

The University of Minnesota

THIRTY-FIRST ANNUAL
REPORT OF THE
AGRICULTURAL EXPERIMENT STATION

JULY 1, 1922, TO JUNE 30, 1923



UNIVERSITY FARM, ST. PAUL.

LETTERS OF TRANSMITTAL

MINNEAPOLIS, MINN.,

JULY 1, 1923

To His Excellency, J. A. O. Preus,

Governor of Minnesota.

SIR: I have the honor to transmit to you herewith the annual report of the Agricultural Experiment Station of the University of Minnesota for the fiscal year ending June 30, 1923.

Respectfully,

FRED B. SNYDER,

President of the Board of Regents

UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.,

JULY 1, 1923

The Hon. Fred B. Snyder,

President of the Board of Regents, University of Minnesota.

SIR: 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, 1923.

Respectfully,

LOTUS D. COFFMAN,

President of the University of Minnesota

UNIVERSITY FARM, ST. PAUL, MINN.,

JULY 1, 1923

Lotus D. Coffman,

President of the University of Minnesota.

SIR: I have the honor to hand you herewith the annual report of the Agricultural Experiment Station for the fiscal year ending June 30, 1923.

Respectfully,

W. C. COFFEY, *Director*

THE BOARD OF REGENTS

The Hon. FRED B. SNYDER, Minneapolis	- - - - -	1928
The President of the Board		
LOTUS D. COFFMAN, Minneapolis	- - - - -	<i>Ex Officio</i>
The President of the University		
The Hon. J. A. O. PREUS, St. Paul	- - - - -	<i>Ex Officio</i>
The Governor of the State		
The Hon. J. M. McCONNELL, St. Paul	- - - - -	<i>Ex Officio</i>
The Superintendent of Education		
The Hon. MILTON M. WILLIAMS, Little Falls	- - - - -	1925
The Hon. William J. MAYO, Rochester	- - - - -	1925
The Hon. GEORGE H. PARTRIDGE, Minneapolis	- - - - -	1926
The Hon. EGIL BOECKMANN, St. Paul	- - - - -	1927
The Hon. ALICE WARREN, Minneapolis	- - - - -	1927
The Hon. JOHN G. WILLIAMS, Duluth	- - - - -	1927
The Hon. A. D. WILSON, Guthrie	- - - - -	1928
The Hon. PIERCE BUTLER, St. Paul	- - - - -	1928
The Hon. J. E. G. SUNDBERG, Kennedy	- - - - -	1929

AGRICULTURAL COMMITTEE

The Hon. MILTON M. WILLIAMS, Chairman	
The Hon. ALICE WARREN	The Hon. A. D. WILSON
The Hon. J. G. WILLIAMS	The Hon. J. E. G. SUNDBERG
The Hon. J. M. McCONNELL	President L. D. Coffman

THE STATION STAFF

ADMINISTRATIVE OFFICERS

W. C. COFFEY, M.S., Director
 ANDREW BOSS, Vice-Director
 F. W. PECK, M.S. in Agr., Director of Agricultural Extension and Farmers' Institutes
 C. G. SELVIG, M.A., Superintendent, Northwest Substation, Crookston
 P. E. MILLER, M.Agr., Superintendent, West Central Substation, Morris
 O. I. BERGH, B.S.Agr., Superintendent, North Central Substation, Grand Rapids
 M. J. THOMPSON, M.S., Superintendent, Northeast Substation, Duluth
 R. E. HODGSON, B.S. in Agr., Superintendent, Southeast Substation, Waseca
 *CHARLES HARALSON, Superintendent, Fruit Breeding Farm, Zumbra Heights (P. O. Excelsior)
 †FRED HARALSON, Assistant Superintendent, Fruit Breeding Farm, Zumbra Heights (P. O. Excelsior)
 G. H. WIGGIN, B.S., Assistant Superintendent, Forest Experiment Station, Cloquet
 W. P. KIRKWOOD, M.A., Editor
 ALICE McFEELY, Assistant Editor of Bulletins
 HARRIET W. SEWALL, B.A., Librarian
 T. J. HORTON, Photographer

* Resigned January, 1923.

† Appointed January, 1923.

DIVISION OF AGRONOMY AND FARM MANAGEMENT

ANDREW BOSS, Agriculturist

Section of Plant Breeding

H. K. HAYES, Ph.D., Plant Breeder
 FRED GRIFFEE, M.S., Assistant Plant Breeder
 H. E. BREWBAKER, B.S., Research Assistant

Section of Farm Crops

A. C. ARNY, M.S., Associate Agronomist
 F. W. MCGINNIS, M.S., Assistant Agronomist
 F. H. STEINMETZ, M.S., Assistant Agronomist
 F. L. HIGGINS, B.S., Graduate Assistant
 C. S. DORCHESTER, B.S., Graduate Assistant

Section of Co-operative Seed Production and Distribution

ANDREW BOSS, Agriculturist
 A. D. HAEDECKE, Assistant in Agronomy
 R. F. CRIM, B.S., Extension Specialist in Agronomy

Section of Cost Accounting

G. A. POND, M.S., Assistant Agriculturist
 R. C. ENGBERG, B.S., Assistant
 A. T. HOVERSTAD, B.S., Assistant

Section of Farm Organization

ANDREW BOSS, Agriculturist
 L. B. BASSETT, Associate Agriculturist
 L. F. GAREY, M.A., Assistant in Farm Management

DIVISION OF AGRICULTURAL BIOCHEMISTRY

ROSS AIKEN GORTNER, Ph.D., Agricultural Biochemist

Section of Proteins and Colloids

ROSS AIKEN GORTNER, Ph.D., Agricultural Biochemist
 WALTER F. HOFFMAN, M.S., Assistant Biochemist

Section of Cereal Technology and Analytical Service

C. H. BAILEY, Ph.D., Associate Agricultural Biochemist
 R. C. SHERWOOD, Assistant Agricultural Biochemist
 G. S. TAYLOR, B.A., Analyst
 *†A. H. JOHNSON, B.S., Special Analyst and Streitmann Fellow
 *AKSEL G. OLSEN, Fleischmann Fellow

Section of Plant Chemistry

J. J. WILLAMAN, Ph.D., Plant Chemist
 C. A. MORROW, Ph.D., Assistant Agricultural Biochemist
 *‡G. O. BURR, M.S., Research Assistant
 *‡F. R. DAVISON, B.S., Research Assistant
 A. K. ANDERSON, M.S., Assistant Agricultural Biochemist

Section of Nutrition and Dairy Chemistry

LEROY S. PALMER, Ph.D., Dairy Chemist
 CORNELIA KENNEDY, Ph.D., Assistant Agricultural Biochemist
 *§H. M. HARSHAW, B.S., Research Assistant
 O. MYDLAND, Animal Caretaker

* Part-time appointee.

† Resigned April 1, 1923, to accept Streitmann Fellowship.

‡ Special assistant in Corn Sirup Investigation.

§ Resigned August 15, 1922.

DIVISION OF AGRICULTURAL ECONOMICS

JOHN D. BLACK, Ph.D., Agricultural Economist
*H. B. PRICE, Ph.D., Assistant Economist
*HOLBROOK WORKING, Ph.D., Assistant Economist
*†P. L. MILLER, M.A., Research Assistant
B. A. HOLT, M.A., Research Assistant
W. C. WAITE, M.A., Research Assistant
EDWIN GAUMNITZ, M.A., Research Assistant
C. F. CLAYTON, M.A., Research Assistant
‡E. C. JOHNSON, B.S., Research Assistant
‡CHARLES M. ARTHUR, B.S., Research Assistant

DIVISION OF ANIMAL HUSBANDRY

W. H. PETERS, M.Agr., Animal Husbandman

Section of Horse Husbandry

W. H. PETERS, M.Agr., Animal Husbandman

Section of Beef Cattle Husbandry

§N. K. CARNES, M.S., Assistant Animal Husbandman
A. L. HARVEY, B.S., Assistant in Beef Cattle Husbandry

Section of Swine Husbandry

E. F. FERRIN, M.Agr., Assistant Animal Husbandman
M. A. McCARTY, B.S., Assistant in Swine Husbandry

Section of Sheep Husbandry and Meats

P. A. ANDERSON, B.S., Assistant Animal Husbandman

DIVISION OF BEE CULTURE

FRANCIS JAGER, Apiculturist
G. C. MATTHEWS, Assistant Apiculturist

DIVISION OF DAIRY HUSBANDRY

C. H. ECKLES, M.S., D.Sc., Dairy Husbandman

Section of Dairy Products

J. R. KEITHLEY, M.S.A., Dairy Husbandman
*C. D. DAHLE, M.S., Assistant Dairy Husbandman
*J. C. HENING, B.S., Assistant in Dairy Husbandry

Section of Dairy Production

C. H. ECKLES, M.S., D.Sc., Dairy Husbandman
A. B. RAYBURN, B.S., Assistant Dairy Husbandman
*T. W. GULLICKSON, M.S., Assistant Dairy Husbandman
*L. M. THURSTON, B.S., Assistant in Dairy Husbandry

Section of Dairy Bacteriology

HAROLD MACY, B.S., Assistant Bacteriologist

* Part-time appointee.
† Resigned December 31, 1922.
‡ Appointed January 1, 1923.
§ Resigned April, 1923.

DIVISION OF ENTOMOLOGY AND ECONOMIC ZOOLOGY

W. A. RILEY, Ph.D., Entomologist and Parasitologist
A. G. RUGGLES, M.A., Entomologist (State Entomologist)
F. L. WASHBURN, M.A., Economic Zoologist
R. N. CHAPMAN, Ph.D., Associate Entomologist, Stored Products Insect Investigations
H. H. KNIGHT, Ph.D., Assistant Entomologist in charge of Collections
*L. V. FRANCE, M.S. in Agr., Research Assistant in Entomology
†J. R. PARKER, M.S., Research Assistant in Entomology
S. A. GRAHAM, Ph.D., Research Assistant, Forest Insect Investigations
PAUL GILMER, M.S., Research Assistant in Insecticidal Investigations
C. E. MICKEL, M.S., Research Assistant in Entomology
W. E. HOFFMANN, B.A., Assistant in Entomology
GIRARD DIKMANS, D.V.M., Assistant in Entomology
JOHN EYER, M.S., Assistant in Entomology

DIVISION OF FARM ENGINEERING

WILLIAM BOSS, Agricultural Engineer

Section of Agricultural Physics

E. A. STEWART, B.S., Associate Agricultural Physicist

Section of Drainage

H. B. ROE, B.S.E., Associate Agricultural Engineer
G. R. B. ELLIOTT, Assistant Agricultural Engineer

Section of Farm Buildings

H. B. WHITE, B.S., Assistant Agricultural Engineer

Section of Farm Mechanics

J. B. TORRANCE, B.S., Assistant Agricultural Engineer

Section of Land Clearing

‡M. J. THOMPSON, M.S., Associate in Land Clearing Investigations
A. J. SCHWANTES, Assistant in Land Clearing Investigations

DIVISION OF FORESTRY

E. G. CHEYNEY, B.A., Forester
J. P. WENTLING, M.A., Associate Forester
J. H. ALLISON, M.F., Associate Forester
G. H. WIGGIN, B.S. in For., Assistant Forester at Cloquet
T. S. HANSEN, B.S. in For., Assistant Forester at Cloquet
S. S. BURTON, B.S., Assistant
L. L. DEFLOM, B.S., Assistant

DIVISION OF HORTICULTURE

W. H. ALDERMAN, B.S., Horticulturist

Section of Pomology

W. G. BRIERLEY, M.S., Associate Horticulturist
J. A. MIDDLETON, B.S., Assistant in Horticulture
BURGESS NIGHTINGALE, M.S., Assistant in Horticulture

* Resigned September 30, 1922.
† Appointed October 1, 1922.
‡ Part-time appointee.

Section of Fruit Breeding

J. H. BEAUMONT, B.S., Assistant Horticulturist
A. N. WILCOX, M.S., Assistant Horticulturist

Section of Vegetable Gardening

W. T. TAPLEY, M.S., Assistant Horticulturist
F. A. KRANTZ, M.S., Assistant Horticulturist
JOHN W. BUSHNELL, M.S., Assistant Horticulturist

Section of Floriculture and Landscape Gardening

LEROY CADY, B.S., Associate Horticulturist
L. SANDO, Florist

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., Assistant Plant Pathologist
*J. J. CHRISTENSEN, M.S., Assistant Plant Pathologist
LOUISE DOSDALL, Ph.D., Mycologist
J. L. SEAL, M.S., Assistant Plant Pathologist
*A. W. HENRY, M.S.A., Assistant Plant Pathologist
HENRY HECKER, B.S., Assistant in Plant Pathology
*C. R. HURSH, B.S., Assistant in Plant Pathology
R. M. NELSON, B.S., Assistant in Plant Pathology
H. H. FLOR, B.S., Assistant in Plant Pathology

Section of Plant Physiology

R. B. HARVEY, Ph.D., Associate Plant Physiologist
L. O. REGELMBAL, B.S., Assistant in Plant Physiology
I. L. CONNERS, M.A., Assistant in Plant Physiology
FRANK M. EATON, Assistant in Plant Physiology

Section of Seed Laboratory

A. H. LARSON, B.S., Seed Analyst
HENRY C. GILBERT, B.S., Assistant

DIVISION OF POULTRY HUSBANDRY

A. C. SMITH, B.S., Poultry Husbandman

DIVISION OF SOILS

F. J. ALWAY, Ph.D., Soils Chemist
CLAYTON O. ROST, Ph.D., Associate Soils Chemist
PAUL R. McMILLER, M.S., Assistant Soils Chemist
GEORGE H. NESOM, B.S., Assistant Soils Chemist
G. B. BODMAN, M.S., Assistant
WILLIAM METHLEY, Assistant
REUBEN PINCKNEY, M.S., Assistant
ERNEST FIEGER, Ph.D., Assistant
SKULI HRUTFIORD, B.Sc., Field Assistant
LUELLE E. GRANGAARD, Assistant

* Co-operating with the Office of Cereal Investigations, Bureau of Plant Industry,
United States Department of Agriculture.

DIVISION OF VETERINARY MEDICINE

C. P. FITCH, M.D., D.V.M., Animal Pathologist and Bacteriologist
W. L. BOYD, D.V.S., Assistant Veterinarian
H. C. H. KERNKAMP, D.V.M., Assistant Veterinarian
M. H. REYNOLDS, D.V.M., Veterinarian
EARL A. HEWITT, D.V.M., Assistant Veterinarian
*WILLIAM A. BILLINGS, D.V.M., Assistant Pathologist
†R. E. LUBBEHUSEN, D.V.M., Assistant Pathologist

* Transferred to Division of Agricultural Extension October 1, 1922.

† Appointed January 1, 1923.

**THIRTY-FIRST ANNUAL REPORT
OF THE
AGRICULTURAL EXPERIMENT STATION**

W. C. COFFEY, Director

FINANCIAL STATEMENT

THE MINNESOTA AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH THE UNITED STATES
APPROPRIATIONS, 1921-1922

CONTENTS	Page
Financial statement	11
United States appropriations.....	11
Supplementary statement	11
Disbursements	12
Report of the director.....	13
Changes in staff	13
Publications	14
Experiment station regular series.....	14
Technical series	15
Annual report series.....	15
Agricultural extension bulletins	16
Special series	16
Circular series	17
Journal series	17
Summary and classification of projects.....	30

Dr.		
To receipts from the Treasurer of the United States in accordance with the appropriation for the fiscal year ending June 30, 1922, under the Act of Congress approved March 2, 1887.....	\$15,000.00	
Cr.		
By salaries	\$15,000.00	\$15,000.00
Total Hatch Fund.....	\$15,000.00	\$15,000.00

Dr.		
To receipts from the Treasurer of the United States in accordance with the appropriation for the fiscal year ending June 30, 1922, under the Act of Congress approved March 16, 1906.....	\$15,000.00	
Cr.		
By salaries	\$15,000.00	\$15,000.00
Total Adams Fund.....	\$15,000.00	\$15,000.00

ABSTRACT I—SALARIES

	Hatch Fund	Adams Fund
Director and other administrative officers.....	\$3,000.00	
Scientific staff	10,500.00	\$14,675.00
Assistants to scientific staff.....	1,450.00	200.00
Special and temporary services.....	50.00	125.00
Total	\$15,000.00	\$15,000.00

SUPPLEMENTARY STATEMENT

To receipts from other sources than the United States for the year ending June 30, 1922:	
State appropriations	\$386,748.48
Sales of farm products, etc.....	43,057.98
Total	\$429,806.46

DISBURSEMENTS

	University Farm	Crookston substation	Morris substation	Grand Rapids substation	Duluth substation	Waseca substation	Zumbra Heights substation	Total
Salaries	\$146,450.44	\$14,064.31	\$12,381.73	\$3,465.00	\$2,025.00	\$1,800.00	\$1,537.50	\$181,723.98
Labor	65,448.94	692.72	6,099.26	7,774.77	6,361.62	4,296.78	6,012.93	96,687.02
Publications	4,211.86	412.47	442.79	.....	102.03	.....	.....	5,229.15
Postage and stationery	6,565.67	1,383.81	876.99	208.65	200.85	160.53	78.03	9,474.53
Freight and express	1,634.37	269.38	255.46	190.62	80.55	118.05	60.72	2,609.15
Heat, light, water, & power ..	13,581.74	2,822.52	2,843.77	633.81	1,368.83	483.96	689.16	21,191.79
Chemicals and lab. supplies ..	26,193.51	5.23	138.69	109.50	19.08	.....	.....	26,466.01
Seeds, plants, and sundry supplies	4,154.14	663.94	631.97	240.78	375.72	292.71	48.33	6,407.59
Fertilizers	50.80	.....	.....	.....	.....	.....	.....	50.80
Feeding stuffs	9,819.87	1,683.73	1,354.01	3,327.75	1,894.26	878.64	74.61	19,032.87
Library	1,072.17	149.25	100.44	.....	9.00	.....	.....	1,330.86
Tools, machinery, and appliances	2,244.18	890.72	849.34	1,030.41	355.50	196.05	631.47	6,197.67
Furniture and fixtures	2,261.93	269.33	649.05	17.07	30.99	30.60	.....	3,258.97
Scientific apparatus and specimens	1,684.39	.....	12.50	.....	.....	.....	.....	1,696.89
Livestock	5,517.50	1,876.42	1,998.37	16.86	53.61	393.75	.....	8,866.51
Traveling expenses	3,544.74	404.19	222.77	363.18	210.99	130.95	.....	4,876.82
Contingent expenses	6,932.68	1,365.85	1,365.96	1,302.06	1,581.84	1,501.71	683.91	14,734.01
Buildings and land	15,372.44	998.46	1,982.38	1.53	911.97	484.98	220.08	19,971.84
Total	\$316,741.37	\$27,952.33	\$31,305.48	\$18,681.99	\$14,409.84	\$10,678.71	\$10,036.74	\$429,806.46

REPORT OF THE DIRECTOR

During the year satisfactory progress has been made in the work of the experiment station. With more than one hundred fifty projects filed with the director it is evident that a full program of research has been under way. It has not been possible, however, to take up all the problems which the station has been asked to investigate. Nor has it been possible to attack all the fundamental problems which clearly belong in a research program but for which a solution has not been requested by forces outside the research staff. The need of research in agriculture was never more apparent than at the present time and one of the serious problems confronting the station in the face of limited resources is the wise selection of lines of investigation. A genius for selecting timely problems of research is second in importance only to the ability necessary to attack these problems in such manner as to secure a product that will bear up under scientific interpretation.

CHANGES IN STAFF

Agricultural Biochemistry.—Arnold H. Johnson resigned as special analyst to receive appointment as Streitmann Fellow in Cereal Chemistry. The employment of George O. Burr and F. R. Davison as research assistants terminated with the completion of the cornstalk sirup investigations. Dr. Burr was appointed research associate in physiological chemistry at the University of California. Mr. Davison was appointed research assistant in plant physiology at this station. The employment of H. M. Harshaw as research assistant terminated with the completion of the yeast nutrition investigations. He was appointed assistant agricultural chemist at the Missouri station.

Agronomy and Farm Management.—C. S. Dorchester was appointed assistant in agronomy to fill the position formerly occupied by P. B. Barker; F. L. Higgins was appointed assistant in agronomy to fill the vacancy caused by the resignation of H. R. Pettigrove; A. T. Hoverstad was appointed assistant in farm management to fill the vacancy caused by the resignation of C. G. Worsham.

Animal Husbandry.—N. K. Carnes resigned as assistant animal husbandman in charge of beef cattle investigations, in April, 1923; H. W. Vaughan was appointed to fill the vacancy July 1, 1923.

Dairy Husbandry.—E. O. Anderson resigned as assistant in dairy husbandry and J. C. Hening was appointed to fill the vacancy; Carl W. Huffman resigned as assistant in dairy husbandry and Lloyd M. Thurston was appointed in his place.

Entomology and Economic Zoology.—J. R. Parker was appointed assistant in entomology to fill the vacancy caused by the resignation of L. V. France. Miss L. E. Krough resigned as assistant in entomology and Girard Dikmans was appointed to take her place.

Horticulture.—Charles Haralson, Superintendent of the State Fruit Breeding Farm at Zumbra Heights, resigned his position January 1, 1923; Fred E. Haralson, horticultural foreman at University Farm, was appointed to fill the vacancy at the fruit farm as assistant superintendent March 1, 1923.

Plant Pathology and Botany.—The following men resigned during the year: L. I. Knight, plant physiologist; H. D. Barker, assistant plant pathologist; D. L. Bailey, assistant in plant pathology; E. B. Lambert, assistant in plant pathology; C. L. Farabaugh, assistant plant physiologist; Alice Reynolds, in charge of germination. The following appointments were made: Henry Hecker, assistant in plant pathology; A. W. Henry, assistant plant pathologist; Harold Flor, assistant in plant pathology; R. M. Nelson, assistant in plant pathology; F. M. Eaton, assistant in plant physiology; I. L. Conners, assistant in plant physiology; F. R. Davison, assistant in plant physiology.

Soils.—J. E. Chapman resigned as field assistant, June 30, 1922, to accept the position of assistant professor of soils in the North Dakota Agricultural College. Skuli Hrutfiord was appointed to the position. G. B. Bodman was appointed assistant in soils, October 15, 1922. Mrs. Margaret Welch resigned as assistant September 30, 1922, and Miss Luella Grangaard was appointed to the position thus made vacant.

Veterinary Medicine.—Dr. W. A. Billings, assistant pathologist, was transferred during the year to the Agricultural Extension Division, as Veterinary Specialist; Dr. R. E. Lubbehusen, of the Agricultural Experiment Station, Fargo, N. D., was appointed to take his place. Mrs. Ruth Dikmans was appointed technician in September, 1922.

PUBLICATIONS

The following publications have been issued during the year.

EXPERIMENT STATION REGULAR SERIES

No. 200. Cattle Feeding Investigations, by W. H. Peters and N. K. Carnes, Division of Animal Husbandry. 33 pages, 10,000 edition.

No. 201. Organization and Management of Livestock Shipping Associations in Minnesota, by E. A. Gaumnitz and J. D. Black, Division of Agricultural Economics. 78 pages, 8,000 edition.

No. 202. Farmers' Co-operation in Minnesota, 1917-22, by H. B. Price, Division of Agricultural Economics. 78 pages, 7,000 edition.

No. 203. Second Growth on St. Louis County Cut-over Lands, by T. S. Hansen, Division of Forestry. 52 pages, 5,000 edition.

No. 204. Wheat and Flax as Combination Crops, by A. C. Arny, Division of Agronomy and Farm Management. 24 pages, 7,000 edition.

TECHNICAL SERIES

No. 6. Comparison of First Generation Tomato Crosses with Their Parents, by R. Wellington, formerly of the Division of Horticulture. 28 pages, 3,000 edition.

No. 7. Inheritance and Yield with Particular Reference to Rust Resistance and Panicle Type in Oats, by R. J. Garber, Division of Agronomy and Farm Management. 62 pages, 3,000 edition.

No. 8. Determination of Biologic Forms of *Puccinia graminis* on *Triticum sp.*, by E. C. Stakman and M. N. Levine, Division of Plant Pathology and Botany. 10 pages, 3,000 edition.

No. 9. Sale Price as a Basis for Farm Land Appraisal, by G. C. Haas, Division of Agricultural Economics. 32 pages, 3,000 edition.

No. 10. Factors Determining the Prices of Potatoes in Minneapolis and St. Paul, by Holbrook Working, Division of Agricultural Economics. 42 pages, 3,000 edition.

No. 11. Studies on the Parasitism of *Helminthosporium sativum*, by J. J. Christensen, Division of Plant Pathology and Botany. 52 pages, 3,000 edition.

No. 12. Studies in the Physical Ecology of the Noctuidae, by W. C. Cook, Division of Entomology and Economic Zoology. 40 pages, 3,000 edition.

No. 13. The Normal and Pathological Histology of the Ventriculus of the Honey Bee, with Special Reference to Infection with *Nosema apis*, by Marshall Hertig, Division of Entomology and Economic Zoology. (Reprint from the Journal of Parasitology.) 40 pages, 700 edition.

No. 14. The Parasitism of *Colletotrichum lindemuthianum*, by J. G. Leach, Division of Plant Pathology and Botany. 58 pages, 3,000 edition.

No. 15. Damping-off Disease of Coniferous Seedlings, by the Divisions of Forestry and Plant Pathology and Botany. 36 pages, 3,000 edition.

ANNUAL REPORT SERIES

Thirtieth Annual Report of the Agricultural Experiment Station, 1921-22. 150 pages, 2,500 edition.

Report of Northwest Substation, Crookston, by C. G. Selvig, Superintendent. 102 pages, 3,000 edition.

Report of West Central Substation, Morris, by P. L. Miller, Superintendent. 56 pages, 1,500 edition.

Report of Southeast Substation, Waseca, by R. E. Hodgson, Superintendent. 500 edition (Multigraphed).

AGRICULTURAL EXTENSION BULLETINS
SPECIAL SERIES

No. 64. The Dairy Cow as a Market for Labor, by W. L. Cavert, Division of Agricultural Extension; and G. A. Pond, Division of Agronomy and Farm Management. 8 pages, 10,000 edition.

No. 65. Making a Living on a Timber Farm, by W. L. Cavert, Division of Agricultural Extension. 12 pages, 15,000 edition.

No. 66. Farm Building Plans, by H. B. White, Division of Farm Engineering. 8 pages, 15,000 edition.

No. 67. Benefits of Drainage, by H. B. Roe, Division of Farm Engineering. 20 pages, 7,500 edition.

No. 68. The Dying Balsam Fir and Spruce in Minnesota, by S. A. Graham, Division of Entomology and Economic Zoology. 12 pages, 7,500 edition.

No. 69. The Home Vegetable Garden, by R. S. Mackintosh, Division of Agricultural Extension. (Reprint from the Minnesota Horticulturist.) 16 pages, 5,000 edition.

No. 70. Dusting Seed Grain to Prevent Smut, by E. C. Stakman and E. B. Lambert, Division of Plant Pathology and Botany. 12 pages, 10,000 edition.

No. 71. What Farm Women are Thinking, by G. A. Lundquist, Department of Sociology. 24 pages, 10,000 edition.

No. 72. Modern Strawberry Growing, by Franc P. Daniels, Division of Horticulture. 20 pages, 10,000 edition.

No. 73. Habits and Activities of Bees, by Francis Jager, Division of Bee Culture. 20 pages, 10,000 edition.

No. 74. Care and Feeding of Swine, by E. F. Ferrin, Division of Animal Husbandry. 16 pages, 10,000 edition.

No. 75. Dairy Improvement Through Cow Testing Associations, by E. A. Hansen, Division of Agricultural Extension. 16 pages, 10,000 edition.

No. 76. Canning Meats, by Genevieve B. Meybohm, Division of Agricultural Extension. 8 pages, 15,000 edition.

No. 77. How Fairfield Kept Farm Accounts, by W. L. Cavert, Division of Agricultural Extension. 8 pages, 10,000 edition.

Reprints

No. 57. Pruning the Apple, by R. S. Mackintosh, Division of Agricultural Extension; and Burgess Nightingale, Division of Horticulture. 8 pages, 10,000 edition.

No. 59. Planning the Farm Business, by W. L. Cavert, Division of Agricultural Extension. 8 pages, 6,000 edition.

CIRCULAR SERIES

No. 8. Storing Potatoes in a Pit, by P. E. Clement. (Reprint from Farmers' Institute Annual No. 32.) 2 pages, 5,000 edition.

No. 9. The Home Spray Calendar, by A. G. Ruggles, Division of Entomology and Economic Zoology; and R. C. Rose, Division of Agricultural Extension. 4 pages, 5,000 edition.

No. 10. Requeening the Apiary, by Francis Jager, Division of Bee Culture. 2 pages, 2,500 edition.

No. 11. Testing Milk on the Farm by the Babcock Method, by C. D. Dahle, Division of Dairy Husbandry. 4 pages, 5,000 edition.

No. 12. Testing Cream for Butterfat by the Babcock Method, by C. D. Dahle, Division of Dairy Husbandry. 8 pages, 5,000 edition.

No. 13. How Should Grape Vines Be Pruned? by W. H. Alderman, Division of Horticulture. (Reprint from the Minnesota Horticulturist.) 4 pages, 10,000 edition.

No. 14. Poisoning Pocket Gophers, by C. E. Mickel, Division of Entomology and Economic Zoology. 4 pages, 10,000 edition.

No. 15. Building up a Dairy Herd Under Farm Conditions, by O. I. Bergh, North Central Substation. 4 pages, 10,000 edition.

MISCELLANEOUS

Nineteenth Report, State Entomologist, by A. G. Ruggles. 152 pages, 4,500 edition.

Poster for Seed Corn Week, 7,000; for picric acid, 1,500; for Farmers' and Homemakers' Week, 5,000; for dairy improvement, 3,000; for Boys' and Girls' Week, 1,000; announcements for Farmers' and Homemakers' Week, 60,000.

Reprints of The Garment Making Project, 44 pages, 10,000; and The Bread Making Project, 16 pages, 7,000, for Boys' and Girls' Club Work.

Weekly News Letter, 52 issues, 1000 each.

Extension Service News, 8 pages, 12 issues, 1,500 each.

Among Ourselves, established in December, 1922, for the editors of the state, 7 issues, 700 each.

JOURNAL SERIES

Sixty-nine articles were approved for publication during the year in the Journal series. Of these, forty-one appeared in print. Eighteen articles approved for publication the preceding year were published.

Following is a brief summary of the articles that were published.

No. 266. "Production of High Protein Maize by Mendelian Methods," by H. K. Hayes. In *Genetics*, Vol. 7 (May, 1922), pp. 237-257.

Protein content in maize is inherited in much the same way as other characters which are dependent for their full expression on many different inherited factors of the plant and likewise upon environmental conditions. The results indicate that improved varieties of maize may be obtained by the isolation of desirable self-fertilized lines and the subsequent crossing of the lines to produce

improved varieties. The method suggested is to recombine several promising self-fertilized lines and then to practice field selection for desirable stalks and ears.

No. 267. "Inheritance of Kernel and Spike Characters in Crosses Between Varieties of *Triticum Vulgare*," by H. K. Hayes. In *Studies in the Biological Sciences*, No. 4; pp. 163-183. 1923.

In the hybrid families of a cross between Marquis, which is awnless, and Preston, which is bearded, a comparison of the average length of seed, average percentage plumpness of seed, and average yield of plant was correlated with presence or absence of awn. The bearded plants and families were somewhat superior to the awnless plants and families in the three characters studied. The awn of wheat is therefore an important organ, and the present tendency to breed only awnless wheat should not be adopted in entirety without further experimental studies.

No. 272. "Biochemistry of Plant Diseases IV. Effect of the Brown Rot Fungus on Plums," by J. J. Willaman and F. R. Davison. In *Botanical Gazette*, Vol. LXXIV, No. 1 (Sept. 1922), pp. 104-109.

Plum tissue rotted by *Sclerotinia cinerea* has a consistently higher ash, calcium nitrogen, and fat content than normal tissue, owing probably to loss of dry matter by greater respiration in the infected samples. The varieties that are resistant to the fungus are conspicuously higher in fiber than the susceptible ones, indicating that the physical structure of the tissue may be a deciding factor in resistance.

No. 277. "Studies on Wheat Flour Grades III. Effect of Chlorine Bleaching upon the Electrolytic Resistance and Hydrogen-Ion Concentration of Water Extract," by C. H. Bailey and Arnold Johnson. In *Journal of Association of Official Agricultural Chemists*, Vol. VI, No. 1, (1922), pp. 63-68.

Specific conductivity of water extracts of wheat flour increased regularly with increasing dosages of chlorine used in bleaching the flour. Hydrogen-ion concentration was also increased in the same manner. Actual change in pH by chlorine treatment was due not only to quantity of chlorine used, but also to buffer action in flour, which is correlated with ash content and grade of flour.

No. 279. "A Revision of Rosanoff's Diagram of the Aldose Sugars," by J. J. Willaman and C. A. Morrow. In *Journal of the American Chemical Society*, Vol. XLV, No. 5 (May, 1923), pp. 1273-1280.

The paper consists essentially of 3 diagrams, containing all the known aldoses, ketoses, and methyl aldoses, respectively, and showing for each sugar its structural formula, occurrence, specific rotation, and derivatives.

No. 283. "Studies on the Temperature of Individual Insects, with Special Reference to the Honey Bee," by Gregor B. Pirsch. In *Journal of Agricultural Research*, Vol. XXIV, No. 4 (April 28, 1923), pp. 275-287.

The literature on the subject is first reviewed at some length in connection with seventeen references. The methods employed and the body temperatures of bees observed are reported, the detail being given in part in tabular form. The studies have led to the following conclusions:

"The average body temperature of the bee is 4.7 degrees C. above that of the surrounding air when the air temperature is 5.5 degrees, and coincides with the air temperature when that is between 35 and 44 degrees. At 52 degrees or above, the temperature of the bee's body is lower than that of the air if not exposed to the high temperature for a long period of time. The maximum fatal temperature of bees is about 46 to 48 degrees and the freezing point is about -1 degree. There is no appreciable difference between the body temperature of the Carniolan and the Italian bees. Bees are not wholly subject to the temperature of their environment, but are capable within certain limits of regulating their body temperature. The ability of a colony to regulate its temperature is undoubtedly due to the ability of the individual to regulate its body temperature plus the ability to regulate and conserve the heat produced."

No. 298. "A Study of Permanence of Variety in the Potato," by Fred A. Krantz. In *Journal of Agricultural Research*, Vol. XXIII, No. 12 (March 24, 1923), pp. 947-961.

This is a report of the result of four years' work in Minnesota with seven lots of Early Ohio potatoes, obtained from different regional sources. No differences could be ascertained between the seven lots when grown under the same conditions. As the different lots had been obtained from different environments and two of them subjected to mass selection for 20 years, the author concludes that potato varieties are relatively stable under vegetative propagation, and that the main value of individual hill and tuber-unit selection lies in the elimination of varietal mixtures and disease.

No. 300. "Wheat Stem Rust from the Standpoint of Plant Breeding," by H. K. Hayes and E. C. Stakman. In *Minutes of Annual Meeting of Western Canadian Society of Agronomy* (Dec. 27, 1921), 14 pages.

The occurrence of biologic forms of stem rust of wheat has furnished a logical explanation for the conflicting views regarding the stability and adaptability of the wheat rust parasite. Disease resistance in plants is inherited in the same way as are other plant characters. After learning the number and prevalence of biologic forms of stem rust, the forms obtained should be used in definite attempts to build up wheat varieties resistant to all forms of stem rust.

No. 313. "*Ips pini* Say as a Primary Pest of Jack Pine," by S. A. Graham. In *Canadian Entomologist* (May, 1922), pp. 99-100.

This paper describes a small outbreak of *Ips pini* Say in which a group of jack pine trees was killed. The insects were apparently attracted to the locality by the presence of several freshly felled trees. As there was not sufficient space in the felled trees to accommodate the swarm of beetles, they attacked the surrounding standing trees.

No. 316. "Border Effect and Ways of Avoiding it," by A. C. Arny. In *Journal of American Society of Agronomy*, Vol. 14, No. 7 (July, 1922), pp. 266-278.

Border effect varied for different varieties. The removal of border rows changed the rank of varieties, compelling the conclusion that this operation was necessary in order to secure reliable results. Sowing two border rows of winter wheat on either side of each variety plot reduced but did not prevent border effect in spring grains.

No. 320. "An Analysis of Textbooks in Clothing and Textiles," by Ethel L. Phelps. In *Journal of Home Economics*, Vol. XIV, Nos. 10 and 12 (October and December, 1922), 14 pages.

A study to show the development of subject matter in clothing and textiles as determined by textbooks, and to ascertain the persistence and recurrence of fundamental topics developed by the 43 available texts in this field in 1921.

No. 322. "A Rapid Method for the Determination of the Moisture Content of Expressed Plant Tissue Fluids," by R. A. Gortner and W. F. Hoffman. In *Botanical Gazette*, Vol. LXXIV, No. 3 (November, 1922), pp. 308-313.

The moisture content of expressed plant sap can be rapidly and accurately determined by use of the Abbe refractometer.

No. 323. "A Method for the Estimation of the Hydrophilic Colloid Content of Expressed Plant Tissue Fluids," by Robert Newton and R. A. Gortner. In *Botanical Gazette*, Vol. LXXIV, No. 4 (December, 1922), pp. 442-446.

The hydrophilic colloid content of expressed plant sap can be estimated approximately by modifications of the standard physico-chemical methods for the determination of molecular weights.

No. 324. "The Care of Morning Milk before Pasteurization," by Harold Macy. In *Journal of Dairy Science*, Vol. V, No. 5 (September, 1922), pp. 502-506.

A study was made to determine the changes in bacterial content of milk produced and handled under average farm conditions, during the first few hours after milking, without cooling.

The results indicated that it was not advisable to hold morning's milk for several hours before pasteurization without cooling, unless it was produced and handled with the most careful sanitary precautions.

No. 326. "The Cultivation of *Bact abortus* Bang," by C. P. Fitch. In *Journal of Infectious Diseases*, Vol. XXXI, No. 3 (September, 1922), pp. 233-236.

Horse serum beef infusion agar with a Ph 6.8-7.2 is excellent for cultivating *Bact. abortus* Bang.

The serum agar cultures develop rapidly in an atmosphere of 10 per cent carbon dioxide and hydrogen.

This method of growing *Bact abortus* has given the most uniform and satisfactory results.

No. 327. "A Statistical Investigation of the Quantity Theory of Money," by Holbrook Working. In *Quarterly Journal of Economics*, Vol. XXXVII (February, 1923), pp. 228-256,—under title "Prices and the Quantity of Circulating Medium 1890-1921."

Two propositions involved in current quantity theory are taken as hypotheses to be subjected to statistical test; (1) That the volume of trade and the velocity of circulation of money change gradually so that the requirements for circulating medium in a progressive society show a relatively steady upward trend; and (2) that any deviation of the actual volume of circulating medium from this necessary amount will be accompanied by an equal change in the general price level. The trend of the quantity of circulating medium required for the United States since 1890 is calculated, and the deviations of the actual quantity from this trend are computed and compared with the fluctuations of the general price level. For the period from 1890 to 1916 the correspondence is found to be very close, with the changes in the price level coming about a year after the changes in the quantity of circulating medium. The war period shows discrepancies which remain unexplained.

No. 328. "The Identification of the Bovine by Means of Nose Prints," by W. E. Peterson. In *Journal of Dairy Science*, Vol. V, No. 3 (May, 1922), pp. 249-258.

The bovine is found to have a definite nose pattern that can be transferred to paper in much the same manner that finger prints are. It was also found that no two animals had the same pattern and that nose prints can be used as a means of positive identification. It is pointed out that nose prints will have a practical application particularly in official testing of breeds that are of solid color.

No. 329. "Breeding Oats Resistant to Stem Rust," by Fred Griffiee. In *Journal of Heredity*, Vol. XIII, No. 4 (April, 1922), pp. 187-190.

The method used for differentiating heterozygous and homozygous F_2 plants in breeding for rust resistance, when resistance is a dominant character, is to grow in the greenhouse F_3 seedling families from each resistant F_2 plant. These seedlings are inoculated with rust and from their reaction the F_2 plants which are homozygous for resistance are determined. In breeding oats resistant to stem rust, 192 of the 567 F_3 seedling families tested bred true for resistance.

No. 330. "Growth of Plants in Artificial Light," by R. B. Harvey. In *Botanical Gazette*, Vol. LXXIV, No. 4 (December, 1922), pp. 447-451.

Plants of great variety were grown from seed to seed in artificial light alone. This was the first time this was ever accomplished altho tried many times by other workers. The requirements of light intensity were determined, making possible installations for commercial development of the use of artificial light in plant culture. The results are of importance in breeding plants in northern regions in which sunlight is of low intensity in winter.

No. 331. "Concrete Drain Tile: Investigations into the Effect upon Concrete Drain Tile of the Products of Organic Decomposition in Soils Containing a High Percentage of Vegetable Matter." In *Journal of Agricultural Research*, Vol. XXIV, No. 6 (May 12, 1923), pp. 471-500, under title "Effect of Organic Decomposition Products from High Vegetable Content Soils upon Concrete Drain Tile." By G. R. B. Elliott.

Studies were carried on in the laboratories of the Minnesota and Wisconsin experiment stations and in different marsh and peat soils in the two states. Concrete tile disintegrated in bogs in which the soil water in winter was strongly alkaline, and tile retained its alkalinity even to the point of ultimate disintegration. After grinding, the nearly disintegrated tile reset on being moistened with water.

The reaction of organic matter with the concrete formed gelatinous compounds which were soluble in water carrying carbonic acid. Organic acids reacted with neat cement and the quantity of such organic compounds increased as decomposition proceeded. Field studies showed that concrete tile as at present made break down in all peat soils in the presence of water. A high percentage of lime was found to delay but not to stop disintegration.

No. 332. "Effects of Self-Fertilization in Timothy," by H. K. Hayes and H. D. Barker. In *Journal of the American Society of Agronomy*, Vol. XIV, No. 8 (November, 1922), pp. 289-293.

Clonal lines of timothy differed widely in their ability to produce seed under conditions of self-pollination or cross-pollination within a line. This was probably due to genetic causes, as there was marked correlation between the percentage of seed set under various conditions. Five out of eleven first-year selfed strains gave some albino seedlings in their progeny.

No. 334. "Some Fungi Causing Root and Foot Rots of Cereals," by Louise J. Stakman. In *Studies in the Biological Sciences*, No. 4, pp. 139-155. 1923. Magazine also appears under name "*Minnesota Studies in Plant Science*."

A large number of fungi were isolated from soil, seed, and various plant parts. An attempt was made to ascertain whether they were pathogenic to cereals. Nine were found to be quite pathogenic. Many others weakened the plants after they already had been injured by other fungi. A detailed description of the pathogenic forms, together with their histological relations to the host, is given in the bulletin.

No. 335. "Varietal Differences in Hardiness," by R. B. Harvey. In *Ecology*, Vol. III, No. 2 (April, 1922), pp. 134-139. Under title "Varietal Differences in the Resistance of Cabbage and Lettuce to Low Temperatures."

A method was described for testing the resistance of common varieties of cabbage and lettuce to low temperatures. The data reported give reliable information on the varieties best adapted for planting under conditions in which frosts are likely to occur.

No. 338. "Inheritance of Flower Types and Fertility in the Strawberry," by W. D. Valleau. In *American Journal of Botany*, X (May, 1923), pp. 259-274.

Five groups of seedlings based on parentage were studied. Results indicate that inheritance of sex in the strawberry is in accord with the chromosome theory of inheritance; the hermaphrodite plants being homozygous for sex determiners and the male and female plants heterozygous. The factor femaleness carries linked with it a factor maleness which is suppressed. The factor maleness is linked with a factor femaleness which is suppressed. The hermaphrodite is the assumed primitive condition in which no sex factors are suppressed. Sterility occurs in certain female clones and hermaphrodite clones in which crossing over is assumed to occur between the linked male and female determiners.

No. 339. "Determination of Secular Trend Reconsidered," by Holbrook Working. In *Quarterly Publication of the American Statistical Association* (December, 1922), pp. 497-502.

In statistical computations it is generally found desirable after fitting a line of secular trend to make use of percentage deviations instead of absolute deviations from the trend line. This paper considers a method developed by W. L. Crum for fitting a straight line secular trend so that the sum of the squares of the percentage deviations shall be a minimum, and concludes that wherever a linear trend is justified, Professor Crum's method gives results which do not differ substantially from those obtained by the usual method, which is much shorter.

No. 340. "A Ropy Milk Organism Isolated from the Finnish 'Piima' or 'Fiili,'" by Harold Macy. In *Journal of Dairy Science*, Vol. VI, No. 2 (March, 1923), pp. 127-130.

The description of a hitherto undescribed species of ropy milk organism is given. This organism was isolated from a sample of the Finnish ropy milk beverage called "Piima" or "Fiili" which was brought to the laboratory by a student.

No. 341. "Yeast as a Source of Vitamin B for Growth of Rats," by Cornelia Kennedy and Leroy S. Palmer. In *Journal of Biological Chemistry*, Vol. LIV, No. 2 (October, 1922), pp. 217-232.

Considerable variation is reported in different samples of commercial yeast as a source of vitamin B for growth. Rats confined to purified foods with yeast as the source of vitamin B did not reproduce normally and seldom reared their young.

No. 342. "The March of Hydrogen-Ion Concentration in Bread Doughs," by C. H. Bailey and R. C. Sherwood. In *Industrial and Engineering Chemistry*, Vol. XV, No. 6 (June, 1923), p. 624.

Hydrogen-ion concentration of bread dough increases regularly from the time the dough is mixed. Rate of change, in terms of pH, appears to be determined by (at least) the following factors: (a) buffer action of dough as influenced by the grade of flour; (b) consistency of the dough, controlled by the proportion of water in the batch; (c) temperature; (d) size or weight of dough batch;

(e) inclusion or absence of certain ingredients, such as Arkady. In terms of pH, there is a decrease of about 0.47 units in commercial straight doughs during a four-hour fermentation period.

No. 343. "Determination of Biologic Forms of *Puccinia graminis* on *Triticum spp.*," by E. C. Stakman and M. N. Levine. In *Technical Bulletin 8* (July, 1922), Minnesota Agricultural Experiment Station. 10 pages.

The bulletin describes the methods for identifying the thirty-eight biologic forms of *Puccinia graminis tritici* which had been found up to that time.

No. 344. "A New Peritropis from Michigan (*Heteroptera-Miridae*)," by H. H. Knight. In *Entomological News*, Vol. XXXIV (February, 1923), pp. 50-52.

Only one species of Peritropis was known from North America before the present paper was published.

No. 345. "The North American Species of Labops (*Heteroptera-miridae*)," by H. H. Knight. In *Canadian Entomologist* (November, 1922), pp. 258-261.

Two new species are described, making three species in the genus for North America.

No. 346. "Flour Strength as Influenced by the Addition of Diastatic Ferments," by F. A. Collatz. In *American Institute of Baking Bulletin No. 9* (August, 1922), 74 pages.

An extended study of malt extracts and malt flours as influencing baking quality of wheat flour.

No. 347. "The Diastatic Enzymes of Wheat Flour and Their Relation to Flour Strength," by L. A. Rumsey. In *The American Institute of Baking Bulletin No. 8* (August, 1922), 86 pages.

An elaborate study of diastatic enzymes in wheat flours of different grade and quality. Diastatic activity is one factor concerned in flour quality.

No. 348. "Investigations Concerning the Murdock Sewing Test and Scale," by Clara M. Brown. In *Teachers College Record* (November, 1922), pp. 459-470.

Report of a study to determine the value of the Murdock Hand Sewing Scale as a measuring instrument and the prophetic value of the Murdock Sewing Test as it relates to placement of pupils, the discovery of their abilities and difficulties, and its use in ascertaining when hand sewing is most advantageously begun. Proofs of the validity of the scale are offered and achievement and speed norms are given, ranging from the sixth grade to second year college.

No. 349. "A Study of Rust Resistance in a Cross Between Marquis and Kota," by H. K. Hayes and O. S. Aamodt. In *Journal of Agricultural Research*, Vol. XXIV, No. 12 (June 23, 1923), pp. 997-1012.

The resistance of Marquis to rust form XIX and the immunity of Kota from rust form XXVII were combined in three F₃ families out of a total of 372 families studied. This is further evidence in support of the belief that there are several genetic factors which determine the differential reactions of Marquis and Kota to the biologic forms in question. That the resistance of one parent to form XIX and the immunity of the other parent from form XXVII can be combined in a hybrid family, is added reason for the hope that resistance to all biologic forms can be obtained eventually.

No. 350. "Mode of Inheritance of Resistance to *Puccinia graminis* with Relation to Seed Color in Crosses Between Varieties of Durum Wheat," by J. B. Harrington and O. S. Aamodt. In *Journal of Agricultural Research*, Vol. XXIV, No. 12 (June 23, 1923), pp. 979-996.

A study was made of the parasitic capabilities of two biologic forms of wheat stem rust on F₃ progeny of crosses between durum wheat varieties. Results for Kubanka No. 8 × Pentad indicate two differential factors for reaction to form XXXIV. With Mindum × Pentad apparently a single main factor governs resistance to form XXXIV and a different factor controls resistance to form I. Some families were resistant to both forms. No relation was found between seed color and rust resistance.

No. 352. "Origin of the Humin Formed by the Acid Hydrolysis of Proteins VII. Hydrolysis in the Presence of Ketones," by R. A. Gortner and E. R. Norris. In *Journal of the American Chemical Society*, Vol. XLV, No. 2 (February, 1923), pp. 550-553.

Ketones are not a factor in the formation of the acid insoluble humin of a protein hydrolysate.

No. 353. "A Fourth Paper on the Species of Lopidea (*Heteroptera-miridae*)," by Harry H. Knight. In *Entomological News*, Vol. XXXIV (March, 1923), pp. 65-72.

In this paper descriptions and figures of the distinctive genitalia are given for 18 new species of Lopidea, also a figure of the heretofore unrecognized *Lopidea nigridea* Uhler.

No. 354. "Controlling Experimental Error in Nursery Trials," by H. K. Hayes. In *Journal of American Society of Agronomy*, Vol. 15, No. 5 (May, 1923), pp. 177-192.

Careful field experiments indicate that the rod-row method is a satisfactory means of obtaining preliminary yielding tests of new varieties of small grains. Three-row plots, each row approximately 16 feet long, the harvesting of the central row for the yield test, and the use of four systematically distributed plots has proved a desirable plan under the conditions prevailing at University Farm, St. Paul, Minn. Deviations from the mean of the variety and the combined use of such deviations in the calculation of a probable error have given probable

errors of about the same relative magnitude as obtained by calculating probable errors by the use of yields from check plots. The use of such probable errors as a means of learning the significance of any particular strain comparison appears to be justified from both the mathematical and the practical standpoints.

No. 355. "Biologic Forms of *Puccinia graminis* on varieties of *Avena spp.*," by E. C. Stakman, M. N. Levine, and D. L. Bailey. In *Journal of Agricultural Research*, Vol. XXIV, No. 12 (June 23, 1923), pp. 1013-1018.

The authors found that *Puccinia graminis avenae*, supposedly a single biologic form, actually consists of at least four forms which can be recognized by their parasitic behavior on three varieties of cultivated oats. Forms 1 and 2 appear to be fairly common in Canada, the United States, and Mexico. Forms 3 and 4 have not yet been found in North America. Form 3 was obtained from South Africa and form 4 was collected in Sweden. The variety White Tartar (White Russian), which Garber used as the resistant parent in producing an agronomically desirable rust-resistant variety, is very resistant to the American forms but not to the South African and Swedish forms. The forms apparently are genetically constant, altho their development is influenced by light intensity, temperature, and the physiologic condition of the host plant.

No. 356. "Observations on Cutting Methods in Norway Pine," by T. S. Hansen. In *Journal of Forestry*, Vol. XX, No. 8 (December, 1922), p. 851.

A short article based on the study of an acre plot where the stand of Norway pine had been removed in two steps and some seed trees left. The first opening of the stand was by a fire about fifty years ago, the second by cutting about fifteen years ago. The results seem to indicate that a partial cutting of Norway pine will secure natural reproduction of this species.

No. 357. "Influence of the Anti-neutritic Vitamin upon the Internal Organs of Single Comb White Leghorn Cockerels," by A. J. Souba. In *American Journal of Physiology*, Vol. LXIV, No. 1 (March, 1923), pp. 181-201.

It is reported in this paper that single comb white leghorn cockerels, on a diet deficient in vitamin B and apparently adequate in all other respects, show a decrease in the size and weight of internal organs in the following order: testes, spleen, heart, liver, kidneys, pancreas, and thyroid gland. In growing birds the testes fail to develop and then atrophy. The suprarenals undergo hypertrophy.

No. 358. "Reports on Cereal Foods," by C. H. Bailey. In *Journal of the Association of Official Agricultural Chemists*, Vol. VI, No. 1, pp. 60-63.

Fat content of dried bread and crackers was determined by seven collaborators, using two methods. Satisfactory agreement in results of analyses followed the use of one of the methods, which involved digestion of the material with ammoniacal alcohol, followed by extraction of the fat from the digest with several portions of ethyl ether. The extract, after drying, was re-extracted with a mixture of ethyl and petroleum ether, the second extract dried, and weighed.

No. 359. "The Application of Genetic Principles to Potato Breeding," by F. A. Krantz. In *Proceedings of the American Society for Horticultural Science*, 1922, pp. 124-129.

A report of the results obtained from a cross between the Sir Walter Raleigh and an unnamed variety of potato obtained from South America. The results reported show that the presence of sterility and the heterozygous condition of potato varieties complicate the problem of combining the desirable characters of parent varieties into a commercial variety, but that such combinations can be obtained if sufficiently large populations can be grown.

No. 360. "The Obligation that Economic Entomology Owes to Forestry," by S. A. Graham and A. G. Ruggles. In *Journal of Economic Entomology*, Vol. XVI, No. 1 (February, 1923). *11 pages*

In spite of the tremendous losses in our forests as a result of insect attacks, forest entomology has been and still is neglected. Entomologists have been prone to say, because the application of the usual method of mechanical insect control, as spraying, is not practical under forest conditions, that forest insects can not be controlled. Only in a few cases has a serious attempt to check a forest insect outbreak by natural means been made. Entomology owes forestry an obligation that should be paid, just as it is paying its obligation to horticulture and farm crops.

No. 361. "Apple Pollen Germination Studies," by J. H. Beaumont and L. I. Knight. In *Proceedings of the American Society for Horticultural Science*, 1922, pp. 151-163.

A culture medium containing 5 per cent sucrose and 1 per cent gelatine was used for germination of apple pollen. The addition of a stigma of any variety to the medium increased the average percentage of germination and the average amount of pollen tube growth occurring within twenty-four hours. No one variety of stigma was generally superior to others in increasing the percentage of germination, but McIntosh and Jonathan stigmas stimulated pollen tubes of all varieties to longer growth than did stigmas of Hibernial and Patten. Apple varieties differed in the production of effective pollen and in the ability of their pollen to produce long tubes within twenty-four hours.

No. 362. "A Preliminary Study of Field Plot Technic in Potato Yield Tests," by F. A. Krantz. In *Report of Potato Association of America*, 1922, pp. 42-44.

A preliminary report of a study on the relation of length of row and number of replications to the reduction of experimental error in potato yield tests. It was found that systematic replication of test was more effective than increasing the length of row.

No. 363. "Determination of Sulfur in Organic Compounds," by W. F. Hoffman and R. A. Gortner. In *Journal of American Chemical Society*, Vol. XLV, No. 4 (April, 1923), pp. 1033-1036.

The Folin-Denis method with slight modification is adapted to the determination of sulfur in all organic compounds except those which are readily volatile or which sublime easily.

No. 364. "Isolation of Uniform Types of Hubbard Squash by Inbreeding," by John W. Bushnell. In *Proceedings of the American Society for Horticultural Science*, 1922, pp. 139-144.

A preliminary report on the results from inbreeding Hubbard squash for the purpose of securing uniform, high-quality strains. A desirable strain was introduced to Minnesota seedsmen under the name of Kitchenette Hubbard. The author concludes that inbreeding is a valuable method for the improvement of normally open pollinated vegetable crops.

No. 365. "Behavior of Cement Mortar and Concrete in Some German Bogs," by F. J. Alway. In *Journal American Peat Society*, Vol. 16, No. 2 (April, 1923), 7 pages.

This is a digest of the report of the special sub-committee (Moorausschuss) that was appointed in 1908 by the German Committee on Reinforced Concrete. The task of this sub-committee was to determine the suitability of the different kinds of concrete for use in peats, in the form of foundations, piling, and drain tile. The results to the date of the report, 1922, lead to the conclusion that concrete may safely be used in contact with peat for both foundations and piling, but that concrete tiles in peat are not to be recommended because of their frequently observed rapid disintegration.

No. 368. "The Physico-chemical Properties of Strong and Weak Flours, IV. The Influence of the Ash of Flours upon the Viscosity of Flour-in-Water Suspensions," by R. A. Gortner and P. F. Sharp. In *Journal of Physical Chemistry*, Vol. 27 (June, 1923), pp. 567-576.

No. 369. "The Physico-Chemical Properties of Strong and Weak Flours, III. Viscosity as a Measure of Hydration Capacity and the Relation of the Hydrogen-Ion Concentration to Imbibition in the Different Acids," by R. A. Gortner and P. F. Sharp. In *Journal of Physical Chemistry*, Vol. 27 (May, 1923), pp. 481-492.

A continuation of the study of the colloidal properties of wheat flour gluten as influencing "strength." Marked differences in colloidal properties were found in glutens of varying strength.

No. 372. "The Bios Requirement of Baker's Yeast," by J. J. Willaman and Aksel G. Olsen. In *Journal of Biological Chemistry*, Vol. LV, No. 4 (April, 1923), pp. 815-836.

An unknown substance called "bios" is required by yeast for normal growth. It is of the nature of a vitamin, but is not identical with vitamin B.

No. 374. "Biochemical Properties of the Blood of Pigeons in Polyneuritis and Starvation," by L. S. Palmer and Clara T. Hoffman. In *Proceedings of the Society for Experimental Biology and Medicine*, Vol. XX (1922), pp. 118-119.

Data are presented on the total solids, total nitrogen, protein nitrogen, non-protein nitrogen, plasma bicarbonate, total erythrocytes, and total leucocytes in

the blood of pigeons in (1) normal state, (2) after starvation until 40 per cent of body weight was lost, (3) in state of "latent" polyneuritis, (4) in state of acute polyneuritis, (5) after complete recovery from acute polyneuritis, and (6) after starvation to 40 per cent loss of body weight following recovery from acute polyneuritis.

No. 378. "Relation Between Skin Color and Fat Production in Dairy Cows," by L. S. Palmer. In *Journal of Dairy Science*, Vol. VI, No. 1 (January, 1923), pp. 83-84.

This paper discusses briefly the proposition that if there is any relation between skin color and fat production in dairy cows, it should be between low skin color and high fat production.

No. 379. "Some Experiences in the First Breaking of Peat Lands," by G. R. B. Elliott and J. Lyman Larson. In *Journal of the American Society of Agricultural Engineers*, Vol. IV, No. 6 (June, 1923), pp. 83-88.

The experiments reported in this paper were conducted during the process of putting under cultivation a tract of heavily timbered peat, tile drained the previous year, but still too soft to be plowed with horses.

Several types of equipment were tried out. It was found that under the conditions of the test a weight of more than 75 pounds per inch of face of driving wheels was too great when the full power of the engine was applied. Tractors operated best with comparatively little weight on the front wheels, they being held in position in turning by a single, deep ring on each wheel. The driving wheels preserved their footing better and gave more power when half the angle lugs were replaced with spade teeth.

Special wide marsh plows were used. Draw bar pull varied from 5.2 to 8.4 pounds per square inch of cross-section of furrow slice turned. In a later trial on sodded peat the lowest draw bar pull was at a speed of $2\frac{3}{4}$ miles per hour and increased slightly as speed increased or decreased. Other things being equal the best work was done by the largest plows.

No. 381. "A Comparison of the Cost of Tile Drainage and the Value of Improved Farm Lands in Minnesota," by H. B. Roe. In *Agricultural Engineering*, Vol. IV, No. 5 (May, 1923), pp. 67-70.

A close study of 15 farm drainage projects installed through 15 years in various parts of the state and presenting wide variations in size, amount of waste land, and character of soil, indicates the following: (1) The average Minnesota farm under cultivation before drainage tends to include areas entirely waste from lack of drainage, amounting to upward of one-fourth of the farm area. (2) The tendency of this condition is to raise the normal value per acre of the part tillable before drainage to an abnormal figure nearly 50 per cent above the flat value per acre of the entire farm before drainage. (3) Drainage of the waste spots will generally bring under cultivation all the land within the existing limits of the farm, frequently at a cost per acre not greater than two-thirds of the flat value per acre of the undrained farm, hence considerably less than one-half the resultant value per acre of the originally tillable land. (4) Such reclamation adds the best acres to the farm, lightens labor and expense of farm operations, and makes the farm a pleasanter and more attractive home.

No. 387. "Application of Colloid Chemistry to Some Agricultural Problems," by R. A. Gortner. In *Colloid Symposium Monograph*, 1923 (Pub. by Department of Chemistry, University of Wisconsin), pp. 392-419.

A review of some of the more important problems which have been attacked by methods of colloid chemistry, together with a discussion of the application of similar methods to problems of the future.

No. 397. "The Vitamin Content of Breast Milk," by Cornelia Kennedy and L. S. Palmer and F. W. Schlutz. In *Proceedings of American Pediatric Society*, held at French Lick, Indiana, May 31-June 2, 1923. 7 pages.

A preliminary report of an investigation with rats showing that breast milk compares favorably with cow's milk as a source of vitamin A, but that cow's milk may be superior to breast milk as a source of vitamin B.

SUMMARY AND CLASSIFICATION OF PROJECTS
SUMMARY

Division	Projects			
	New	Active	Dormant	Closed
Agricultural Biochemistry	1	10	2	..
Agricultural Engineering	1	15	..	..
Agronomy and Farm Management.....	..	15	..	..
Animal Husbandry	2	3	..	..
Bee Culture .....	..	5	..	..
Dairy Husbandry	2	6	1	2
Entomology and Economic Zoology....	5	22	2	1
Forestry .....	..	12	3	..
Horticulture .....	..	13	..	1
Plant Pathology and Botany.....	5	15	1	1
Soils .....	..	8	..	..
Veterinary Medicine	4	12	..	2
	21	147	9	7

Three projects previously reported closed were active during the last year.

CLASSIFICATION

Division	Class				Total
	Research	Experi- mental	Demonstra- tional	Survey	
Agricultural Biochemistry	10	2	..	..	12
Agricultural Economics	10	..	1	..	11
Agricultural Engineering	9	6	..	..	15
Agronomy and Farm Management...	9	5	1	..	15
Animal Husbandry	16	2	4	..	22
Bee Culture .....	..	2	2	1	5
Entomology and Economic Zoology..	19	2	1	2	5
Forestry	4	8	1	2	15
Horticulture	7	6	..	..	13
Plant Pathology and Botany.....	12	2	..	2	16
Soils	3	4	..	1	8
	99	39	10	8	156