
Subproject: Timothy. (Dormant)
Subproject: Red clover.
Subproject: Sweet clover.
Subproject: Sugar beets. (Cooperative with the Office of Sugar Plant Investigations, Bureau of Plant Industry, United States Department of Agriculture)
Subproject: Alfalfa.
Subproject: Sunflowers. (Dormant)

105. Diseases of ornamental plants. (Louise Dosdall)

108. Fruit diseases. (E. C. Stakman, C. J. Eide, T. H. King, Kermit Kreitlow)

Subproject: Diseases of small fruits and methods of control.
Subproject: Diseases of tree fruits and methods of control.

109. Minnesota fungi. (Louise Dosdall, C. M. Christensen)

110. Plant disease survey. (Louise Dosdall)

111. Rusts of cereals. (Cooperative with the Division of Cereal Crops and Diseases and the Division of Barberry Eradication, Bureau of Plant Industry, and the Division of Plant Disease Control, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture) (E. C. Stakman, Helen Hart, M. N. Levine, L. W. Melander, R. U. Cotter, R. C. Cassell) (Adams)

Subproject: Nature of resistance.
Subproject: Biologic specialization in cereal rusts.
Subproject: Epidemiology of cereal rusts.
Subproject: Barberry eradication.

115. Physiologic specialization of smuts of cereals. (E. C. Stakman, M. B. Moore, E. K. Vaughan, Helen Hart, M. F. Kernkamp, A. E. Eagle) (Purnell)

116. Garden truck diseases. (J. G. Leach)

Subproject: Potato diseases.
Subproject: Miscellaneous truck crop diseases.

117. The relation of insects to the spread, transmission, and development of plant diseases. (Joint project with Entomology and Economic Zoology Project No. 139) (J. G. Leach) (Adams)

Subproject: Miscellaneous dipterous insects and bacterial soft rots. (Dormant)
Subproject: The relation of insects to the decay of felled timber.
Subproject: The cucumber beetle in relation to cucumber wilt.
Subproject: The relation of insects to the storage rots of apples.
Subproject: The association of leafhoppers with the alfalfa yellow top disease.
Subproject: The relation of white grubs and other subterranean insects to raspberry crown gall.
Subproject: Insect transmission of virus diseases of plants.

118. Development of disease-resistant varieties of vegetable crops. (Joint project with Horticulture Project No. 414; cooperative with Office of Horticultural Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture) (J. G. Leach, Hanna Becker) (Adams)

Subproject: Potatoes.
Subproject: Cabbage.
Subproject: Muskmelon wilt.

119. Pathological factors affecting the deterioration of stands of clover and other leguminous forage plants. (E. C. Stakman, J. J. Christensen, Lawrence Henson) (New)

120. The nature and variability of plant disease resistance. (Cooperative with the Division of Horticulture) (E. C. Stakman) (Bankhead-Jones) (New)

Subproject: Wheat and other small grains.
Subproject: Flax. (Dormant)
Subproject: Potatoes and other vegetables.

201. Effect of low temperature on plants. (Cooperative with the Division of Agronomy and Plant Genetics) (R. H. Landon, A. C. Vogele)

Subproject: Varietal differences in frost resistance of crop plants.
Subproject: Physiological factors concerned in frost injury.
Subproject: Desiccation in the frozen condition as a cause of injury. (Dormant)
Subproject: Killing of seeds and seedlings of forest trees and horticultural plants by low temperatures. (Dormant)

203. Investigations on respiratory enzymes. (Cooperative with the Division of Horticulture and the Bureau of Plant Industry, United States Department of Agriculture) (R. H. Landon, W. G. Brierley)

Subproject: Oxydo reductase.
Subproject: State of oxidation in tissues.

204. Light relations of plants. (R. H. Landon) (Dormant)

Subproject: Importance of factors which may alter the tolerance of a given species of plants.
Subproject: Studies on difference in tolerance of different species.
Subproject: Internal reactions of leaf cells of various types of forest trees to light of varying intensity and quality.

205. Physiological changes occurring in the storage and ripening of fruits and vegetables under varying conditions. (Cooperative with the Division of Horticulture) (R. H. Landon, A. C. Vogele)

Subproject: Physiological and chemical changes of fruits and vegetables in storage.
Subproject: Storage optimum temperature and humidity. (Dormant)
Subproject: Length of holding in storage in relation to state of maturity of fruit. (Dormant)
Subproject: Storage in frozen conditions. (Dormant)
Subproject: Ripening in storage.

206. Physiology of reproduction. (R. H. Landon) (Dormant)

Subproject: Temperature as a factor in self-fertility.
Subproject: Effect of fertilizer treatments upon self-fertility.
Subproject: Studies on plant hormones.

207. Physiology of seed germination. (A. H. Larson, A. C. Vogele)

Subproject: Physiology of dormancy in seeds, including a study of means to shorten or eliminate the rest period.
Subproject: Effects of seed treatment upon germination, subsequent growth, and yield.

208. Studies in plant metabolism and growth. (Cooperative with the Division of Horticulture) (R. H. Landon, W. G. Brierley)

Subproject: Effect of length of illumination and light intensity upon growth and reproduction. (Dormant)
Subproject: Salt nutrition.
Subproject: Movement of photosynthate in fruiting red raspberry canes. (New)

301. Seed studies. (A. H. Larson)

Subproject: Weed seed cases.
Subproject: Seed testing survey. (Cooperative with State Seed Laboratory)

Subproject: Effects of chemical treatment on viability.
Subproject: Germination of lettuce seed. (Dormant)
Subproject: Seed herbarium.

302. Weeds. (A. H. Larson, A. C. Vogele, R. H. Landon)

Subproject: Chemical eradication.
Subproject: Weed identification and survey.

Rural Sociology

104. The distribution and functioning of rural social agencies in Minnesota. (Cooperative with the Agricultural Extension Division and the Minnesota State Federation of Churches) (R. W. Murchie) (Purnell)

Subproject: The distribution of religious agencies in rural Minnesota.
Subproject: Educational and social agencies.

106. The effects of an organized program of adult education and recreation on the community life and social participation in certain rural areas. (R. W. Murchie, W. M. Garthune) (Purnell)

107. A study in rural leadership. (R. W. Murchie, G. W. Newhouse) (Purnell) (New)

108. A survey of Beltrami Island Forest Reserve Resettlement Area. (Cooperative with the Resettlement Administration of the United State Department of Agriculture) (R. W. Murchie, C. R. Wasson, J. T. Howard) (Purnell) (New)

109. Standards of living in rural Minnesota. (Cooperative with the Resettlement Administration, the United States Weather Bureau and the State Planning Board) (R. W. Murchie, G. W. Newhouse) (Purnell) (New)

Soils

101. Agricultural value of marl. (F. J. Alway, G. H. Nesom)

102. Fertilizer experiments. (Cooperative with the branch stations and the county agents of Clearwater and Roseau counties) (F. J. Alway, G. H. Nesom, William Methley, A. Marsh)

104. Land classification. (F. J. Alway, P. R. McMiller)

105. Movement of water in soils. (F. J. Alway, D. Sherman) (Adams)

106. Peat soils. (F. J. Alway, G. H. Nesom, D. Sherman)

107. Sandy soils. (F. J. Alway, G. H. Nesom, D. Sherman, William Methley)

108. Soils of the low-lime area. (F. J. Alway, C. O. Rost, D. Sherman)

109. Soil survey. (Cooperative with the Soil Conservation Service and the Bureau of Chemistry and Soils, United States Department of Agriculture) (F. J. Alway, P. R. McMiller)

110. Soils of the red drift. (F. J. Alway, D. Sherman)

111. Amount and placement of fertilizers for cultivated crops. (C. O. Rost)

112. Composition of forest floor. (Cooperative with the Division of Forestry) (F. J. Alway, E. G. Cheyney, Gerda Nelson, William Methley) (Adams)

113. Replaceable ions in soils. (C. O. Rost, K. A. Maehl)

114. Soil erosion factors. (C. O. Rost)

Veterinary Medicine

104. Bang's disease and related diseases of the reproductive organs of cattle. (Cooperative with the Divisions of Agricultural Biochemistry and Dairy Husbandry) (L. M. Bishop, W. L. Boyd, M. H. Roepke, C. P. Fitch, Margaret Kelly, Lawrence Jergenson, Joy Berger, Edwin Morseth, Rhea Post, Charlotte Thompson, Norma Olson) (Adams)

Subproject: The relation of the mineral content of the ration to reproduction in cattle. (Joint project with Agricultural Biochemistry Project No. 205 and Dairy Husbandry Project No. 106)

Subproject: The serological tests and their relation to infectious abortion, or Bang's disease. (Cooperative with Bureau of Animal Industry, United States Department of Agriculture)

Subproject: *Corpus luteum* and its relation to breeding efficiency in cattle.

Subproject: Elimination of *Brucella abortus* from cattle and other species of animals.

Subproject: Biological requirements of *Brucella abortus.*

Subproject: Investigation of the relation of *Brucella abortus* to hygromata and arthritis in cattle. (Dormant)

Subproject: Changes occurring in the reproductive organs in cows following parturition or abortion.

Subproject: A study of animals which have been infected with *Brucella abortus* and have ceased to react to the agglutination test for this disease.

Subproject: A study of animals that have been infected with *Brucella abortus* and its relation to poll evil and fistula of horses.

Subproject: Significance of *Brucella abortus* in the udder of cows, with special reference to its importance as a source of spread of the disease.

Subproject: The bull as a factor in the spread of infectious abortion and sterility.

Subproject: Causes of so-called non-specific abortion.

Subproject: A study of calves from dams affected with *Brucella abortus.*

Subproject: Examination of possible carriers of *Brucella abortus.*

105. Investigation of obscure diseases. (Cooperative with the Divisions of Agricultural Biochemistry and Dairy Husbandry, Minnesota Agricultural Experiment Station, and with the Minnesota State Livestock Sanitary Board) (R. Fenstermacher, W. L. Boyd, H. C. H. Kernkamp, L. M. Bishop, C. P. Fitch, B. S. Pomeroy)

Subproject: The investigation of obscure diseases in the state, with special reference to infectious diseases.

Subproject: The investigation and treatment of diseases affecting University Farm animals.

111. Lymphadenoma of the domestic fowl. (Cooperative with the Division of Animal and Poultry Husbandry) (R. Fenstermacher, Marion Diehl, Gladys Christianson, Evelyn Bolstad)

113. Diagnosis of hog cholera. (H. C. H. Kernkamp) (Purnell)

General

1. Problems concerning the calcium and phosphorus requirements of cattle in Minnesota. (L. S. Palmer, T. W. Gullickson, J. W. Nelson, F. C. Fountaine, C. E. Calverley, F. C. Olson) (Purnell)

Subproject: The calcium and phosphorus requirements for maintenance and for maintenance plus milk production of dairy cattle. (Dormant)

Subproject: The relationship of various levels and ratios of calcium and phosphorus requirements for maintenance, for maintenance plus growth, and for maintenance plus milk production of dairy cattle. (Dormant)

Subproject: The relationship of the skeletal reserves of calcium and phosphorus laid down during growth to the future productiveness of dairy cows.

Subproject: The relative availability to cattle of the calcium and phosphorus in natural food, and in the various proprietary sources of these elements offered for sale to dairy farmers and cattle breeders in Minnesota.

Subproject: The relation of the nutritive deficiencies of other major nutrients in the ration to the effects of phosphorus deficiency in cattle.

Subproject: An experimental study of the necessity for and the advantages of adding mineral supplements to typical dairy rations fed in Minnesota and the proper basis for the economic evaluation of the most common forms when their use is necessary or advantageous. (Dormant)

3. Regional adjustment in agriculture. (Cooperative with the Divisions of Agronomy and Plant Genetics, Animal and Poultry Husbandry, Dairy Husbandry, Soils, and Agricultural Extension, Minnesota Agricultural Experiment Station, and with the Bureau of Agricultural Economics and the Agricultural Adjustment Administration, United States Department of Agriculture) (G. A. Pond, S. A. Engene, G. M. Myers)

4. The genetic reactions of swine as influenced by various systems and intensities of inbreeding and outbreeding. (Cooperative with the Divisions of Animal and Poultry Husbandry and Veterinary Medicine, and the Southeast, West Central, Northwest and North Central branch stations, Minnesota Agricultural Experiment Station, and with the Bureau of Animal Industry, United States Department of Agriculture) (L. M. Winters, E. F. Ferrin, R. E. Comstock, R. E. Hodgson, O. M. Kiser, P. S. Jordan, C. L. Cole, Catherine Barrett, H. C. H. Kernkamp) (Bankhead-Jones)

Subproject: The development of inbred lines by brother and sister mating.

Subproject: The development of inbred lines by a flexible system of inbreeding.

Subproject: The economic advantages of crossbreeding.

Subproject: An attempt to combine the desirable features of the Landrace and Tamworth breeds.

6. Growth habits and feeding qualities of plants suitable for pasture. (Cooperative with the branch stations) (H. K. Hayes, I. J. Johnson, D. C. Anderson, H. K. Schultz, R. E. Hodgson, R. O. Bridgford, R. S. Dunham, O. W. Swenson, M. J. Thompson) (Bankhead-Jones)

7. Pasture management studies. (Cooperative with the Division of Soils and the branch stations, Minnesota Agricultural Experiment Station, and with the Soil Conservation Service, United States Department of Agriculture) (A. C. Arny, R. F. Crim, F. J. Alway, C. O. Rost, R. S. Dunham, R. E. Hodgson, R. O. Bridgford) (Bankhead-Jones)

Subproject: Methods of renovating permanent bluegrass pastures.

Subproject: Delayed vs. continuous grazing of treated and untreated permanent pastures. (Dormant)

Subproject: Mixtures of grasses and legumes for permanent pastures (a) in the eastern part of the state, and (b) in the western part of the state.

Subproject: Sweet clover vs. Sudan grass as a supplementary pasture crop.

Subproject: Freeing permanent pastures from weeds and brush. (Dormant)

8. Characteristics, growth habits, and control methods of weedy plants. (Cooperative with Northwest, West Central and Southeast branch stations, Minnesota Agricultural Experiment Station; the State

Department of Agriculture, and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture) (H. K. Wilson, R. B. Harvey, R. H. Landon, L. M. Stahler, Henry Johnson, John Zalar, A. H. Larson, A. C. Vogele, R. F. Crim) (Bankhead-Jones)

Subproject: Cultural methods as a means of control, with special reference to field bindweed.
Subproject: The morphology and physiology of perennial weeds.
Subproject: Chemical eradicants in the control of weeds.
Subproject: The development of new chemicals for weed control.
Subproject: Weed dissemination.

9. Utilization of disease-resistant germ plasm in the improvement of the potato. (F. A. Krantz, A. G. Tolaas, J. G. Leach, Harold Mattson) (Bankhead-Jones)

10. A study of inbreeding in the fowl. (Cooperative with the North Central, Northwest and West Central branch stations) (L. M. Winters, A. W. Edson, A. M. Pilkey, A. F. Dahlberg) (New) (Closed)

11. The nutritional status of college women as related to their dietary habits and indicated by (a) anthropometric measurements, (b) basal metabolism determinations, and (c) blood studies. (Cooperative with Iowa State College, Kansas State College, University of Ohio, University of Wisconsin, and the Health Service of the University of Minnesota) (Eva Donelson, J. M. Leichsenring, Alice Biester, L. M Wall, Loana Norris) (Purnell) (New)

12. A genetic study of the bovine. (Cooperative with the Divisions of Animal and Poultry Husbandry and Agricultural Biochemistry) (W. E. Petersen, L. M. Winters, J. B. Fitch, W. M. Sandstrom) (Bankhead-Jones) (New)

Subproject: Color inheritance.

North Central Station

101. Investigations in farm crop production. (R. L. Donovan, O. W. Swenson)

Subproject: Succotash trials.

102. Experiments in general horticulture. (T. S. Weir, R. L. Donovan)

Subproject: Ornamental planting.
Subproject: Herbarium.
Subproject: Potato seed plot.
Subproject: Potato variety test.
Subproject: Wild fruit culture.

103. Investigations in animal and poultry husbandry. (C. L. Cole, A. F. Dahlberg, R. L. Donovan)

Subproject: Tuberculosis and Bang's disease testing.
Subproject: Building up a herd of purebred Guernseys.
Subproject: Normal growth rates for Guernseys.
Subproject: Establishing a turkey flock.

104. Investigations in forestry. (T. S. Weir, R. L. Donovan)

Subproject: Forest planting.
Subproject: Arboretum.

Northeast Station

101. Investigations in farm crop production. (Cooperative with the Division of Agronomy and Plant Genetics) (M. J. Thompson, H. K. Hayes, H. K. Wilson, A. C. Arny, R. F. Crim)

Subproject: Grain variety tests.
Subproject: Legume studies.
Subproject: Hay crops not legume.
Subproject: Crop rotations.
Subproject: Fertilization. (Closed)
Subproject: Corn improvement.
Subproject: Sunflower improvement.
Subproject: Outlying field tests.
Subproject: Crop succession. (Dormant)
Subproject: Seeding and cultural practices.
Subproject: Sunflower cultural studies. (Closed)

102. Experiments in general horticulture. (Cooperative with the Division of Horticulture) (M. J. Thompson, F. A. Krantz, T. M. Currence, A. E. Hutchins)

Subproject: Cooperative orchard experiment. (Old)
Subproject: Cooperative orchard experiment. (New)
Subproject: Garden fertilizers. (Dormant)
Subproject: Variety testing—small fruits.
Subproject: Variety testing—vegetables.
Subproject: Seed improvement.
Subproject: Windbreak.
Subproject: Root crops.
Subproject: Raspberry fertilizer test. (New)

103. Investigations in potato culture. (Cooperative with the Division of Horticulture) (M. J. Thompson, F. A. Krantz)

Subproject: Variety tests.
Subproject: Spray studies.
Subproject: Rotations.
Subproject: Complete fertilizer.
Subproject: Potato breed plots.

Subproject: Rate of manuring.
Subproject: Clover utilization.
Subproject: Continuous cropping.
Subproject: Mosaic determinations.
Subproject: Date of harvest.
Subproject: Deep tillage.
Subproject: Special fertilizer studies. (New)

104. Investigations in animal husbandry. (Cooperative with the Divisions of Agronomy and Plant Genetics, Dairy Husbandry, Animal and Poultry Husbandry, Soils, and Veterinary Medicine) (M. J. Thompson, C. P. Fitch, F. J. Alway, A. C. Arny)

Subproject: Heifers on roughage and pasture.
Subproject: Abortion control through blood test.
Subproject: Quack grass control with sheep. (Dormant) (Closed)
Subproject: Pasture studies with cattle and sheep.

105. Studies in soil fertility. (Cooperative with the Division of Soils) (M. J. Thompson, F. J. Alway, G. H. Nesom)

Subproject: Continuous cropping without clover or manure.
Subproject: Rate of manuring.
Subproject: Complete fertilizers on potatoes, hay, grain.
Subproject: Clover utilization.
Subproject: Garden fertilization.
Subproject: Pasture fertilization.
Subproject: Sunflower fertilization.
Subproject: Rutabaga fertilization.
Subproject: Fertilization of rotation plots.
Subproject: Fruit land fertilization.
Subproject: Cooperative work with county agents and Smith-Hughes instructors.
Subproject: Clover failure.
Subproject: Special potato fertilization.
Subproject: Nitrogen on grasses.

106. Investigations in farm engineering. (Cooperative with the Division of Agricultural Engineering) (M. J. Thompson, A. J. Schwantes) (New)

Subproject: Studies in exposure of field stone through heaving or erosion.
Subproject: Studies in stoning land.
Subproject: Studies in stone utilization.
Subproject: Studies in deep tillage.

Northwest Station

101. Tree, shrub, and flour investigations. (Cooperative with the Division of Horticulture) (T. M. McCall)

Subproject: Growth and hardiness tests of ornamental and windbreak trees.

Subproject: Variety and hardiness tests of ornamental shrubs and trees.
Subproject: Variety and hardiness tests of perennial and other flowers.

102. Root crop investigations. (Cooperative with the Division of Soils, Minnesota Agricultural Experiment Station, and the Office of Sugar Plant Investigations, Bureau of Plant Industry, United States Department of Agriculture) (T. M. McCall)

Subproject: Variety tests of mangels. (Dormant) (Closed)
Subproject: Variety tests of stock carrots. (Dormant) (Closed)
Subproject: Variety tests of rutabagas. (Dormant) (Closed)
Subproject: Variety tests of turnips. (Dormant) (Closed)
Subproject: Methods of culture of root crops. (Closed)
Subproject: Demonstration planting of mangel varieties.
Subproject: Variety and culture test of sugar beet varieties.

103. Crop rotation and soil management studies. (Cooperative with the Division of Soils) (F. J. Alway, R. S. Dunham, T. M. McCall)

Subproject: Continuous cropping of corn.
Subproject: Continuous cropping of wheat alone and wheat with red and alsike clover.
Subproject: Comparison of sweet clover and cultivated crops in rotation for weed control.

106. Potato investigations. (Cooperative with the Divisions of Agricultural Engineering and Horticulture) (T. M. McCall)

Subproject: Variety testing.
Subproject: Tuber and leaf diseases.
Subproject: Methods of planting.
Subproject: Fertilizer tests—soil improvement.
Subproject: Seed selection.
Subproject: Rotation tests.

107. Fruit investigations. (Cooperative with the Division of Horticulture) (T. M. McCall)

Subproject: Variety and hardiness tests of small fruits.
Subproject: Variety and hardiness tests of tree fruits.

108. Garden crop investigations. (T. M. McCall)

Southeast Station

103. Maintaining a herd of grade Milking Shorthorn cows to observe production of beef and butterfat under farm conditions. (R. E. Hodgson)

104. A study of line breeding as a method of fixing desired characters in Milking Shorthorn cattle. (Cooperative with the Divisions of

Animal and Poultry Husbandry and Veterinary Medicine, Minnesota Agricultural Experiment Station, and the Bureau of Animal Industry, United States Department of Agriculture) (R. E. Hodgson, W. H. Peters, C. P. Fitch)

106. Growth studies of common varieties of trees in southern Minnesota. (Cooperative with the Division of Forestry) (R. E. Hodgson)

West Central Station

101. Bush and tree fruit investigations. (J. A. Anderson)

102. The testing of trees and ornamentals for western Minnesota conditions. (Cooperative with the Division of Horticulture) (J. A. Anderson)

104. The cultivation of alfalfa in relation to hay production, seed production, disease resistance, and duration of life of the stand. (Cooperative with the Division of Agronomy and Plant Genetics) (R. O. Bridgford, A. C. Arny)

105. Crop rotation investigations. (Cooperative with the Divisions of Agronomy and Plant Genetics and Soils) (F. J. Alway, A. C. Arny, R. O. Bridgford)

Subproject: Utilization of sweet clover.

Subproject: A three-year rotation of oats, clover, corn, applying six tons of manure per acre preceding corn.

Subproject: A five-year rotation of oats, sweet clover, corn, flax, wheat for hay, applying ten tons of manure preceding corn.

106. The effect of nitrogen, phosphate, and potash fertilizers on non-leguminous crops. (Cooperative with the Division of Soils) (F. J. Alway, R. O. Bridgford)

107. Sweet clover as a source of nitrogen. (Cooperative with the Divisions of Agronomy and Plant Genetics and Soils) (R. O. Bridgford, F. J. Alway, A. C. Arny)

108. The suitability of open range shelters for rearing pullets. (A. W. Edson)

SUMMARY OF PROJECTS

Division	Total	Active	Dormant	Closed	New
Agricultural Biochemistry	12	12	0	0	0
Agricultural Economics	23	18	5	3	1
Agricultural Engineering	20	19	1	1	1
Agronomy and Plant Genetics	27	26	1	1	0
Animal and Poultry Husbandry	18	16	2	6	4
Dairy Husbandry	13	11	2	1	1
Entomology and Economic Zoology	30	29	1	3	3
Forestry	18	16	2	1	5
Home Economics	8	7	1	0	1
Horticulture	19	19	0	1	0
Plant Pathology and Botany	23	21	2	0	2
Rural Sociology	5	5	0	0	3
Soils	13	13	0	0	0
Veterinary Medicine	4	4	0	0	0
General	10	10	0	1	3
North Central Station	4	4	0	0	0
Northeast Station	5	5	0	0	1
Northwest Station	6	6	0	0	0
Southeast Station	3	3	0	0	0
West Central Station	7	7	0	0	0
Total	268	251	17	18	25

FINANCIAL STATEMENT

Expenditures

Classification	University Farm	Branch Stations					Total
		Crookston	Morris	Grand Rapids	Duluth	Waseca	
Salaries and labor	$403,551.67	$21,405.96	$20,819.45	$10,568.81	$ 7,923.60	$ 9,876.36	$474,145.85
Stationery and office supplies	2,967.16	430.60	323.18	78.10	128.20	49.89	3,977.13
Scientific supplies	18,111.83	223.54	403.11	144.87	61.65	82.19	19,027.19
Feeding stuffs	16,056.52	2,730.62	2,607.87	1,580.13	2,285.55	1,214.69	26,475.36
Fertilizers	21.39	.....	.....	.....	.....	.....	21.39
Sundry supplies	5,504.73	867.69	1,412.77	492.61	861.99	1,235.67	10,375.46
Communication service	2,675.79	326.82	285.09	168.40	151.41	126.33	3,733.84
Travel expenses	7,884.71	177.91	194.28	241.21	297.69	34.68	8,830.48
Transportation of things	1,153.69	141.99	208.28	133.66	17.73	48.79	1,704.14
Printing	1,628.07	450.93	98.18	80.33	14.25	.12	2,271.88
Heat, light, water, and power	12,255.28	2,140.47	2,882.09	1,110.26	682.60	514.65	19,585.35
Contingent expenses	2,322.66	360.45	300.99	571.84	248.04	440.43	4,244.41
Furniture, furnishings, and fixtures	2,122.86	348.34	87.67	.....	.....	149.61	2,708.48
Library	2,402.42	8.08	.....	1.49	.....	.....	2,411.99
Scientific equipment	6,998.59	20.31	.....	78.02	.....	.....	7,096.92
Tools, machinery, and appliances	7,928.25	3,004.51	1,483,85	887.56	313.00	1,668.69	15,285.86
Livestock	3,123.01	15.00	1,298.99	124.33	57.00	.....	4,618.33
Buildings and land	17,360.74	435.21	999.92	1,211.18	221.28	689.16cr	19,539.17
Total	$514,069.37	$33,088.43	$33,405.72	$17,472.80	$13,263.99	$14,752.92	$626,053.23

FINANCIAL STATEMENT

Revenue

Source of revenue	University Farm	Branch Stations					Total
		Crookston	Morris	Grand Rapids	Duluth	Waseca	
Federal appropriations:							
Hatch fund	$ 15,000.00	.....	.....	.....	.....	.....	$ 15,000.00
Adams fund	15,000.00	.....	.....	.....	.....	.....	15,000.00
Purnell fund	60,000.00	.....	.....	.....	.....	.....	60,000.00
Bankhead-Jones fund	28,398.82	.....	.....	.....	.....	.....	28,398.82
State appropriations:							
General University support	238,417.69	$24,356.30	$24,102.26	$14,582.41	$ 9,185.78	$ 4,974.42	315,618.86
Special appropriations	41,000.00	.....	.....	.....	.....	.....	41,000.00
Endowments, fellowships, and other similar grants	7,554.00	.....	.....	.....	.....	.....	7,554.00
Fees	883.75	.....	.....	.....	.....	.....	883.75
Sales and miscellaneous	21,249.18	8,732.13	9,303.46	2,890.39	4,078.21	9,778.50	56,031.87
Emergency funds	81,265.93	.....	.....	.....	.....	.....	81,265.93
United States Department of Agriculture funds for cooperation	5,300.00	.....	.....	.....	.....	.....	5,300.00
Total	$514,069.37	$33,088.43	$33,405.72	$17,472.80	$13,263.99	$14,752.92	$626,053.23

EXPERIMENT STATION STAFF

The Board of Regents

The Hon. LOTUS D. COFFMAN, PRESIDENT	ex officio
The Hon. JULIUS A. COLLER, Shakopee	1937
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The Hon. ALBERT PFAENDER, New Ulm	1941
The Hon. RAY QUINLIVAN, St. Cloud	1939
The Hon. RUFUS R. RAND, Jr., Minneapolis	1937
The Hon. FRED B. SNYDER, Minneapolis	1941
The Hon. JOHN G. WILLIAMS, Duluth	1941

The Agricultural Committee

The Hon. A. J. OLSON, Chairman
The Hon. O. J. HAGEN
The Hon. FRANK W. MURPHY
The Hon. A. E. OLSON
The Hon. ALBERT PFAENDER
The Hon. J. G. WILLIAMS

Administrative Officers

W. C. COFFEY, M.S., LL.D., Director
F. W. PECK, M.S., Vice-Director
W. T. MIDDLEBROOK, B.A., M.C.S., Treasurer
A. A. DOWELL, Ph.D., Superintendent, Northwest Experiment Station, Crookston
P. E. MILLER, M.Agr., Superintendent, West Central Experiment Station, Morris
R. L. DONOVAN, B.S., Superintendent, North Central Experiment Station, Grand Rapids
M. J. THOMPSON, M.S., Superintendent, Northeast Experiment Station, Duluth
R. E. HODGSON, M.S., Superintendent, Southeast Experiment Station, Waseca
F. E. HARALSON, Assistant Superintendent, Fruit Breeding Farm, Zumbra Heights
RAPHAEL ZON, F.E., Director, Forest Experiment Station, Cloquet
H. L. HARRIS, B.S., Editor
HARRIET W. SEWALL, B.A., Librarian
R. A. GORTNER, Ph.D., Chief, Division of Agricultural Biochemistry
O. B. JESNESS, Ph.D., Chief, Division of Agricultural Economics
WILLIAM BOSS, Chief, Division of Agricultural Engineering
H. K. HAYES, D.Sc., Chief, Division of Agronomy and Plant Genetics
W. H. PETERS, M.Agr., Chief, Division of Animal and Poultry Husbandry
J. B. FITCH, M.S., Chief, Division of Dairy Husbandry
W. A. RILEY, Ph.D., Chief, Division of Entomology and Economic Zoology
HENRY SCHMITZ, Ph.D., Chief, Division of Forestry
W. B. MCNEAL, M.A., Chief, Division of Home Economics
W. H. ALDERMAN, B.S.A., Chief, Division of Horticulture

E. M. FREEMAN, Ph.D., Chief, Division of Plant Pathology and Botany
F. J. ALWAY, Ph.D., Chief, Division of Soils
C. P. FITCH, D.Sc., D.V.M., Chief, Division of Veterinary Medicine

Division of Agricultural Economics

O. B. JESNESS, Ph.D., Agricultural Economist
W. C. WAITE, Ph.D., Agricultural Economist
G. A. POND, Ph.D., Associate Agricultural Economist
*E. C. JOHNSON, Ph.D., Associate Agricultural Economist
†A. A. DOWELL, Ph.D., Agricultural Economist
L. B. BASSETT, Associate Agricultural Economist
R. W. COX, Ph.D., Assistant Agricultural Economist
‡G. A. SALLEE, M.S., Assistant in Agricultural Economics
W. P. RANNEY, M.S., Assistant in Agricultural Economics
§H. F. HOLLANDS, B.S., Assistant in Agricultural Economics
E. F. KOLLER, M.A., Assistant in Agricultural Economics
S. A. ENGENE, B.S., Assistant in Agricultural Economics
R. C. BEVAN, B.S., Assistant in Agricultural Economics
||HARRY TRELOGAN, M.S., Assistant in Agricultural Economics
¶R. H. LOREAUX, B.S., Field Agent
**F. E. WETHERILL, Field Agent

* Resigned March 15, 1937.
† Appointed April 1, 1937.
‡ On leave July 1, 1936 to June 30, 1937.
§ Resigned August 22, 1936.
|| Appointed August 23, 1936.
¶ Resigned February 27, 1936.
** Appointed March 1, 1937.

Division of Agricultural Engineering

WILLIAM BOSS, Agricultural Engineer

Section of Farm Power and Machinery

A. J. SCHWANTES, M.S., Associate Agricultural Engineer
J. B. TORRANCE, B.S., Assistant Agricultural Engineer
*JULIUS ROMNESS, M.A., Assistant Agricultural Engineer
A. G. TYLER, B.S., Assistant Agricultural Engineer
J. G. DENT, Assistant in Agricultural Engineering
†ANDREW HUSTRULID, Ph.D., Assistant Agricultural Engineer
‡J. E. SHUMWAY, Assistant in Agricultural Engineering

Section of Farm Structures

H. B. WHITE, M.S., Assistant Agricultural Engineer
C. H. CHRISTOPHERSON, M.A., Assistant in Agricultural Engineering
§L. W. NEUBAUER, M.S.C.E., Assistant in Agricultural Engineering

Section of Reclamation

H. B. ROE, C.E., Agricultural Engineer
||J. H. NEAL, A.E., Assistant Agricultural Engineer
¶O. W. Howe, B.S., Assistant in Agricultural Engineering
P. W. MANSON, B.S., Assistant in Agricultural Engineering

Section of Land Clearing

M. J. THOMPSON, M.S., Associate Land Clearing Specialist

Detailed by the United States Department of Agriculture for Co-operative Work
Bureau of Agricultural Engineering

D. G. MILLER, C.E., Senior Drainage Engineer
N. A. KESSLER, B.S. in For., Associate Land Clearing Specialist
O. W. HOWE, B.S., Assistant Agricultural Engineer

* Died January 22, 1937.
† Appointed March 16, 1937.
‡ Appointed September 1, 1936.
§ On leave July 1 to September 30, 1936.
‖ On leave September 1, 1936 to June 30, 1937.
¶ Resigned March 31, 1937.

Division of Agronomy and Plant Genetics

*H. K. HAYES, D.Sc., Agronomist and Plant Geneticist
H. K. WILSON, Ph.D., Associate Agronomist
†A. C. ARNY, M.S., Associate Agronomist
F. R. IMMER, Ph.D., Associate Geneticist
I. J. JOHNSON, Ph.D., Assistant Plant Geneticist
R. F. CRIM, B.S., Assistant Agronomist and Extension Specialist in Agronomy
W. M. MYERS, B.S., Assistant in Agronomy
H. K. SCHULTZ, M.S., Assistant in Agronomy
C. R. BORGESON, M.S., Assistant in Agronomy
D. C. ANDERSON, M.S., Assistant in Plant Genetics

* Sabbatical leave April 1, 1936 to March 31, 1937.
† On leave June 26 to September 30, 1937.

Detailed by the United States Department of Agriculture for Co-operative Work

Division of Cereal Crops and Diseases

E. R. AUSEMUS, Ph.D., Associate Agronomist
J. O. CULBERTSON, M.S., Assistant Agronomist

Division of Animal and Poultry Husbandry

W. H. PETERS, M.Agr., Animal Husbandman
P. A. ANDERSON, B.S., Assistant Animal Husbandman
A. L. HARVEY, M.S., Assistant Animal Husbandman

Section of Animal Feeding

E. F. FERRIN, M.Agr., Animal Husbandman
D. W. JOHNSON, Ph.D., Assistant in Animal Husbandry

Section of Animal Genetics

L. M. WINTERS, Ph.D., Animal Husbandman
*R. T. CLARK, Ph.D., Assistant in Animal Genetics
R. E. COMSTOCK, M.S., Assistant in Animal Genetics

* Resigned April 30, 1937.

W. W. GREEN, M.S., Assistant in Animal Genetics
CATHERINE BARRETT, B.S., Assistant in Animal Genetics

Section of Poultry Husbandry

H. J. SLOAN, Ph.D., Poultry Husbandman
T. H. CANFIELD, B.S., Assistant in Poultry Husbandry

Division of Agricultural Biochemistry

ROSS AIKEN GORTNER, Ph.D., D.Sc., Agricultural Biochemist

Section of Proteins and Colloids

ROSS AIKEN GORTNER, Ph.D., D.Sc., Agricultural Biochemist
WILLIAM M. SANDSTROM, Ph.D., Assistant Agricultural Biochemist
*D. R. BRIGGS, Ph.D., Associate Agricultural Biochemist

Section of Cereal Technology and Analytical Service

C. H. BAILEY, Ph.D., Agricultural Biochemist
R. C. SHERWOOD, Ph.D., Assistant Agricultural Biochemist
M. C. MARKLEY, Ph.D., Assistant in Agricultural Biochemistry
WESLEY STELLER, B.S., American Soya Products Fellow
O. E. STAMBERG, M.S., American Dry Milk Institute Fellow —
G. S. TAYLOR, B.A., Analyst
J. W. NELSON, M.S., Analyst

Section of Plant Chemistry

C. F. ROGERS, M.S., Assistant Agricultural Biochemist

Section of Nutrition and Dairy Chemistry

L. S. PALMER, Ph.D., Dairy Chemist
CORNELIA KENNEDY, Ph.D., Associate Agricultural Biochemist

* Appointed September 16, 1936.

Division of Dairy Husbandry

J. B. FITCH, M.S., Dairy Husbandman

Section of Dairy Production

J. B. FITCH, M.S., Dairy Husbandman
W. E. PETERSEN, Ph.D., Associate Dairy Husbandman
T. W. GULLICKSON, Ph.D., Assistant Dairy Husbandman
N. N. ALLEN, Jr., Ph.D., Assistant in Dairy Husbandry

Section of Dairy Products

W. B. COMBS, M.A., Dairy Husbandman
S. T. COULTER, Ph.D., Assistant Dairy Husbandman
F. E. NELSON, Ph.D., Assistant in Dairy Husbandry

Section of Dairy Bacteriology

HAROLD MACY, Ph.D., Dairy Bacteriologist

Division of Entomology and Economic Zoology

W. A. RILEY, Ph.D., D.Sc., Entomologist and Parasitologist
A. G. RUGGLES, M.A., Entomologist
M. C. TANQUARY, Ph.D., Apiculturist
C. E. MICKEL, Ph.D., Associate Entomologist
A. A. GRANOVSKY, Ph.D., Associate Entomologist
H. H. SHEPARD, Ph.D., Assistant Entomologist
A. C. HODSON, Ph.D., Assistant in Entomology
M. H. HAYDAK, Ph.D., Assistant in Entomology
*R. T. KING, M.A., Assistant in Economic Zoology
D. M. HATFIELD, M.A., Assistant in Economic Zoology

* Resigned April 15, 1937.

Division of Forestry

HENRY SCHMITZ, Ph.D., Forester
E. G. CHEYNEY, A.B., Forester
J. H. ALLISON, M.F., Forester
T. S. HANSEN, M.F., Associate Forester
R. M. BROWN, M.S., Assistant Forester
L. W. REES, Ph.D., Assistant Forester
*FRANK KAUFERT, Ph.D., Assistant in Forestry
R. W. LORENZ, B.S., Assistant in Forestry
RAPHAEL ZON, F.E., Director, Forest Experiment Station, Cloquet
†A. J. BAILEY, Ph.D., Assistant Forester

* Resigned November 30, 1936.
† Appointed December 16, 1936.

Division of Home Economics

W. B. MCNEAL, M.A., Home Economist
ALICE BIESTER, M.S., Associate Home Economist
A. M. CHILD, M.A., Associate Home Economist
J. M. LEICHSENRING, Ph.D., Associate Home Economist
E. L. PHELPS, M.S., Assistant Home Economist
EVA DONELSON, Ph.D., Assistant in Home Economics

Division of Horticulture

W. H. ALDERMAN, B.S.A., Horticulturist
*R. B. HARVEY, Ph.D., Horticulturist

Section of Pomology

W. G. BRIERLEY, Ph.D., Horticulturist

Section of Fruit Breeding

A. N. WILCOX, Ph.D., Assistant Horticulturist
ERNEST ANGELO, Ph.D., Assistant in Horticulture
F. E. HARALSON, Assistant Superintendent, State Fruit Breeding Farm

Section of Vegetable Gardening

F. A. KRANTZ, Ph.D., Associate Horticulturist
T. M. CURRENCE, Ph.D., Assistant Horticulturist

A. E. HUTCHINS, Ph.D., Assistant in Horticulture
A. G. TOLAAS, M.A., Assistant Horticulturist

Section of Floriculture and Ornamental Horticulture

L. E. LONGLEY, Ph.D., Assistant Horticulturist
L. SANDO, Assistant in Floriculture

* On leave July 1, 1936 to June 30, 1937.

Division of Plant Pathology and Botany

E. M. FREEMAN, Ph.D., Plant Pathologist and Botanist

Section of Plant Pathology

*E. C. STAKMAN, Ph.D., Plant Pathologist
J. G. LEACH, Ph.D., Associate Plant Pathologist
*J. J. CHRISTENSEN, Ph.D., Associate Plant Pathologist
LOUISE DOSDALL, Ph.D., Mycologist
†HELEN HART, Ph.D., Assistant Plant Pathologist
C. J. EIDE, Ph.D., Assistant in Plant Pathology
C. M. CHRISTENSEN, M.S., Assistant in Plant Pathology
‡C. P. SHUMWAY, M.S., Assistant in Plant Pathology
M. B. MOORE, M.S., Assistant in Plant Pathology
E. K. VAUGHAN, M.S., Assistant in Plant Pathology
§E. W. HANSON, B.S., Firestone Plantations Company Fellow
‖M. F. KERNKAMP, B.S., Assistant in Plant Pathology
¶T. H. KING, B.S., Firestone Plantations Company Fellow

Section of Plant Physiology and Agricultural Botany

**R. B. HARVEY, Ph.D., Plant Physiologist and Botanist
A. C. VOGELE, Ph.D., Assistant Plant Physiologist
A. H. LARSON, B.S., Assistant Botanist
R. H. LANDON, Ph.D., Assistant in Plant Physiology

Detailed by the United States Department of Agriculture for Co-operative Work
Bureau of Plant Industry

Division of Cereal Crops and Diseases

M. N. LEVINE, Ph.D., Pathologist
††R. H. BAMBERG, Ph.D., Agent
‡‡E. W. HANSON, B.S., Agent

* Cooperating with the Division of Plant Disease Control, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.
† On leave May 1 to June 30, 1937.
‡ Resigned September 30, 1936.
§ Resigned February 15, 1937.
‖ Appointed September 5, 1936.
¶ Appointed March 8, 1937.
** On leave July 1, 1936 to June 30, 1937.
†† Resigned February 1, 1937.
‡‡ Appointed February 16, 1937.

Division of Sugar Plant Investigations

E. L. LeClerg, Ph.D., Assistant Pathologist

Bureau of Entomology and Plant Quarantine

Division of Plant Disease Control

R. U. Cotter, Ph.D., Associate Pathologist
L. W. Melander, Ph.D., Associate Pathologist (State Leader of Barberry Eradication)
R. C. Cassell, M.S., Agent

Detailed by the State Department of Agriculture for Co-operative Work

A. G. Tolaas, M.S., in Charge, Office of Seed Potato Certification
Ruby Crouley, Seed Analyst
J. L. Larson, In Charge, Seed Germination

Division of Soils

F. J. Alway, Ph.D., D.Sc., Soils Chemist
C. O. Rost, Ph.D., Soils Chemist
P. R. McMiller, M.S., Assistant Soils Chemist
G. H. Nesom, B.S., Extension Specialist in Soils

Division of Veterinary Medicine

C. P. Fitch, D.V.M., D.Sc., Animal Pathologist and Bacteriologist
W. L. Boyd, D.V.S., Veterinarian
H. C. H. Kernkamp, D.V.M., Associate Veterinarian
R. Fenstermacher, D.V.M., Assistant Pathologist
*W. H. Roepke, Ph.D., Assistant Pathologist
L. M. Bishop, M.S., Assistant in Animal Pathology
B. S. Pomeroy, D.V.M., Assistant in Animal Pathology

* Appointed September 14, 1936.

Rural Sociology

*R. W. Murchie, Ph.D., Rural Sociologist

* Died April 20, 1937.

Northwest Experiment Station

*A. A. Dowell, Ph.D., Superintendent
†T. M. McCall, M.S., Superintendent
R. S. Dunham, M.S., Assistant Agronomist
O. M. Kiser, M.S., Assistant Animal Husbandman
R. J. Christgau, B.S.Agr., Assistant Animal Husbandman
A. M. Pilkey, Assistant in Poultry Husbandry
E. R. Clark, M.S., Pure Seed Specialist

* Resigned March 31, 1937.
† Appointed April 1, 1937.

West Central Experiment Station

P. E. Miller, M.Agr., Superintendent
P. S. Jordan, B.S.Agr., Assistant Animal Husbandman
A. W. Edson, B.S., Assistant Poultry Husbandman
R. O. Bridgford, M.S., Assistant Agronomist
J. A. Anderson, B.S.Agr., Assistant Horticulturist
T. H. Fenske, B.S., Assistant Animal Husbandman

North Central Experiment Station

R. L. Donovan, B.S.Agr., Superintendent
O. W. Swenson, Assistant in Agronomy
A. F. Dahlberg, B.S., Assistant in Poultry Husbandry
C. L. Cole, M.S., Assistant in Animal and Dairy Husbandry
T. S. Weir, B.S.Agr., Assistant in Horticulture and Entomology

Northeast Experiment Station

M. J. Thompson, M.S., Superintendent

Southeast Experiment Station

R. E. Hodgson, M.S., Superintendent